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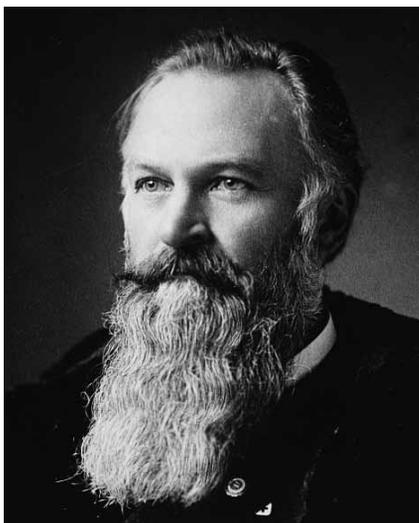


Alternatives to Blood Transfusions

JOEL MASSOP, CST

Bloodless surgery is a term that was popularized in the early 1900s by the practice of an internationally famous orthopedic surgeon, Dr Adolf Lorenz, who was known as “the bloodless surgeon of Vienna.” At that time, carbolic acid was routinely used in the operating room to clean a surgeon’s hands. Due to Lorenz’ allergic reaction to carbolic acid, he began treating his patients with non-invasive techniques. Thus the term “bloodless surgeon of Vienna.”¹⁰

Dr Lorenz developed a huge reputation for his ability to treat clubfeet. He was able to stretch even to the point of breaking the tendons, ligaments and epiphyseal plates until the foot was appropriately aligned. He then would apply a cast until the foot healed in that position.



Dr Adolf Lorenz

He was also involved with the treatment of scoliosis, but was most famous for his treatment of congenital dislocation of the hip. His technique involved manipulating the hip in young children under light anesthesia and holding them in a body cast as

LEARNING OBJECTIVES

- ▲ Identify alternatives to blood transfusions
- ▲ List the types of methods and procedures used as alternatives for these procedures
- ▲ Examine the various intraoperative surgical techniques and instruments that can be used
- ▲ Recall the risks associated with these types of procedures
- ▲ Define hypotensive anesthesia as related to bloodless surgery

they matured.¹⁰ The New York Times, in December of 1902, wrote about a case involving double dislocation of the hip bones in which he was able to reduce one of the deformed hips in one minute and 25 seconds.

Since those early years, there has been an increased surge of interest in bloodless surgery for a variety of reasons. It is well known in the field of transfusion medicine that some patients do not believe in receiving blood transfusions due to religious or personal convictions. For example, Jehovah's Witnesses refuse on religious grounds the transfusion of whole blood, packed red blood cells, plasma, white blood cells, platelets, auto transfusion of pre-deposited blood or any technique that involves blood storage. In some instances they will accept transfusions of products that have minor blood fractions. Much of the earliest data available on bloodless surgery were collected from patients who refused blood transfusions for religious reasons, primarily Jehovah's Witnesses. Dr Denton Cooley, a pioneering American heart surgeon who graduated from the University of Texas, performed the first bloodless open heart surgery on a Jehovah's Witness patient in 1962. He continued his work with bloodless surgery performing intricate heart operations and vascular surgery without blood on both adults and children. He felt that the risks involved in surgery without blood were no greater than the risks with blood at the time.¹⁶

Those who perform bloodless surgery do transfuse products made from allogeneic blood and they also make use of pre-donated blood for autologous transfusion. Others define bloodless surgery as a procedure in which techniques and steps are used to help the body compensate for blood loss before, during and after surgery, without the use of donor blood. Also, the use of pharmaceutical agents, intravenous fluids and improved diagnostic procedures and surgical techniques can prevent and lessen anemia associated with surgery and other medical procedures. When possible, patients who wish to have surgery without

blood should be evaluated for anemia and any indication of this should be treated before surgery.

Kenneth Kipnis, PhD, from the Department of Philosophy at the University of Hawaii in Manoa, acknowledges that "health care providers have not always been as respectful of patient rights as they should be. Patients who refuse transfusions historically have been considered heretics in the cathedrals of medicine. This attitude, which, unfortunately has been common in the medical community, disregards patient autonomy."²²

ALTERNATIVES FOR PATIENTS WHO DO NOT CONSENT TO BLOOD TRANSFUSIONS

If the loss of blood is rapid and great, a person's blood pressure drops, and he or she may go into shock. What is primarily needed is for the bleeding to be stopped and the volume in his or her system to be restored. This action will serve to prevent shock and keep the remaining red cells and other components in circulation.

Volume replacement can be accomplished without using whole blood or blood plasma. Various non-blood fluids are effective volume expanders. The simplest is saline (salt) solution, which is both inexpensive and compatible with human blood. There are also fluids with special properties, such as dextran, Haemacel and lactated Ringer's solution.



Photo courtesy of Martind

Hetastarch (HES) is a newer volume expander. Such fluids have definite advantages. “Crystalloid solutions [such as normal saline and lactated Ringer’s solution], Dextran and HES are relatively nontoxic and inexpensive, readily available, can be stored at room temperature, require no compatibility testing and are free of the risk of transfusion-transmitted disease.”⁸

Since those early years, there has been an increased surge of interest in bloodless surgery for a variety of reasons. It is well known in the field of transfusion medicine that some patients do not believe in receiving blood transfusions due to religious or personal convictions.

The accepted “rule” was to transfuse a patient before surgery if his hemoglobin was below 10 (or 30 percent hematocrit). The Swiss journal *Vox Sanguinis* reported that “65% of [anesthesiologists] required patients to have a pre-operative hemoglobin of 10 gm/dl for elective surgery.” This point of view was debated by Professor Howard L Zauder, MD, PhD who asked, “How Did We Get a ‘Magic Number?’” He stated: “The etiology of the requirement that a patient have 10 grams of hemoglobin (Hgb) prior to receiving an anesthetic is cloaked in tradition, shrouded in obscurity, and unsubstantiated by clinical or experimental evidence.”

One such case supporting Dr Zauder’s comment was a team of British doctors who treated a woman who had lost so much blood that her haemoglobin fell to 1.8 g/dlitre. She was with oxygen concentrations and transfusions of large volumes of gelatin solution and had an excellent outcome.¹

A few of the methods and procedures for those that refuse blood transfusions include:

- **Neupogen:** A man-made form of protein that stimulates the growth of white blood cells in the body. White blood cells help the body fight against infection.⁷
- **Granulocyte Macrophage Colony Stimulating Factor:** GM-CSF is a cytokine (protein) molecule that functions as a white blood cell growth factor.⁴
- **Neumega** is used to stimulate the bone marrow to produce platelets in order to prevent low platelets that may be caused by chemotherapy. Platelets are blood cells that allow the blood to clot, and prevent bleeding. It may be given to decrease the need for platelet transfusions.¹³

- **Oxygent:** An intravascular oxygen carrier designed to temporarily augment oxygen delivery in patients at risk of acute tissue oxygen deficit due to transient anemia, blood loss or ischemia. Oxygent can be used in patients of any blood type. Oxygent is heat sterilized to prevent bacterial contamination; blood and hemoglobin cannot be heat sterilized. Oxygent does not transmit viruses or other infectious agents; can be stored for about two years (versus whole blood, which can be stored for about 21 days); and it delivers twice as much oxygen twice as fast as an equal amount of blood’s hemoglobin. Alliance completed Phase III of their Oxygent study in Europe in May of last year.⁶
- **Recombinant factor VIIa:** Rombinant factor VIIa was initially developed for the treatment of hemorrhagic episodes in hemophilic patients. After its introduction, it also has been used to enhance hemostasis in non-hemophilic patients who experience bleeding episodes not responsive to conventional therapy. Anecdotal reports also suggest that the product is safe and effective in controlling bleeding in nonhemophilic patients. The product is still under investigation.¹²
- **Recombinant Human Erythropoietin:** A synthetic hormone used to stimulate the bone marrow to produce more red blood cells. This hormone is naturally produced by the kidneys. This drug can be used both preoperatively and postoperatively to help increase the production of red blood cells. It can be administered subcutaneously or intravenously, and it can be given either weekly, starting 3 weeks before surgery and ending on the day of surgery, or daily, beginning 9 days before surgery and continuing for 4 days after surgery.
- Another drug that is inexpensive and has been used to reduce heavy bleeding during menstrual cycles is **tranexamic acid**. TA has been found to be highly effective in trauma patients and those undergoing minimally invasive total knee arthroplasty. The Network for Advancement of Transfusion Alternatives states that studies conducted on TA have demonstrated a reduced amount of red blood cell transfusions in total knee arthroplasty. Tranexamic acid is a synthetic derivative of the amino acid lysine. It is an anti-fibrinolytic. It works by preventing blood clots from breaking down too quickly. This helps reduce excessive bleeding.³

A few of the intraoperative surgical techniques and instruments that are available are:

- **Gamma knife** is a minimally invasive surgical technique that delivers a high dose gamma radiation. The affected tissue receives a precisely focused dose while the surrounding tissue absorbs little radiation. This technique is mostly used for brain surgery.
- **Electrocautery** is a safe procedure that is routinely used in surgery to remove unwanted or harmful tissue. It can be used to burn and seal blood vessels, which helps to reduce or stop massive bleeding.
- **Harmonic scalpel:** This device can be used for open or laparoscopic procedures. The harmonic scalpel cuts via vibration. The scalpel surface cuts through tissue by vibrating in the range of 20,000 Hz. The vibration cuts through tissue and seals it using protein denaturation, rather than heat. Blood vessels are sealed at a lower temperature than is needed for electrosurgery and lasers. Because it can be used in multiple configurations, it is a great tool for a number of procedures, such as dental, ophthalmic, OB-GYN and general surgery.
- **Argon beam:** A pen-like instrument that sprays argon gas on the surgically cut tissue thereby reducing blood loss. The flow of gas blows away blood and debris from the surgical field and produces a coagulated surface that is more uniform and shallower than that produced in standard electrosurgical coagulation. The argon beam quickly coagulates profuse bleeding tissues. Rapid hemostasis results in minimal blood loss reducing costs and risks associated with transfusions. In addition, argon gas prevents oxidation. This results in less charring, tissue destruction and formation of necrotic tissue. This results in optimal healing.¹⁵

HYPOTENSIVE ANESTHESIA

Moderate hypotensive anesthesia was found to significantly decrease the average blood loss by nearly 40%, reduce the need for transfusion by nearly 45% and shorten the average operating time by nearly 10%.¹⁷

Hypotension can be induced using peripheral vasodilators and inhalation agents.

The three most commonly used vasodilators are: sodium nitroprusside (SNP), nitroglycerin (NTG) and trimethaphan.

SNP acts as a vascular smooth muscle relaxant which acts quickly but has a brief duration of action. Its primary

influence is on arteriolar and venous vessels, but without significant myocardial effects.

NTG reduces blood pressure by relaxing venous smooth muscle and, like SNP, has rapid onset of action but short duration. NTG is less toxic than SNP; however, it is more difficult to fine-tune the degree of hypotension with NTG since it is less potent than SNP in its capacity to reduce blood pressure.

Trimethaphan that produces hypotension is also short acting and provides control of blood pressure. Commonly used inhalation agents, or volatile anesthetic agents, include halothane, isoflurane and enflurane. The concentration of a volatile anesthetic agent produces a dose-dependent decrease in mean arterial pressure.⁹

Intraoperative blood salvage: This is also known as the cell saver. It is used intraoperatively if the bleeding becomes heavy. This allows the patient to recover shed blood as it flows through the device, filters debris, washes red cells as they circulate and can save as much as 15% of blood that would have been lost. It is used if blood loss is expected to be greater than one liter or more in adult patients. Some types are even good to be used on infants.¹¹ The cell salvage method, along with acute normovolemic hemodilution, may be acceptable to many including those who object due to religious reasons.

As of 2011, in the US, there are at least 12 hospitals that specialize in bloodless surgery for infants, and more than 160 hospitals that have a dedicated full-time Bloodless Surgery Program.

Acute normovolemic hemodilution involves removing and storing several units of blood in the operating room just before surgery. The patient's remaining blood is then diluted with either crystalloids or colloids to maintain a normal circulating blood volume. Any of this diluted blood that is lost during surgery will have fewer red blood cells and lowered levels of clotting factors. The whole fresh blood that was stored is then re-administered after surgery, or, if necessary, during the procedure. Jehovah's Wit-

ness patients may accept this method if it is modified. If the blood does not completely leave their system but remains in a continuous circuit with their circulatory system it may be considered as an option.¹⁴

BLOODLESS SURGERIES ON THE RISE

There are an increasing number of medical professionals who are beginning to utilize these alternative methods as standard of practice. In January 2010, the United States Defense Department granted Englewood Hospital in New Jersey a total of \$4.7 million to train the entire US military and civilian physicians in bloodless surgery and other medical procedures. Dr Shandler (a director of the Englewood Institute) encourages using less blood. He believes that withholding blood is a viable and preferable choice for most patients. This benefits patients and “tests surgeons in their willingness to depart from tradition.” It is possible that as more medical professionals are trained in bloodless alternatives, patients who do not consent to blood transfusions will meet less resistance.

Many patients view it not as a last resort but as a preferred treatment. Stephen Geoffrey Pollard, a British consultant surgeon, notes that the morbidity and mortality rates among those who receive bloodless surgery are “at least as good as those patients who receive blood, and in many cases they are spared the postoperative infections and complications often attributable to blood.” In a study of 1,915 patients, those who received a blood transfusion had twice the five-year mortality rate of those who did not. Even after correcting for comorbidities, age and other factors, there was still a 70% increase in mortality. Most research available seems to indicate that reducing or eliminating blood transfusions also results in improved patient outcomes. Many studies document an increase in morbidity and mortality after a blood transfusion.²⁰

There is also the cost associated with blood transfusions. Banked blood is a limited resource. The current cost of acquiring and processing a unit of blood is estimated to range from \$337 to \$658 per unit.¹⁴ Other studies put the cost between \$522 and \$1,183 per unit of blood. Most insurances will not reimburse the cost of the first three units of blood given to a patient per year. However, hospitals may be reimbursed for drugs that boost a patient’s red blood cell count. Geisinger Medical Center began a blood conservation program in 2005 and reported a record savings of \$273,000 in its first six months of operation. Cost will continue to rise as more testing for transfusion-transmitted

diseases is implemented and the blood supply continues to decrease because of the increased identification of tainted blood. One hospital that implemented a bloodless medicine program documented a 16% reduction in surgical costs if blood was not used and a 17% reduction in overall costs due to decreased length of stay.

A number of studies have revealed that transfusion-transmitted HIV infection is approximately 50 to 100 times less likely to occur than transfusion error. A case report presented by the University of Cologne in Germany stated that “on the basis of current estimates of the risks of transfusion-transmitted infection and transfusion errors, an anesthesiologist of a major general hospital or trauma center who transfuses an average of 500 U of packed red cells per year can be estimated to transmit HIV infection once in 1000 years, hepatitis C once in 200 years, hepatitis B once in 120 years, and to administer blood to the wrong recipient once in 30 years or once within his professional lifetime.”⁵ Human error includes administration to the wrong recipient, phlebotomy errors, testing of wrong specimen and failure to detect at the bedside before transfusion.

MOVING FORWARD

It can be said that one advantage of bloodless surgery is that it promotes better-quality care. “The surgeon’s skill is of the greatest importance in the prevention of blood loss,” says Dr Benjamin J Reichstein, a director of surgery in Cleveland, Ohio. A South African legal journal, as many others have admitted, says that in certain instances surgery without blood can be “quicker, cleaner and less expensive. ... Certainly the aftercare treatment in many instances has proved cheaper and less time-consuming.”¹⁸

These are just a few of the reasons why some 180 hospitals around the world now have programs specializing in bloodless medicine and surgery. Twenty years ago there were less than 60 hospitals in the United States with established Bloodless Medicine and Surgery Programs. As of 2011, in the US, there are at least 12 hospitals that specialize in bloodless surgery for infants, and more than 160 hospitals that have a dedicated full-time Bloodless Surgery Program.

The Wall Street Journal weighed in on the topic by stating: “Originally developed to accommodate Jehovah’s Witnesses, the practice has gone main stream with many hospitals promoting their bloodless surgery programs to the general public.”¹⁹

ABOUT THE AUTHOR

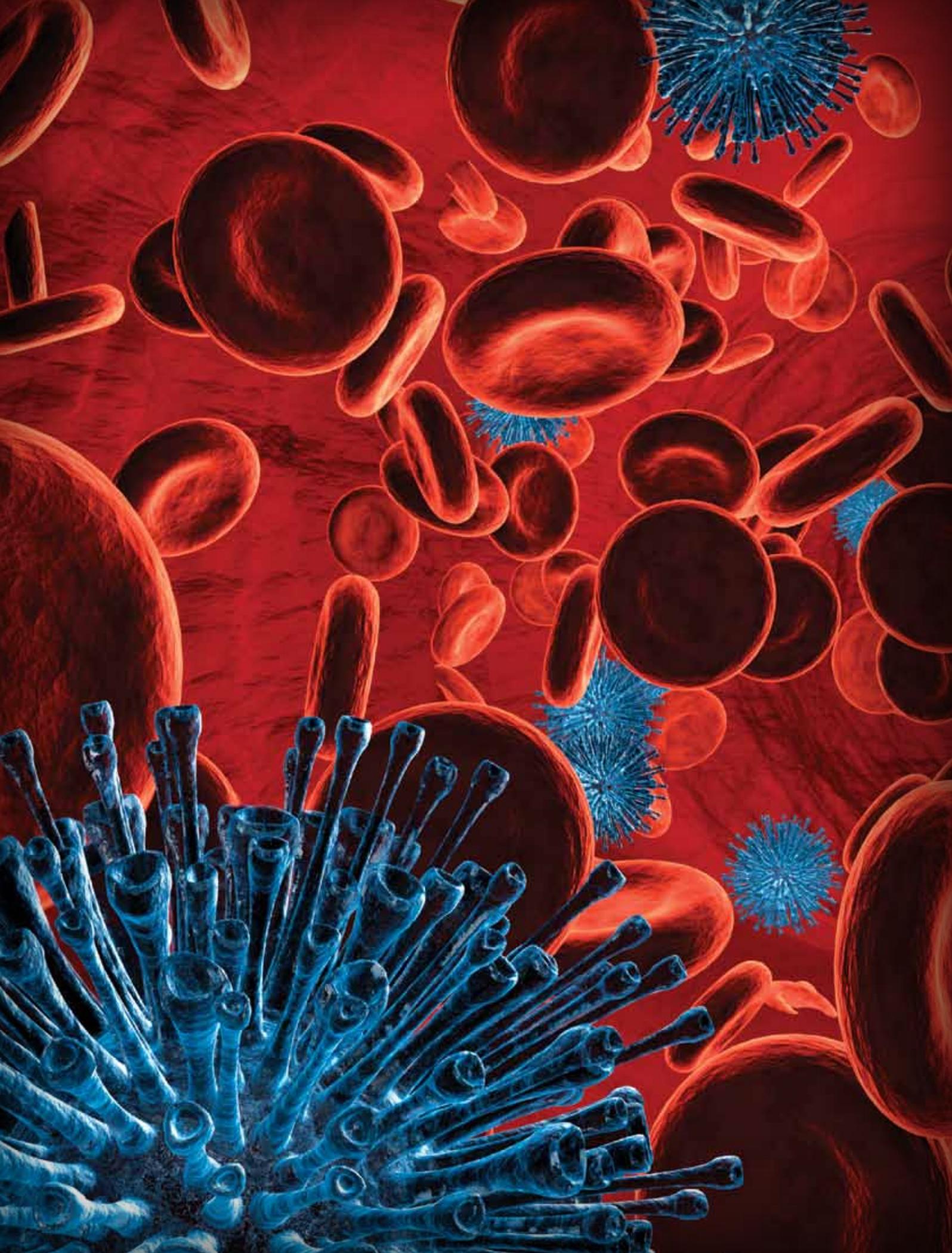


Joel Massop, CST, currently works at Lehigh Regional Medical Center, a small community hospital in Lehigh Acres, Florida.

He graduated High Tech North in Cape Coral, Florida, and has been a CST since December 2007 and started working at the hospital in May 2008. He plans to earn his CSFA in the near future.

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A Crash Course in Microbiology

A Review of Pathogens and Disease

TERI JUNGE, CST, CSFA, FAST

Did you know that a tradesman, dealing in fabrics, was the one who discovered the basis for biology? Antony van Leeuwenhoek (1632-1723) designed microscopes in order to better view the fabrics and cloths he was purchasing. By using these lenses that magnified material as much as 200 times greater, Leeuwenhoek discovered bacteria, free-living and parasitic microscopic protists, sperm cells, blood cells microscopic nematodes and rotifers on everyday items including his teeth, his clothes and on pond water. He created more than 500 microscopes during his lifetime.



Leeuwenhoek's discoveries opened the door for many others to research biology and the characteristics that make up the aspects of microbiology. The following article breaks down the basic microbiology concepts and lets you, the reader, interact as you test your knowledge about pathogens and disease. Use the blank spaces to

write your answers down, and then flip the pages to see if you correctly answered the statements. The review section is for the reader's benefit only, and the answers do not need to be submitted. As usual, the normal CE exam follows the article.

Editor's Note: This article is only meant to serve as an introduction to microbiology for surgical technology students and a review for practicing surgical technologists. It is not a comprehensive review.

LEARNING OBJECTIVES

- ▲ Explain the organism classification system and describe how organisms are classified.
- ▲ Name the main structures of an animal cell and describe the function of each
- ▲ Describe the composition, location and function of DNA within a cell
- ▲ Explain the function of the three types of RNA within a cell
- ▲ List and describe the stages of mitosis
- ▲ Define meiosis
- ▲ Describe passive and active methods by which substances enter and exit cells
- ▲ List five types of microorganisms that cause harm to humans, identify the characteristics of each type of organism and provide at least one example of a disease caused by each organism

ORGANISM CLASSIFICATION

The organism classification system, also called biological classification or scientific classification in biology, is a method for grouping and categorizing organisms by biological type.

- ▲ Organism classification system – method by which biologists group and categorize organisms by biological type
- ▲ Linnaean system is a hierarchal structure that utilizes the following terms for identification of all organisms (from most general to most specific):
 - Domain
 - Kingdom
 - Phylum
 - Class
 - Order
 - Family
 - Genus
 - Species

STRUCTURE AND FUNCTION OF AN ANIMAL CELL

All living organism are composed of cells that contain information that regulate cell functions and transfers information to the next generation of cells.

The structures and functions of each animal cell

- ▲ Cell membrane – outer covering of the cell (aka plasma membrane or plasmalemma)
- ▲ Consists of a double phospholipid layer that contains proteins and carbohydrates
 - Phospholipids allow free passage of water molecules through the cell membrane via osmosis.
 - The cell is either hydrophilic (attracts water) or hydrophobic (repels water).
 - Some proteins in the cell membrane allow passage of molecules and ions via transport channels or by active transport while other proteins act as receptor sites and identity markers.
- ▲ Protoplasm – liquid portion of the cell
 - Protoplasm that is inside of the cell membrane, but outside of the nucleus is called the cytoplasm.
 - Main constituent of cytoplasm is water that contains chemical compounds (e.g., mineral salts) in solution and organic compounds in colloidal suspension.
 - Cytoplasm also contains organelles, storage granules, fat droplets and vacuoles

- ▲ Vacuole – area within the cytoplasm
 - Surrounded by a membrane filled with a watery mixture of nutrients or waste products
- ▲ Mitochondria – considered the powerhouse of the cell
 - Composed of two membranes
 - Outer membrane is shaped in a capsular form
 - Inner membrane folds into itself to increase surface area (the folds are called cristae)
 - Aerobic phase of cellular respiration occurs in the mitochondria
- ▲ Lysosomes – small structures in the cytoplasm that contain powerful digestive enzymes.
 - Lysosomes perform three important functions:
 - Work with food vacuoles to digest stored food
 - Provide maintenance and repair of other organelles and are the building blocks of protoplasmic structures
 - Destroy old or weakened cells
- ▲ Endoplasmic reticulum (ER) – complex system of membranes that make up channels called cisternae that connect the outer nuclear membrane with the cell membrane
 - ER exists in two forms (rough and smooth):
 - All cells have rough ER which has attached ribosomes that synthesize protein
 - Only certain cells have smooth ER which transports fat or synthesizes sex hormones
- ▲ Golgi apparatus (also called Golgi body) – collection of flat saclike cisternae that store compounds secreted by the cell and aid in synthesis of necessary substances (eg, carbohydrates)



This photograph shows Legionella sp colonies which were cultured on an agar plate and illuminated using ultraviolet light

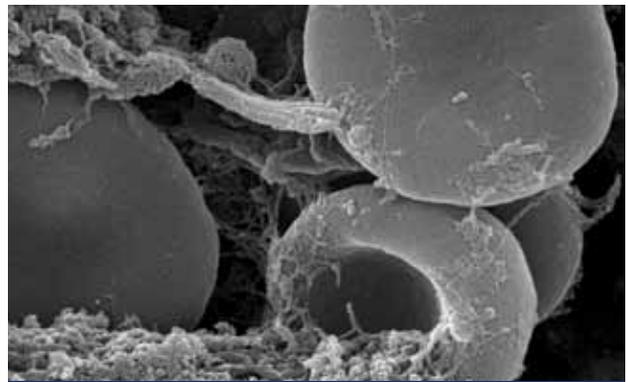
- ▲ Ribosomes – small granules distributed throughout the cytoplasm
 - Attached to the ER
 - Protein synthesis occurs in the ribosomes
- ▲ Centrioles – found in pairs
 - Centrioles form microtubules that assist in cell division
- ▲ Nucleus – control center of the cell
 - Contains the genetic material
 - Nucleus is surrounded by a membrane called the nuclear membrane
 - Nuclear membrane is a porous double membrane that allows passage of materials (eg: messenger RNA) to the cytoplasm
 - Inner layer of the nuclear membrane surrounds the nucleoplasm, which is the protoplasmic portion of the nucleus
 - Outer layer connects with the endoplasmic reticulum
- ▲ Nucleolus – spherical particle within the nucleoplasm
 - Produces ribosomes
- ▲ Chromatin – contains genetic material within the nucleoplasm
 - Consists of darkly stained threads of nucleic acids
 - Chromatin duplicates, shortens and thickens during cell division and becomes visible as chromosomes

DNA

- ▲ DNA (deoxyribonucleic acid) – composed of two strands (double helix structure) of alternating sugars and phosphates with four protruding nitrogenous bases (adenine, cytosine, guanine and thymine provide the DNA sequence)
 - Secluded from the rest of the cell within the nucleus for protection
 - Contains the genes necessary for cell reproduction
 - Genes contain all of the hereditary information for the cell and are organized into chromosomes

RNA

- ▲ RNA (ribonucleic acid) – Involved with protein synthesis for all cells and carries genetic information for reproduction of certain viruses
 - Three types of RNA
 - Ribosomal RNA (rRNA) is involved in translation of the genetic message into a protein and along with that protein makes up the ribosomes which are the site of protein synthesis.



This scanning electron micrograph (SEM) depicted a number of red blood cells found enmeshed in a fibrinous matrix on the luminal surface of an indwelling vascular catheter; magnified 11432x

Janice Gair, CDC

- Transfer RNA (tRNA) works with other types of RNA to transfer genetic information to proteins and carries an amino acid that may be used to build a protein at the ribosome.
- Messenger RNA (mRNA) is built on a strand of DNA and transcribes the nucleotide code. Messenger RNA moves to the cytoplasm and attaches to a ribosome to allow for protein synthesis.

THE PROCESS OF MITOSIS

- ▲ Mitosis – process of cell division in which two duplicate cells are the result
 - Four stage process with a resting/functional phase in between divisions:
 - Prophase – during prophase the DNA coils and the nucleolus and nuclear membrane begin to disappear. The centrioles move toward opposite ends of the cell and spindle-shaped fibers form in between.
 - Metaphase – During metaphase the chromosomes line up across the center (equator) of the cell and attach to the spindle fibers.
 - Anaphase – During anaphase the centromere splits and the duplicated chromosomes separate and move toward opposite ends of the cell.
 - Telophase – During telophase the membranes appear around each group of separated chromosomes forming two new nuclei completing division of the cell.
 - The resting/functional phase in between cell divisions is called interphase. During interphase the cell functions normally and prepares for mitosis.

THE PROCESS OF MEIOSIS

- ▲ Meiosis – only applies to formation of the sex cells (sperm and ovum)

- During meiosis the number of chromosomes is cut in half.

ACTIVE AND PASSIVE TRANSPORT

- ▲ For cells to function properly, it is necessary for materials such as nutrients and oxygen to be able to enter the cell and the products of cell activity such as hormones, neurotransmitters, digestive enzymes, and waste products to be able to exit the cell. Passive and active transport are the two main methods by which materials enter and exit the cell.

- Passive Transport

- Uses no energy
- Substances move from an area of high concentration to an area of low concentration
- Four types of passive transport
 - Diffusion – substances move through a medium such as air or a permeable membrane
 - Osmosis – special type of diffusion that requires passage of a substance through a semipermeable membrane
 - Filtration – involves passage of a substance through a membrane using force such as pressure or gravity
 - Facilitated diffusion – requires use of a transporter

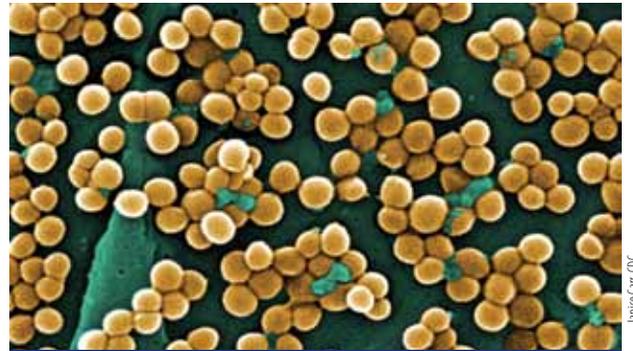
- Active Transport

- Uses energy in the form of ATP
- Substances move from an area of low concentration to an area of high concentration
- Endocytosis
 - Bulk movement of materials into the cell
 - Three types:
 - Phagocytosis – large particles are engulfed by the plasma membrane and moved into the cell
 - Receptor-mediated phagocytosis – receptors on the cell surface detect specific molecules and allow rapid movement of the molecule into the cell
 - Pinocytosis fluid droplets are engulfed by the plasma membrane and moved into the cell
- Exocytosis
 - Bulk movement of materials out of the cell
 - Vesicles are employed as transporters

HARMFUL MICROORGANISMS

- ▲ Bacteria

- Prokaryotic (lack a true nucleus)



This 2005 scanning electron micrograph (SEM) depicted numerous clumps of methicillin-resistant Staphylococcus aureus bacteria, commonly referred to by the acronym, MRSA; magnified 9560x

Janine Carr, OIC

- Unicellular organisms
- Usually multiply by cell division
- Some bacteria capable of producing spores
 - A resistant form of the bacteria that can tolerate adverse conditions such as extreme heat, cold, humidity, etc.
- Bacteria compose the largest group of pathogens. Antibiotics are effective against bacteria.
- Additional characteristics of Bacteria
 - Oxygen requirement
 - Aerobic – requires oxygen to sustain life
 - Anaerobic – capable of living without oxygen
 - Motility
 - Motile – capable of spontaneous movement
 - Usually due to the presence of flagella
 - Nonmotile – not capable of movement
 - Dependency
 - Free-Living – capable of making their own food; not dependent
 - Commensal – dependent on another organism for food; the relationship is not harmful to either organism
 - Sustenance
 - Saprophytic – requires dead or decaying organic matter to sustain life
 - Parasitic – requires live organic matter to sustain life; the relationship is often harmful to the host
 - Pathogenicity
 - Pathogenic – capable of producing disease
 - Beneficial – advantageous; such as normal flora
- Classified according to shape.
 - Bacilli – straight, slender, rod-shaped bacterial cells that may have tapered ends
 - Vibrio – comma shaped rods

- Spirilla – corkscrew shaped rods
- Spirochetes – corkscrew shaped rods that are capable of waving and twisting motions
- Cocci – spherical or round cells that appear in characteristic arrangements.
 - Diplococci – appear in pairs
 - Streptococci – appear in chains
 - Staphylococci – appear in clusters
- Also classified by the way they react to the Gram staining procedure during which the organism is affixed to a slide and stained with blue/purple dye, then a weak iodine solution is added to promote colorfastness and the slide is washed with alcohol.
- If the blue/purple dye remains the organism is called Gram positive.
- If the blue/purple dye is removed the organism is called Gram negative; the gram negative bacteria are then stained with pink/red dye to enhance visibility.

▲ Viruses

- Small microorganisms (smaller than bacteria)
- Cannot replicate unless they are within a living cell (obligate intracellular parasites)
- Most viruses are pathogenic with the exception of bacteriocidal viruses called bacteriophages
- All viruses are capable of mutation
- Viruses are not affected by antibiotics

▲ Fungi

- Eukaryotic (contain a true nucleus)
- Unicellular or filamentous (threadlike in structure)
- Multiply by budding (sexual) or spore formation (asexual)
- Some fungi resemble plants

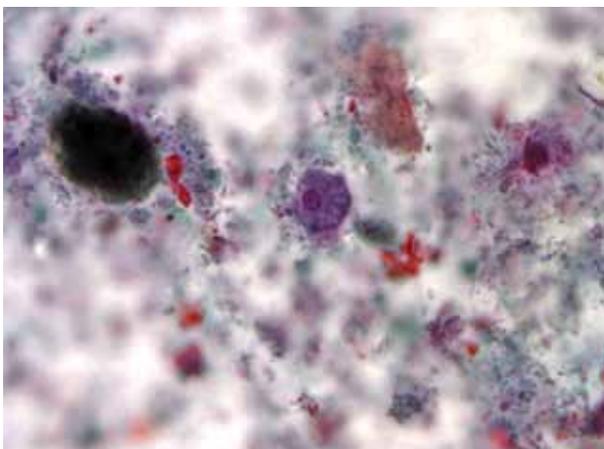
- Lack roots, stems, leaves, and chlorophyll and grow in irregular masses
- Yeasts, molds and mushrooms are all considered fungi
- Require an external carbon source
- Chemoheterotrophic (use chemicals as their energy source)
- May be saprophytic or parasitic
- Antimycotic (antifungal) drugs are effective against fungi
- Typically opportunistic in humans and are likely to occur in individuals who experience immune deficiency, immunosuppression, corticosteroid use, chemotherapy, antibiotic therapy or suffer from a comorbid condition such as diabetes

▲ Protozoa

- Unicellular, animal-like microorganisms
- Saprophytes
- Amoeba is a type of protozoa
- Protozoan infections are spread by fecal-oral contamination, ingestion of contaminated food or water and vectors such as mosquitoes

▲ Prions (pronounced “pree-ons”)

- First identified in 1982 by Stanley Prusiner of the University of California, San Francisco
- Simple proteins
- Much smaller than a virus
- Unique because they lack a genome (all other known infectious agents contain genetic material)
- The term prion represents the term proteinaceous infectious particle.
- Protein particles exist in two forms:
 - Normal, an innocuous (harmless) protein called PrP^c can change its shape to a harmful, disease-causing form called PrP^{Sc}
 - Abnormal, conversion from PrP^c to PrP^{Sc} then proceeds via a chain reaction
 - Several PrP^{Sc} proteins form long filamentous aggregates that gradually damage neuronal tissue
- All known prion diseases affect the nervous system and are fatal because the immune system does not recognize proteins as foreign and protection does not develop.
- Theories concerning transmission of prion diseases include genetic transmission, spontaneous mutation of the proteinaceous particle, consumption of infected meat (including cannibalism), transplantation/injection of contaminated tissue such as dura mater grafts,



This photomicrograph shows a trophozoite of an Entamoeba histolytica (center) using a trichrome stain. During the life cycle of E histolytica, trophozoites multiply by binary fission and produce cysts, which can be passed in the feces causing the spread of Amebiasis.



corneal transplants and injection of human growth hormone, and contact with contaminated surgical instruments.

ABOUT THE AUTHOR

Teri Junge has worked in surgery since 1973 and holds the credentials of Certified Surgical Technologist and Certified Surgical First Assistant. Her Associate Degree is in Surgical Technology, her Bachelor of Science degree is in Health Services Administration, and her Master of Arts in Education degree has a Curriculum and Instruction emphasis. In 2007, she was selected as a Fellow of the Association of Surgical Technologists. Ms Junge is currently the Surgical Technology Program Director for the San Joaquin Valley College, Fresno, California, campus.

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Taking Control of Infection Control

Jodi B Farmer, AST editor, and Teri Junge, CST, CSEFA, FAST, MA

In the last decade, one health care-related issue has frequented headlines, not only in medical and health-related journals, but also getting attention in major newspapers in North America and Europe. It's an issue that impacts the entire surgical team; an issue that is critical to the welfare of the patient. That issue: surgical site infections (SSIs).

According to the Association for Professionals in Infection Control and Epidemiology, Inc, there are an estimated 1.7 million hospital-acquired infections (HAIs) annually in the US, with approximately 99,000 of those resulting in death.⁸ Of that number, the CDC (Centers for Disease Control) estimates that there are as many as 500,000 SSIs annually in the US, resulting in a staggering price of more than a billion in overall healthcare costs and an additional 3.7 million days spent in the hospital. A study performed in December 2009 showed that patients infected with MRSA (methicillin-resistant *Staphylococcus aureus*) after surgery spent an additional three weeks in the hospital which added up to an additional \$60,000 per patient in care costs.⁵ In the past decade, committees and agencies have made committed efforts to improve infection control. Some groups even have been formed to monitor SSIs across the country and offer practitioners the tools they need to help reduce the amount of SSIs, as clinical studies have shown that they these infections are largely preventable.⁷

LEARNING OBJECTIVES

- ▲ Identify the leadership roles that are crucial in reducing SSIs at healthcare facilities
- ▲ Learn about the E3 Discipline and how it relates to SSIs
- ▲ Assess how data sharing can benefit your staff and improve patient safety
- ▲ Explore the options your team can use to increase collaboration among staff members
- ▲ Determine how communication can be an effective tool in reducing SSIs at your facility

These committees and agencies, as well as other long-standing healthcare organizations, have taken a proactive approach to studying and analyzing SSIs and HAIs in order to reduce the number of incidences on a yearly basis. A variety of organizations have made a call for actions and stepped forward to announce new initiatives and guidelines to assist healthcare facilities and practitioners in reducing SSIs. In 1999, the CDC issued its recommendations for reducing surgical site infections. Its detailed report covers everything from an overview of SSIs to how surgical attire and instruments to asepsis and operative characteristics, and surveillance methods can make a difference in reducing infection in the operating room.⁴ The CDC offers specific recommendations for every step of an operation including setup and post-op.

VHA, Inc, the national healthcare alliance, launched its national initiative in 2006 with its main focus on pre-

venting SSIs within the clinical setting. Ken Smithson, MD, and vice president of research at VHA said “Hospital acquired infections signal that less than optimum care is being provided and we’ve got to raise the bar. It’s the right thing to do for patients, and it has a significantly positive impact on a hospital’s bottom line.”⁷

More recently, 3M gathered with industry leaders and experts to form a call to action to help healthcare professionals and facilities combat SSIs. The call to action focuses on improving team work and communication so that surgical prevention can be reduced to improve patient safety.¹ This set of guidelines was formed this past October at the fourth annual Infection Prevention Leadership Summit (IPLS), which allowed professionals to share expertise and ideas that focused on one goal: “improving patient care through reducing SSIs.”³ They decided that three elements should be included when discussing and practicing safer

FIGURE 1. BREAKING THE CHAIN OF INFECTION

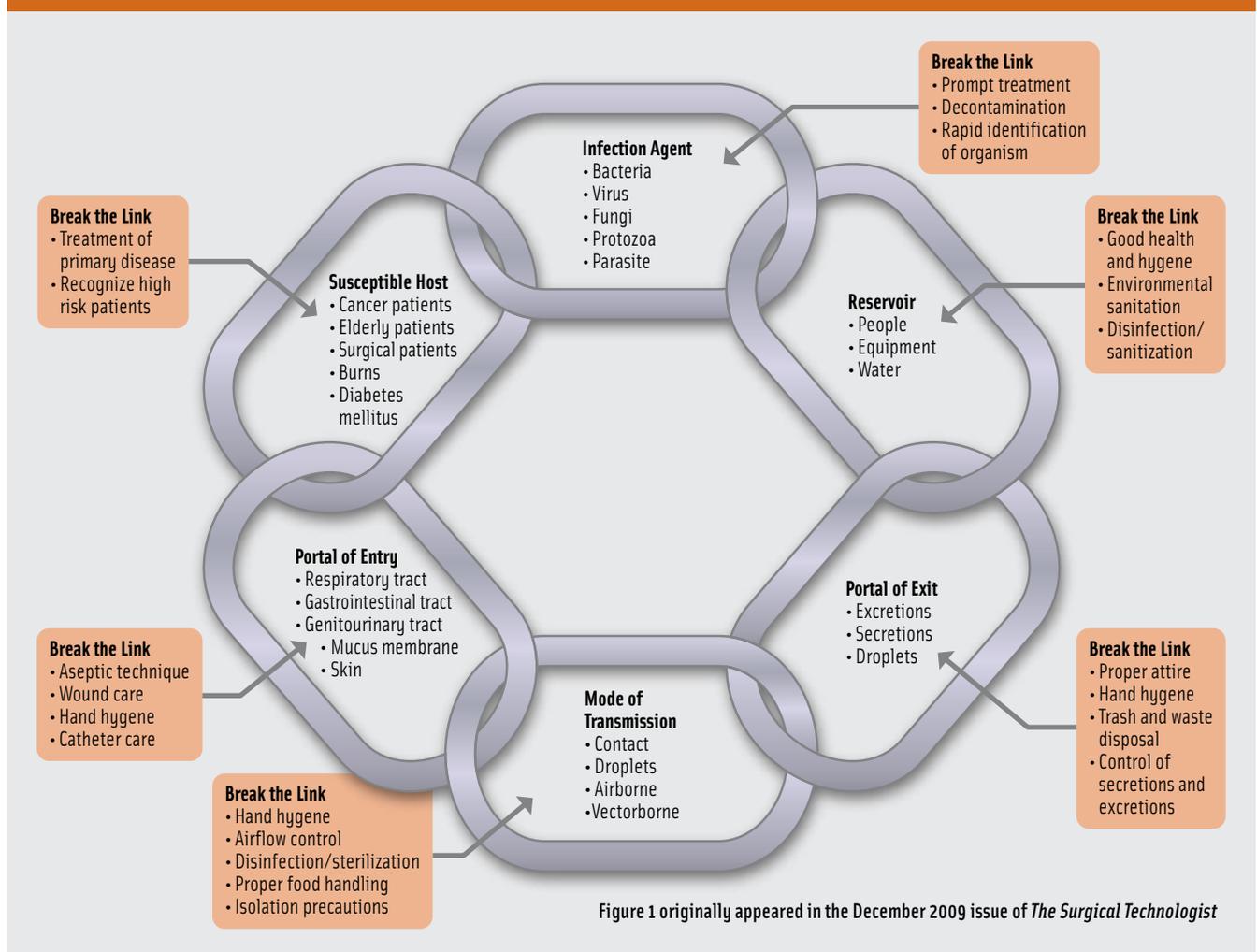


Figure 1 originally appeared in the December 2009 issue of *The Surgical Technologist*

patient safety; to educate, empower, and engage all parties involved in surgical care.

THE E3 DISCIPLINE

As the healthcare community gathered for this conference, leaders and professionals concluded that three elements were needed to create the E3 discipline. They determined that these three aspects can greatly affect a team's ability to communicate and function collaboratively to reduce SSIs.

When staff members are engaged in their position, they care about the well-being of the patient, their team members and themselves.

Education is the first component of the E3 discipline model. It encourages all practitioners to attend and seek out more didactic courses than required and to pursue and earn certifications related to their position. The model also stresses that healthcare facilities should provide educational sessions so that staff members may be allowed to grow within their profession and expand their knowledge base which can lead to a safer surgical environment.

Healthcare institutions also should empower their staff by creating a culture of accountability. Empowering is the second element to the E3 discipline. Everyone in the surgical suite should harness the power they need to carry out their job duties and report anything that is not in the best interest of the patient. Staff members should feel that they can report any inappropriate behavior or issues that need improvement without the fear of retribution.

By engaging staff, healthcare institutions are creating a healthier environment for all involved in a patient's care. As the third element of the E3 discipline, staff members who are engaged in their job and workplace demonstrate a higher commitment to the patient, their team members and themselves. It also creates pride among individuals so that each one strives to perform to the best of their ability so that patient safety remains the number one priority.³

CRITICAL PRACTICES TO REDUCING HAIS

Heeding the call for setting effective and immediate practices for reducing HAIs, the IPLS discussed the different components it takes to build team work and collaboration needed to reduce incidences in patient safety. They found

A CALL-TO-ACTION CHECKLIST

Industry leaders gathered for the fourth Infection Prevention Leadership Summit (IPLS) in October 2011. They came up with questions that practitioners should ask regarding reducing SSIs and their workplace. This list is especially beneficial to hospital and OR settings and should be shared with everyone on your surgical team.

Questions to ask for all team members:

1. Are we having regular meetings with our cross-functional coworkers?
2. Do we utilize checklists to assure patient safety in a serious manner?
3. Are we sharing needs, concerns, opportunities and successes with each other?
4. What steps can we take to achieve better patient safety every operation?
5. Where and how can we improve?

Questions for team leaders:

1. Does our institution invest adequately in our employees to foster a culture of the three Es (education, empowerment, and engagement)?
2. Are our board members, executives and site managers modeling leadership behaviors necessary to reduce SSIs?
3. What more can we do to support our staffers in order to increase patient safety?
4. Do all surgical team members have access to shared data regarding patient safety and reducing SSIs?

The leadership at IPLS determined that the following collaborative opportunities at each healthcare facility could include:

- "Developing bundles of policies and procedures that go beyond required courses and certifications, creating an interdisciplinary SSI-focused governance structure with leaders representing the OR, Infection Control, Central Sterile Supply, and patients/caregivers.
- "Generating organizational best practices mandates for OR staff, surgical chiefs, infection preventionists, and other involved staff to meet regularly, beyond just immediate pre- or post-surgical procedures.
- "Universally adopting processes that educate, empower, and engage patients as part of the team.
- "Promoting the SSI challenge by organizations to their members and creation of a set of common principles highlighting collaboration to share as part of national meetings, through newsletters, websites, journal commentaries, or editorials."³

Figure 2. CDC Best Practices for Standard Precautions and Transmission-Based Precautions

COMPONENT	Standard Precautions (Every Patient)	Transmission Based Precautions (Isolation Patients) <i>*May vary based on facility. Know your facility's protocol!</i>
Hand hygiene	After touching blood, body fluids, secretions, excretions and contaminated items. Immediately after removing gloves and between patient contacts.	Same as SP
Gloves	For touching blood, body fluids, secretions, excretions and contaminated items. Use for touching mucous membranes and nonintact skin.	For <i>all contact</i> with a patient, patient's environment, and/or equipment in a patient's room. (Contact and droplet only.)
Gown	During procedures and patient-care activities when contact of clothing/exposed skin with blood/body fluids, secretions and excretions is anticipated.	For <i>all contact</i> with a patient, patient's environment, and/or equipment in a patient's room. (Contact and droplet only.)
Mask, eye protection (goggles), face shield	During procedures and patient-care activities likely to generate splashes or sprays of blood, body fluids and secretions. Especially during suctioning and endotracheal intubation.	Droplet: Mask with eye protection must be worn within three feet of the patient. Airborne: Respirator (N-95/PAPR) or surgical mask before entering a room. TB always requires a fit-tested respirator. Refer to your facility's requirement for other organisms such as varicella/disseminated zoster.
Patient-care equipment	Handle in a manner that prevents transfer of microorganisms to others and to the environment. Wear gloves if visibly contaminated and perform hand hygiene.	<i>All contact</i> with all equipment used on a patient or in a patient's room requires gown and gloves. All equipment must be disinfected before leaving the room. (Contact and droplet only.)
Environmental control	Develop procedures for routine care, cleaning, and disinfection of environmental surfaces – especially frequently-touched surfaces in patient-care areas. Standard cleaning with low-level disinfectants for noncritical items such as tables, Mayo, BP cuffs etc.	Organism-specific protocols are required (eg, TB, <i>Clostridium difficile</i>) for cleaning. TB requires an intermediate-level disinfectant. <i>Clostridium difficile</i> requires bleach.
Textiles and laundry	Handle in a manner that prevents the transfer of microorganisms to others and to the environment.	<i>All contact</i> with laundry/linen that contacted patient or was in a patient's room requires gown and gloves. (Contact and droplet only.)
Needles and other sharps	Do not recap, bend, break or hand-manipulate used needles. If recapping is required, use a one-handed scoop technique only. Use safety features when available and place used sharps in a puncture-resistant container.	Same as SP
Patient resuscitation	Use a mouthpiece, resuscitation bag or other ventilation devices to prevent contact.	Based on the situation, if time permits, wear gown and gloves. (Contact and droplet only.)

four areas that need to be regularly analyzed within a healthcare institution. Leadership, communication, collaboration, and sharing are key elements that need to be present to help a healthcare team create the most effective patient-safe environment.³ Leadership on all levels must be functional for the team to accomplish patient safety initiatives. VHA proposes that healthcare facilities take part in leadership programs where participants learn implementation and evaluation, so that they can change and improve the patient care culture within their team and facility.⁷

When leadership is missing, views of exceptionalism may surface as team members may feel they are above each other. Selfish mind frames not only takes the focus away from the patient, but can divide a team and create an environment of blame. Leaders who can enforce discipline if unethical conduct or inappropriate practice has taken place are critical when building a strong team that trusts and respects each other. Due to this, strong leadership at the departmental and management level may be one of the most important components in reducing the number of SSIs.³ These employees have the power to create and foster a positive, healthy environment and drive change if needed. They also have the power to eliminate negative behavior or practices. When these leaders are committed and focused on reducing SSIs, the entire surgical team benefits.

Communication and collaboration between team members

Figure 2 first appeared in the March 2011's *Surgical Technologist*

go hand in hand. Strong and effective communication can be linked to successful collaboration in the surgical suite. Respect also plays a crucial part in team work as members who respect each other will work harder for the patient and their team members, even when something goes wrong. Strong communication, whether formal or informal, creates a sense of unity among coworkers and that bond can keep the entire team engaged and focused on their main goal: patient safety.

A report that came out of the IPLS offered suggestions for creating effective communication and collaboration across team members. The suggestions included job shadowing, departmental open houses, briefing and debriefing meetings before/after each operation, monthly meetings to discuss surgical infection prevention, in-house educational sessions, and staff recognition.³ The belief is that these actions help acknowledge hard work and encourage employees to keep an open dialogue about what's working, what's not working, and possible solutions.

Industry leaders also felt employees should have access to data sharing. Sharing results and findings between leaders, staff members, and across departments is a way for the complete entity to improve communication and education. By sharing information, departments can form a focus on certain markers whether those may be actual numbers or a general decrease in SSIs. Charts and visuals should be kept and prepared so that all staff members are aware of a department's specific goal so they can view their department's progress. By sharing this information with staff members, leaders can create a unified and open environment so that all staff may have the opportunity to change the outcomes of patient care. With a clear measurement of progress, staffers are able to see the impact they are making on patient safety and, in return, take a sense of pride in their work and further unite their team. A risk index can also be used as surgical team members can learn how to gauge the risk of SSI infection on certain procedures. CDC has coordinated a couple of indexes based on specific variables and newer predictors have emerged to allow practitioners to continue to estimate the SSI risk and overcome obstacles that may present an infection, such as unsterile instruments.

MOVING FORWARD

There are many obstacles that continually need to be studied to help combat the number of SSIs. Superbugs, such as MRSA, and the increase in the number of patients electing for surgical procedures, raises awareness to how important

With a clear measurement of progress, staffers are able to see the affect they are making on patient safety and, in return, take a sense of pride in their work and further unite their team.

it is for healthcare facilities to reduce SSIs. Since the risk of SSIs always will be present, all surgical technologists should be committed to surgical safety every time they step into the operating room. By being vigilant and aware of what is taking place before, during, and after an operation, team members can take an active role in decreasing the number of SSIs that occur in their hospitals, thus reducing the overall number of SSIs worldwide.

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The Modern-day C-section

JADE RITTER, CST

HISTORY OF THE CAESAREAN

A Caesarean section is a surgical procedure in which one or more incisions are made through a mother's abdomen and uterus to deliver one or more babies, or, rarely, to remove a dead fetus. The first modern Caesarean section was performed by German gynecologist Ferdinand Adolf Kehrer in 1881.⁵

The first successful Caesarean section performed in America took place in Mason County Virginia (now Mason County West Virginia) in 1794. At that time, a woman named Elizabeth, was experiencing a difficult labor and was convinced she was going to die. She insisted that a Caesarean be performed so the baby could be saved. Her delivery doctor refused to do the operation, but her husband Jesse Bennett, also a doctor, agreed. He performed the operation and delivered a baby girl.⁹

Although "Caesarean section is usually performed when a vaginal delivery would put the baby or the mother's life or health at risk,"⁵ in recent years some women have elected for the operation instead of vaginal delivery. The C-section rate has climbed more than 50% since 1996, according to the National Center for Health Statistics, which is part of the Centers for Disease Control and Prevention.⁸ In the most recent data submitted by ACOG (American Congress of Obstetricians and Gynecologists) available, 31.8% of births were by Caesarean.¹ Nearly one in three babies are now delivered surgically.

"C-section rates may be on the rise for a variety of reasons, the average age of the expectant mother is higher, the rising obesity rate among moms-to-be, and an increase in multiple births and an increase in induced labors. Additionally, because of some health reports warning the dangers of attempting a vaginal delivery after a Caesarean (VBAC), there has also been a decrease in the number of women attempting vaginal deliveries for subsequent deliveries."²

LEARNING OBJECTIVES

- ▲ Learn about the procedure for the modern-day Caesarean section
- ▲ Review what instruments are needed for this procedure
- ▲ Examine the indications that may require a C-section to be the necessary procedure for delivery
- ▲ Define the differences between a spinal and epidural anesthesia
- ▲ Discuss the complications of this common surgery

TYPES OF CAESAREAN SECTION

There are several types of Caesarean section. An important distinction is the type of incision made on the uterus, which is different than the incision on the skin. The lower uterine segment section is the procedure most commonly used. It involves a transverse cut just above the edge of the bladder and results in less blood loss and is easiest to repair. The classical Caesarean section involves a mid-line longitudinal incision which allows a greater space to deliver the baby. It is rarely performed today due to the increase in possible complications.

Once labor has commenced due to unexpected labor complications, an unplanned Caesarean section is performed. A stat/emergency C-section is performed in a true obstetrical emergency, where complications of pregnancy onset suddenly during the process of labor and quick action is required to prevent the death of the mother, child(ren) or both.

A repeat Caesarean section is performed when a

patient has had a previous Caesarean section and is typically performed through the old scar incision. This is usually done at 39 weeks or later unless there is a medical indication that the baby needs to be delivered prior to 39 weeks.

The obstetrician must use discretion to decide whether a Caesarean is necessary. Some indications for Caesarean delivery are:⁵

- Fetal distress: refers to what happens when an unborn baby starts to have problems while the mom is in labor, ie, deceleration in the heart rate.
- Cord prolapse: umbilical cord precedes the fetus' exit from the uterus. The fetus moves downward into the pelvis and puts pressure on the cord. As a result, oxygen and blood supplies to the fetus are compromised and the baby must be delivered quickly.
- Prolonged labor or failure to progress (dilate)
- Serious maternal health problems where a delivery through the vagina would put the baby at risk such as herpes or AIDS.
- PIH (pregnancy induced hypertension) after amniotic rupture
- Placental problems
- Placental abruption (where the placental lining has separated from the uterus of the mother)
- Placental previa (where the placenta is attached to the uterine wall close to or covering the cervix)
- Placental Accreta (where the placenta attaches itself too deeply in the wall of the uterus but does not penetrate the uterine muscle. Hemorrhaging is the biggest concern with this condition due to manual attempts to detach the placenta)
- Failed labor induction
- Contracted pelvis
- Overly large baby (macrosomia)
- Abnormal presentation (breech or transverse positions)
- Uterine rupture

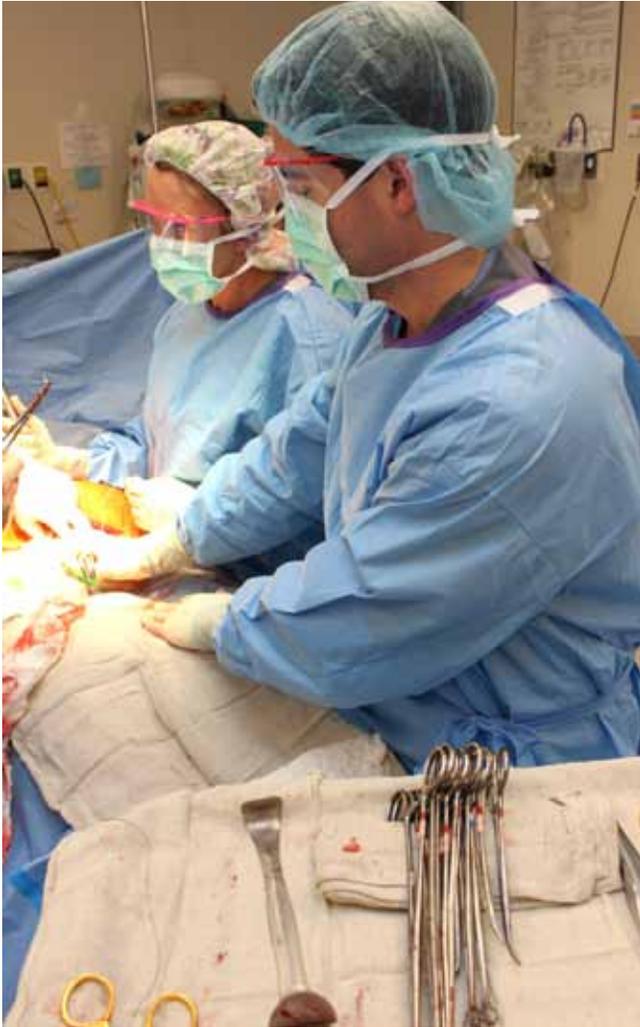
INSTRUMENTS

2 Knife handles with 2 #10 blades	4 curved hemostats
1 curved mayo scissor	2 needledrivers
1 curved metzenbaum scissor	1 Suture scissor
1 bandage scissor	1 Doyen Retractor (Bladder Blade)
1 Russian forcep	1 Bull retractor
1 Ferris Smith forcep	1 Richardson retractor
2 Adson forceps	4 Ring forceps
2 Kocher clamps	1 Rat tooth tissue forcep
4 Allis clamps	



PRE-OPERATIVE PROCEDURES

All patients having a Caesarean will have blood work drawn prior to their surgery. This consists of a Type and Screen which ensures that a patient who may need a blood transfusion during surgery receives blood that matches her own and that clinically significant antibodies are identified if present. Patients must receive blood of the same blood type; otherwise, a severe transfusion reaction may result. A CBC to monitor hemoglobin, hematocrit, and plate-



Jade Ritter, CST, assists with a Caesarean section

let counts is needed to measure the types and number of blood cells and also to determine if the blood is normal. This test also shows signs of infection, dehydration, anemia, the need for post-surgery transfusion, etc. "A RPR (Rapid Plasma Reagin) is also done, which is a blood test to check for syphilis antibodies in patients who may not have symptoms. The CDC and the US Preventive Services Task Force (USPSTF) recommend all pregnant women be screened for syphilis during pregnancy."^{12,13}

The patient is told not to eat or drink anything eight hours prior to surgery if it is a scheduled Caesarean. An IV is started on the patient typically

using an 18G or larger needle. A lactated Ringers solution of a minimum of 1,000mL is infused prior to the patient entering the OR suite. Pre-op meds are given approximately 30 minutes before surgery. This includes Kefzol 1 gm IVPB x 1 if patient weighs <80Kg or cefazolin 2 gm IVPB x1 if patient weighs > 80 Kg. This is given routinely to prevent post-operative infection. The patient is also given one or a combination of heartburn relief medication between 2 hours and not less than 30 minutes prior to surgery. A combination of citric acid/sodium citrate may also be given by mouth 30 to 45 minutes prior to the scheduled surgery. These medications are given to neutralize gastric acid in the event of the patient possibly aspirating stomach contents. The patient is brought to the OR where she is positioned sitting up on the OR table so a spinal or epidural anesthesia block can be placed. This regional anesthetic is used so the mother can remain awake and interact immediately with her baby. The difference between a spinal and an epidural is as follows.

- Spinal Anesthetic involves the administration of a needle, in the lumbar region, between the vertebrae through the epidural, beyond the dura, and just before the spinal cord. This injection is directly into the spinal fluid followed by the injection of a local anesthetic solution. This onset of anesthesia is very rapid and generally lasts around 2 hours after it's placed. "A long lasting pain medication, morphine, can be injected along with the spinal anesthetic, but the duration of pain relief is only about 12 to 24 hours."⁷
- During the placement of an epidural, the needle tip is placed in the epidural space, which lies just outside the membrane covering the spinal fluid. An epidural can progress slower and may result in a denser block, allowing some sensation at the surgical site. An epidural can be left in place to treat pain effectively post-surgery.⁷

"The main difference between the two is how it is

Once labor has commenced due to unexpected labor complications, an unplanned Caesarean section is performed. A stat/emergency C-section is performed in a true obstetrical emergency, where complications of pregnancy onset suddenly during the process of labor and quick action is required to prevent the death of the mother, child(ren) or both.

administered and that the spinal anesthetic has a higher incidence of spinal headaches (where spinal fluid leaks from the injection site and causes a headache from the spinal cord pulling down from the loss of equilibrium. A spinal headache can be treated with painkillers and oral fluids. If this does not work, a blood patch can be performed, which



is a procedure where the patient's own blood is injected into the epidural space in the same region where the original spinal block was done, thus eliminating the headache.”⁷ This procedure is performed by an anesthesiologist.

After placement of the anesthetic by the anesthesiologist, the patient is put in the supine position with a wedge underneath the right hip. Uterine displacement to the left during surgery is necessary to shift the uterus away from the large abdominal vessels. The positional effect on cardiac output is of major importance in avoiding maternal hypotension and maintaining fetal well-being. Heart tones of the baby are monitored with a hand-held Doppler prior the start of surgery so documentation can be made of the baby's heart rate. Normal fetal heart rate varies between 120 to 160 beats per minute (bpm). At this time, the patient has a Foley catheter inserted that will stay in for 24 hours and her abdomen is prepped for surgery using abdominal gel prep. The patient has SCD (sequential compression device) applied to the legs during surgery to prevent DVT (deep vein thrombosis) blood clotting in the legs. The patient is draped with a bipod that goes over her feet and legs, and a laparotomy drape — with built-in pouch to collect the amniotic fluid when her water is broken — is placed on the

abdomen. At this point, a time out is done with everyone in the entire OR suite, using active communication to be briefly documented and should include: asking the patient her name, the correct site, and agreement on what procedure she is having performed. A liter of normal saline is poured into a basin by the circulator for irrigation if the physician chooses to use it.

The skin is tested before the incision is made to ensure the patient is numb. After the patient is tested, the circulator retrieves the significant other/family member to accompany the mom in the OR suite as a support person. If, due to an emergent and stat situation and mom has had no prior epidural or spinal anesthesia, a general anesthetic is performed and no support person would be allowed in the OR suite.

INTRAOPERATIVE

A horizontal incision is made into the lower abdomen. A scalpel with a #10 blade is used to make the incision. Dissection is made until a shiny, fibrous layer called the fascia is seen.

The fascia which lies over the abdominal muscles, also serves as a floor for the adipose layer just cut into. A finger is placed by each surgeon's hand against this fascia to move away the adipose tissue, exposing an adequate length of this tough lower layer. “The scalpel is then used to ‘nick’ an opening into the fascia that runs up and down from the upper abdomen to the pubic bone. They are joined together at the midline,”⁶ being dissected away using a pair of curved Mayo scissors.

Uterine displacement to the left during surgery is necessary to shift the uterus away from the large abdominal vessels. The positional effect on cardiac output is of major importance in avoiding maternal hypotension and maintaining fetal well-being.

The next layer is the peritoneum, a film-like layer that is the lining of the abdominal cavity. Two curved hemostats

are used to grasp this layer. The layer is separated with a curved Metzenbaum scissor. The dissection is made up and down to see the lower abdomen with good visibility. "Because the bladder wraps itself under the lowermost portion of this lining, care is taken not to injure it. Once the opening is made into the peritoneum, a 'bladder blade' (Doyen Retractor) is placed to pull the lowest part of the opening downward,"⁶ so the peritoneal incision is not taken down too far, thus getting into the bladder. The uterus is then exposed, with the other half of the bladder riding up to the lowest part of the uterus and a bladder flap is created. This is to push the bladder away from the rest of the surgery and is done with a pair of smooth tissue forceps (usually Russians) and a pair of Metzenbaum scissors. The uterine incision is made with a second, clean #10 blade. If the patient's amniotic sac has not broken it will protrude through the uterine incision. The bag of water is artificially ruptured using a blunt instrument, such as an allis clamp.

The baby's head is delivered through the uterine incision with a bulb syringe readily available for suctioning of the infant's nose and throat. Once the baby's body is delivered, the cord is clamped with an infant cord clamp and one Kocher clamp and dissected between the two with a pair of curved Mayo scissors/or bandage scissors freeing the baby from placenta. The newborn will then be taken to an infant warmer to be assessed by a neonatal nurse and/or pediatrician. At this point, the clamp is removed from the cord that is attached to the placenta and a cord blood specimen is obtained to get baby's blood type. The placenta is removed manually by the surgeon with fragmented pieces adhered to the uterus removed by a ring forcep **foerster**. "The uterus, anchored into the pelvis by ligaments that attach to it near its bottom, is easily tilted through all of the incisions and laid on the mother's abdomen for easy access."⁶ However, some physicians leave the uterus in place in the abdomen. This is strictly the physician's preference. Twenty units of oxytocin usually is administered through the IV so the uterus will contract and help control bleeding.¹⁰

The uterine incision is then closed typically using a



Once the baby is delivered, the newborn is handed to a neonatal nurse and/or pediatrician and the infant is assessed



0-polyglactin 910 suture on a CT-1 needle that will dissolve in several weeks. "The closure stops the bleeding from the edges of the incision. If there is no further bleeding at this re-approximated incision line, the uterus is allowed to fall back into the pelvis."⁶ The peritoneum is left open or closed due to physician's preference. If closed it is usually with a 2-0 or 3-0 polyglactin 910 suture with a tapered needle. "Recent studies have indicated if closed it might lead to internal scarring called adhesions."⁶ A uterine count is performed, which consists of counting sponges. With Caesarean sections, an extra count is performed due to the opening of the uterus with the uterine layer being the extra count.



The newborn has its vitals assessed as it lays on an infant warmer



After it has been determined the infant has a good bill of health, it is swaddled and prepared to meet his or her mother

The next layer, “the abdominal muscles, are usually left open as well because they too usually fall together by themselves.”⁶ However, tying them together at spots along their lengths can be done using a 2-0 or 3-0 polyglactin 910 suture. The fascia layer is the most important layer to close since it is the support layer for the abdomen. This layer needs to be closed with a thicker, more durable suture such as 0 polydioxanone or 0 polyglactin 910 suture. A full count is done with the circulator at this point, which consists of sponges, needles, blades, Bovie tip and instruments.

The subcutaneous layer is physician preference as well,

but if closed it is usually done with a 3-0 plain gut suture. The skin, the weakest re-approximation of the whole repair, is gently brought together with Adson forceps and either stapled, sutured or glued. If sutured, this is usually done with a 2-0 or 3-0 Prolene on a Keith needle or, if glued, using a tissue adhesive. A final count is done with

‘C-section rates may be on the rise for a variety of reasons, the average age of the expectant mother is higher, the rising obesity rate among moms-to-be, and an increase in multiple births and an increase in induced labors. ...’

the circulator consisting of sponges, needles, blades and bovie tip only.

Dressing is applied to stapled or sutured incision using sterile pads and abdominal dressings. If glue is used, no dressing is applied. The fundus is compressed with the hand to make sure the uterus is nice and firm and to check for any bleeding. The entire Caesarean surgery process takes about 30 to 45 minutes unless complications arise.

POST OPERATIVELY

The patient is sent to the PACU (Post Anesthesia Care Unit) for approximately 30 to 45 minutes. Vitals are monitored closely and fundal checks are done periodically to check for bleeding. The patient is then transferred to the post-partum unit until she is discharged to home. An average hospital stay for a Caesarean patient is approximately two to four days. A follow up appointment with the obstetrician is usually performed two weeks post-delivery and again at six weeks.

COMPLICATIONS AND RISKS

A Caesarean is a relatively safe procedure. However, it is a major surgery. As with any surgery, it has complications and risks that can include:

- Increased bleeding
- Reactions to anesthesia (nausea, vomiting, spinal headache)

- Blood clots in the legs or lungs (the risk of this is greater after a C-section than with a vaginal birth. If the blood clot goes to the lungs, which is called pulmonary embolism, the damage can be life-threatening.)
- Endometritis (inflammation and infection of the membrane lining the uterus, which may cause chills, fever, back pain, etc. It can be treated with IV antibiotics.)
- Surgical injury. Although rare, surgical injuries to nearby organs can occur during a C-section. If this happens, additional surgery may be needed.”³
- Wound infection

Because of advances in medical technology, Caesareans are now a safe procedure that saves millions of lives, both mothers and infants, every year.



ABOUT THE AUTHOR

Jade Ritter, CST, studied at IU Health Bloomington Hospital Surgical Technology Program and has been a CST specializing in Obstetrical and Gynecological care for 13 years. In addition to being a CST, he is responsible for ordering all OBOR surgery supplies for the department.

In the past, he has served on the IU Health Bloomington Advisory Board of Directors for the Surgical Technology Program.

He has been an active member of AST since 1998. He has been married for eight years to his wife Beth (who is a Charge Nurse in the Special Care Nursery Department at IU Health Bloomington) and has two children, a son, Carter, and daughter, Alexis.

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Jade Ritter, CST, center, and the rest of the surgical team, stands with a proud mother and her daughter after a successful C-section

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A Facial Rejuvenation

Short-scar face-lift/simple MACS: Minimal Access Cranial Suspension

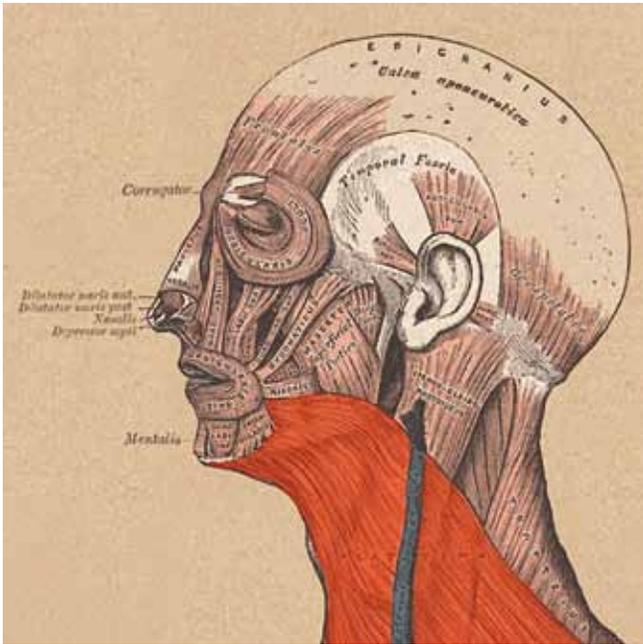
NYDIA I MORALES, CST

An increase in age demonstrates the process of nature. When it comes to the face – sagging skin, wrinkles, fat deposits and folds begin to evolve in the area of the neck, nose, jawline and mouth. Other contributing factors include general health issues: excessive weight gain, smoking and heredity. Rhytidectomy helps wrinkles disappear via plastic surgery, a procedure known as a face-lift.³

The traditional rhytidectomy encompasses the initial incision in the temporal region; in front of the ear and extending downward to follow the contour in a continuous dissection, then upward behind the ear and into the hairline and then onto the mandible bone. The short-scar face-lift/MACS — minimal access cranial suspension — eliminates the extensive dissection around the ear and into the hairline. The use of this technique minimizes the incision to the front of the ear only.³ This technique is relatively new. It was modified in 1999 from the traditional rhytidectomy. It reduces extensive dissection by using two strong permanent purse-string sutures that are woven into the SMAS tissues in a vertical U-shape and an oblique O-shape (extended MACS Lift) via a strong anchorage in the deep temporal fascia on the helical crus. The superficial musculoaponeurotic system is a gliding membrane that aids in reattachment when the three major facial muscles are tightened via an uplifting pull to the zygomatic arch. When the sutures are tied they produce a smooth vertical readjustment of the drooping facial features that rest on the jowls and upper neck.⁴

LEARNING OBJECTIVES

- ▲ Define the difference between a traditional rhytidectomy and a simple MACS procedure
- ▲ Identify what instrumentation is needed for this type of face-lift surgery
- ▲ Examine the role a surgical technologist plays in a short-scar face-lift
- ▲ Evaluate the alternatives to this operation
- ▲ Review the anatomy affected by this procedure



ANATOMY OF MAJOR MID AND UPPER FACIAL MUSCLES

The large muscle that is known as epicranii, is divided into two parts: the occipitalis and the frontalis portions. The occipitalis section covers the occipital bone and connects to the frontalis. The occipitalis draws the scalp backward, whereas the frontalis draws the scalp forward. The orbicularis oculi covers a path around the eye. The buccinator, levator labii and the zygomaticus major also play critical roles in the anatomy of the face. On the lateral region of the face, the buccinator muscle lies between the maxilla and the mandible. It is a thin quadrilateral muscle and its function is to pull back the angle of the mouth and soften the cheek. The buccinator muscle also holds

In general, the MACS lift is an anti-gravitational lifting procedure that suspends the soft tissues of the face and neck along with the skin jointly in a vertical pull and resets it to its original facial placement.

the cheek to the teeth when active in chewing, whistling and smiling. Infants also use it in sucking. The levator labii lifts the upper lip and the lateral rounded part of the nostril. It is attached to the frontal area of the maxilla.

It produces a snarl, a facial gesture made famous by Elvis Presley. The zygomatic major muscle controls the facial expression via the angular pull of the mouth as in a smile. The muscle extends from the zygomatic arch to the corners of the mouth joining with the orbicularis oris.⁷

SIMPLE MACS LIFT TECHNIQUE

For the purpose of simplicity, this article will feature the MACS lift technique. This technique is strictly for patients with early jowls, primary facial aging and marionette grooves. Patients with intensive facial ptosis require deep plane manipulation. Extended MACS lift targets the nasolabial grooves and lifts the malar fat pad on the midface. The incision is extended on the temporal hairline. In general, the MACS lift is an anti-gravitational lifting procedure that suspends the soft tissues of the face and neck along with the skin jointly in a vertical pull and resets it to its original facial placement. This enhanced process delivers a facial rejuvenation. There is no injury to the facial nerve branches, nor vascular compromise since they are deep to the SMAS facial muscle layer. The osseocutaneous ligaments support the skin and facial structures against the force of gravity. On the face-lift flap, they must be released to adhere to its stretch in movement.⁴

PREOPERATIVE PREPARATION

The patient is required to cease smoking and consuming alcohol for two weeks prior to the procedure. This helps ensure healing post operatively. In addition, aspirin should not be taken preoperatively as it can cause bleeding. The patient should wear loose comfortable clothing during and after the procedure to facilitate nonrestrictive circulation. Baggy clothing or a sweatsuit is encouraged. An ace bandage

will be wrapped around the head and chin after the procedure. Therefore, the patient should bring a scarf or hat to cover the head and neck, or a hooded sweatshirt. The surgeon will review the procedure with the patient, as well as take his or her complete medical history. Photos of the patient are

taken before and after to provide a comparison. The surgical technologist remains in the OR suite for the duration of the procedure to monitor the patient at all times. There



A face-lift operation is performed

is no circulating nurse or anesthesiologist present. Prior to the procedure, the surgical technologist witnesses that the consent form has been signed and counter signs it. He or she also reviews all medical entries at this time. Vital signs, including blood pressure and pulse oximeter readings, are recorded and close attention is given to any irregularities, such as cardiac dysrhythmia, that could indicate a potential medical risk.

The choice of anesthetic will vary depending on several factors, including the patient's overall health, medications the patient is currently taking and the number of procedures and length of time of each procedure. The patient and surgeon also may state a preference for anesthesia. A short-scar face-lift can be performed under general anesthesia, with IV sedation or local anesthesia. Most cases are done in-office and are performed under local anesthesia. The local anesthetic for this procedure is a tumescent solution: a combination of 400 ml of normal saline, 90 ml one percent of lidocaine without epinephrine, 10 ml 8.4 percent

bicarbonate and one ml of epinephrine 1:1000. Preoperative antibiotics also are administered to reduce the risk of bacterial infections. In some cases, a sedative is used. Five to 10 mg of diazepam is administered sublingually to treat anxiety in patients who request it. The sedative is used based on patient preference; however, the surgeon will dictate the dose to be administered.

The patient is placed in the supine position. The surgeon then outlines the planned incisions with a marking pen on the temporal region in front of the ear. The local anesthetic is administered by injection into zygomatic arch of the surrounding areas of the buccinator, levator labii and zygomaticus major muscles.¹ The surgical technologist places a surgical cap on the patient, sweeping all hair strands away from the incision site and secures it in a tight knot. The patient's temporal and zygomatic region is then cleaned with a scrub cleaner. The patient's thoracic region is draped in order to create and maintain the sterile field during the procedure.

**THE SURGICAL TECHNOLOGIST
PREPARES THE MAYO STAND
WITH THE FOLLOWING
INSTRUMENTATIONS:**

2 #15 knife blades and #3 knife handle
2 Senn retractors
2 Army Navy
2 Adson forceps with teeth
Mayo-Negar needle holder
Curved and straight Metzenbaum scissors
Mayo scissors
Small mosquito (placed to the side in
case it is needed for hemostasis)
4x4 gauze sponges
2-0 polydioxanone sutures
2 5-0 nylon sutures
2 3-0 chromic gut

PROCEDURE

A 4x4 gauze sponge is cut into a short-end strip and rolled into a ball. Using Adson forceps, the ball is placed into the ear of the patient to prevent fluid from entering the ear canal from the incision site. The surgeon positions the patient's head to the side. An incision is made with a #15 blade along the hairline angle (or a zig-zag pattern is used to facilitate new hair growth) and continues downward to the auricle lobule. An Adson is used to pick up the initial skin. The dissection continues with Metzenbaum scissors. In an open and closed spreading motion it separates the subcutaneous fat layer, to create a flap. The skin over the tragus is elevated with 2 Senn retractors (one on each side of the flap ends) and an electro-surgical pencil is used to control bleeding. It protects facial nerves and maintains the correct plane. The dissection further continues superiorly until the lateral edge of the orbicularis oculi muscle is reached and the dissection continues onto the superior region of the platysma muscle. This is made visible with the surgeon's magnified glasses. The zygomatic arch is identified. With the use of the Metzenbaum scissors, the tissue is spread to the deep temporal fascia. The electro-surgical pencil is used as needed. A 2-0 polydioxanone suture is used as the suspen-

sion suture. An interrupted purse-string stitch encompasses the superficial musculoaponeurosis and jointly the buccinator, levator labii and zygomaticus major muscles. The suture is returned to the starting point (O-shaped) under exerted force and tension with an uplifting pull to the zygomatic arch and is tied with four square knots. A small amount of the parotid fascia in the cranial part and the platysma in the caudal part is captured in every stitch with the needle. This vector elevates the jowls and corrects marionette grooves and upper neck. It is anchored at the fascia of the platysma muscle, at the angle of the mandible.⁵ A customized skin excision from the flap is resected and sutured subcutaneous with polyglactin 910. The preauricular and hairline incision is sutured with minimal tension with 5-0 chromic gut. The skin flap by the earlobe is customized and cut as well, and set without tension to secure a normal setting. It is also sutured with a polyglactin 910.⁵ The identical procedure is repeated on the other side of the face.

POST-OPERATIVE CARE

An elastic wrap — snug from the chin to the head, but not tight and comfortable to wear all day — should be worn for five days following the operation, removing it only for a shower and meals. The incision should be gently cleaned with 50-50 combination of hydrogen peroxide and warm water for the first three days. An antibiotic cream can be applied on the incision line for as many as seven days. Drainage from the incision four to five hours after surgery is common and may occur as long as 24 hours after the operation. Should bleeding occur, a gauze bandage should be applied with pressure. If there is no remedy, call the doctor immediately.

For the first 24 hours, ice packs should be applied on face, cheeks and under the chin for 15 to 20 minute intervals. After two days, ice packs should be applied every three to four hours for 15 to 20 minutes each. The head needs to be elevated with at least two pillows during sleep to minimize swelling for three to four nights. The patient is required to take antibiotic medication for the completion of seven days in order to prevent infection. Patients should not take aspirin or ibuprofen as it may cause bleeding. Prescription pain medication can be prescribed or the patient can take extra strength acetaminophen as needed.

RISKS AND COMPLICATIONS

A family history of bleeding problems yields extensive pre-operative evaluation. Patients on anticoagulants (and vitamin E) must cease taking the medication, both pre- and post-operative. Smoking will compromise vascularity and healing. Taking multivitamins and vitamin C may be recommended to help healing. Swelling, bruising, pain and discomfort are normal after surgery. Scarring will occur and is made to minimize its appearance. Skin heals differently for every patient and it may be noticeable, large, raised, hypertrophic or a keloid can evolve, and it may require more treatment. Other complications may include hematoma and infection.

Tissue and/or skin loss is possible during healing. Additional surgery of skin grafts or wound debridements may be needed. Facial asymmetry of the neck, lip and nose may be temporary or permanent. Also, additional surgery may be needed as a touch-up procedure to correct problems.³ Follow-up visits are scheduled for one week post-surgery, two weeks post-surgery and four weeks post-surgery. Photographs are then taken to compare the before and after images at four weeks progress. A follow-up visit is scheduled six months afterward the operation.

ALTERNATIVES

Skin resurfacing (chemical peel, dermabrasion or laser resurfacing), fillers or botulinum toxin injections, as well as liposuction and blepharoplasty are all possible alternatives to a face-lift. All of these procedures or alternatives can produce a youthful appearance and target a specific area of the face.

ABOUT THE AUTHOR



Nydia I Morales, CST, was an elementary school teacher before entering the medical field. She graduated from New York University Langone Medical Center's surgical technology program in New York City and passed the National Board Certification exam in September 2007. She has written two other plastic surgery articles for *The Surgical Technologist*: "Autologous Fat Grafting," November 2009, and "Platysmaplasty: A Resolve for the Turkey Neck," July 2010.

THE HISTORY OF THE RHYTIDECTOMY IN THE 20TH CENTURY:

- 1916** – Lexer: Consisted of limited skin excision and elevation.
- 1968** – Skoog: Sub platysmal dissection in the neck, rising simultaneously the skin and platysma muscle.
- 1976** – Mitz and Peyronie: SMAS (superficial musculoaponeurotic system) in rhytidectomy techniques.
- 1979** – Tessier: Vertical lift to the soft tissue (remodeling and repositioning). Tessier, Santana and Psilakis extended subperiosteal dissection of mid face, jawline and neck.
- 1990** – Hamra: Deep-plane rhytidectomy to reposition malar fat pad.
- 1992** – Hamra: Additional modification to include oricularis oculi muscle into the flap.⁶
- 1999** – Saylan: S-lift The suspension of sagging facial feature via a strong purse-string suture.
- 1999** – Tonnard, Verpaele, Monstrey, Landuyt, Blondeel, Hamdi and Matton, MD: MACS, adopted S-lift and modified incision, purse-string anchorage site and direction and shape of the skin excision.⁴

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Adenocarcinoma of the Appendix

KATRINA CRAIG, CST

Once in a while, what is thought to be a routine appendectomy becomes a more critical issue when cancer is discovered in the appendix. This is a rare occurrence as cancer in this area accounts for a small percentage of all intestinal tumors. Since this is a rare type of malignancy, which is generally not caught until it is in advanced stages, treatment options are limited. Finding probable causes or even genetic predispositions has been challenging as there are not enough cases to obtain the kind of data needed to narrow down such issues.⁶

ANATOMY OF THE APPENDIX

The appendix is a small gland, about four inches long, and extends off the cecum of the large intestine. It is long and thin, resembling a worm, which prompted it to be named vermiform appendix. Just as the other organs of the gastrointestinal tract, the appendix has four layers of tissue: the innermost being the mucosal layer, then the submucosal layer, followed by the muscle layer and the external serosal layer. The muscle layer of this structure is thin as it is not involved in peristalsis. The appendix is composed of lymphatic tissue which is contained in the submucosa layer, but is not considered part of the lymphatic system, even though it does contain a lumen. The function of the appendix is not fully understood, but some believe it contains fluids to help reboot the intestinal tract after its balance has been upset by diarrhea. There is also the theory that the appendix has a special function in the immune system, although removal of this gland does not have an adverse effect on one's health.⁹

LEARNING OBJECTIVES

- ▲ Review the anatomy of the appendix
- ▲ List the supplies needed to perform an appendectomy
- ▲ Analyze which procedures may be necessary for various advancing stages of cancer
- ▲ Study the procedure for the removal of the appendix
- ▲ Determine which operations prove to have the best overall success rates



An appendectomy is observed on a laparoscopic monitor



Surgeons watch the laparoscopic monitor while performing an appendectomy

ANATOMY OF CANCER

“Tumors that occur in the appendix comprise a large group of both benign and malignant diseases. Appendix cancer is extremely rare, affecting an estimated 600 to 1,000 Americans each year. Most patients are diagnosed after undergoing surgery for acute appendicitis, or when an abdominal mass is seen during a CT scan for an unrelated condition.”⁷

The cellular layer of the appendix that is involved in the development of the tumor is the determining factor in the type of cancer that is diagnosed. In about two-thirds of cases diagnosed, carcinoid tumors are found at the distal end of the appendix, which does not cause an obstruction between the appendix and colon. It is more common to find a carcinoid tumor in a female than in a male, and usually occurs when the patient is in their 40s.⁷ When a patient is examined for other issues, 66 percent of appendiceal tumors that are classified as carcinoid, are found by accident.¹¹

Tumors that originate in the epithelial cells of the inside

lining of the appendix, or mucosa, are classified as non-carcinoid cancer. Because of the mucus produced by these cells, a noncarcinoid tumor may spread into the abdominal cavity and, if not treated, eventually may cause bowel obstruction and cachexia.⁷ While this condition may be life-threatening, it is not malignant.

Goblet cell carcinomas are classified as adenocarcinoid tumors which are similar to both the carcinoid and adenocarcinoma tumors occurring in the appendix.⁷ Adenocarcinoid tumors occur most frequently in patients in their 50s and are found when the symptoms of acute appendicitis present themselves.⁷ When the appendix develops goblet cell carcinoma, it usually infiltrates the entire gland which makes it easier to detect during a CT scan.⁸ This type of tumor is very rare, occurring in less than one percent of appendiceal tumors, and usually is diffused along the appendix wall.¹¹

Cystadenocarcinoma occurs in 20 percent of appendi-

ceal tumors and is found in varying places in the gland.¹¹ This classification of tumor is found in the mucosa cells of the appendix which develop into cysts. In 90 percent of cases this cancer remains localized and presents symptoms of appendicitis.¹¹

Adenocarcinoma develops at the base of the appendix and accounts for about 10 percent of appendiceal tumors. It involves the cells of the epithelial layer which has a higher

risk of metastasis into the abdominal cavity or colon. As with some of the other classifications of appendiceal cancer it is usually diagnosed after the patient presents symptoms of acute appendicitis.^{4,11} Signet ring is a rare form of adenocarcinoma, so named for the way the cells appear under the microscope, and is found in less than one percent of tumors. This particular type of adenocarcinoma is very aggressive and difficult to successfully treat.¹¹

ANATOMY OF CANCER

The word cancer strikes fear into the heart of almost anyone familiar with the term, but it is not a single disease. Cancer is the term given to hundreds of different diseases that have similar characteristics. What they have in common is uncontrolled abnormal cell growth and the spread of those cells.¹⁰ It is the altering of the DNA of a particular cell that can begin the cascade of events that leads to a malignancy. If the mutated cell is not destroyed by the immune system it will begin to replicate which will produce many more cells with a mutated genetic code.

In normal tissue there is a code that regulates growth, but if there is a mutation in that code, the cells may begin to reproduce uncontrollably. Hyperplasia begins to take place and a tumor begins to form, this is still considered a benign state. If left unchecked, the cells may continue to change which may lead to dysplasia, which follows the classification of hyperplasia, which is rapid over growth of the tissues. As the cells continue to grow unchecked the purpose of those cells may begin to change. When the cells of a tissue lose the ability to carry out their original function, and the only purpose they fulfill is reproduction, a diagnosis of cancer is given. Once carcinogenesis has begun, the cancer will begin not only destroying the surrounding tissues but will eventually metastasize to other parts of the body. As the cancerous tissue spreads throughout different systems it takes up residence and begins the destruction of the organs, glands and tissues, eventually causing death.¹⁰

Malignant neoplasms can originate in any of the different tissues and are named accordingly.

A malignancy that develops in the epithelial tissue is considered a carcinoma, connective tissue sarcoma, and lymphatic tissue cancer is a lymphoma. Malignant tumors in the brain, breast or stomach that occur outside of lymphatic tissue are considered extranodal lymphomas.

CLASSIFICATIONS OF CANCER

One of the first parts of diagnosing cancer is to determine the size and spread of the malignant tumor or cells. This is called grade and stage of the disease. How a treatment for cancer is determined, depends on the grade and stage of the tumor as the cells will react differently at different levels.

"Grading is a means of affixing a value to a clinical opinion of the degree of dedifferentiation (anaplasia) of cancer cells, or how much the cells appear different from their original form."¹⁰ A pathologist will examine the tissue sample and assign a grade from I to IV. The numbers determine the severity of the cancerous cells, the higher the grade the worse the cancer is thought to have progressed. In healthy tissue there is good differentiation of the cells, but in cancer this is the opposite, and the poor differentiation progresses as does the disease.

The higher the grade assigned to a tissue sample, the more advanced the cancer is, or the more dedifferentiated the cells have become. The next step in determining how advanced a malignancy is depends on the staging. There are different systems used for this purpose, if it is done in a clinical setting it is considered clinical staging. If the value given is assigned by a pathologist it is considered pathologic staging. One example is the TNM staging system. The T will give a value for the size of the tumor, the N is for the number of lymph nodes that test positive for cancer, and the M represents how far the cancer has metastasized. The values given to T, N and M are added together to give the staging number, which will help to determine the best course of treatment.¹⁰

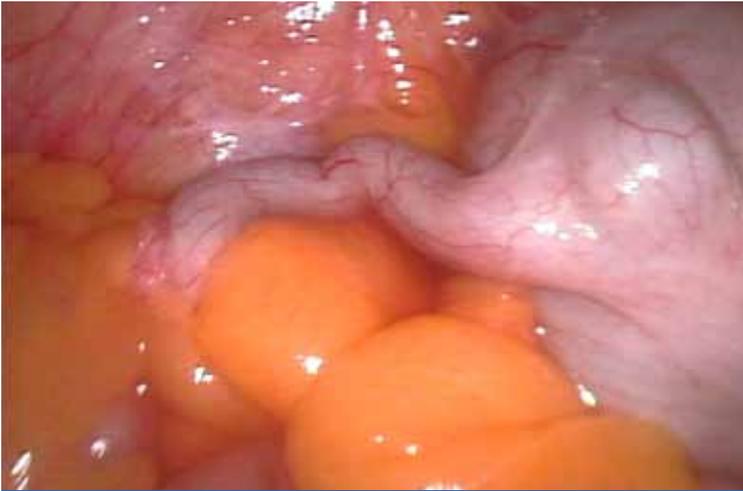
If the cancer has not spread past the original site and has not invaded the organ it is considered to be carcinoma in situ (CIS). The site of the original tumor is called the primary location and if the cells metastasize to another location this is considered secondary locations. An example of this would be when adenocarcinoma of the appendix has metastasized to the liver, the malignant cells in the liver will be composed of the same type of tissue as the original cancer in the appendix.¹⁰

DIAGNOSIS OF CANCER

A diagnosis of cancer in the appendix usually does not occur until the tumor has reached stage IV and the gland has ruptured. It is during what is thought to be a routine appendectomy for acute appendicitis that this rare form of

TREATMENT

Once it is determined that cancer is present in the appendix a course of action is chosen. If the tumor is a carcinoid and less than 1 centimeter in size with no metastasis, then an appendectomy is usually performed as this approach has



Before the removal of the appendix



At the removal of the appendix

cancer is found. Intermittent pain in the lower right quadrant in the initial stages, followed by continuous pain and abdominal tenderness are some of the first symptoms that may be noticed. Most neoplasms are found once the appendix has been removed and sent to pathology for analysis.^{7,8} Signs and symptoms of adenocarcinoma of the appendix prior to stage IV development are difficult to track as most cases are asymptomatic. Even in advanced disease sometimes the only symptoms are abdominal discomfort and bloating.

Some appendiceal neoplasms may be found because the patient is having secondary symptoms in the genitourinary area. If the cancer has metastasized it is possible that the reproductive organs or urinary system may have neoplastic cells which may cause symptoms.⁷ The mass also may be palpable or there may be gastrointestinal bleeding which would be cause for investigation.⁸

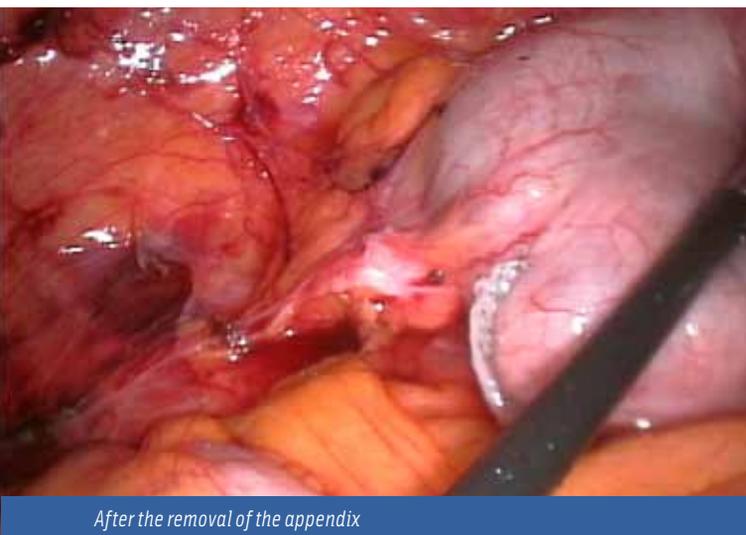
been shown to be sufficient at this stage of development of the tumor.¹¹ When the tumor is larger than two centimeters the recommendation is a right colectomy, and if the cancer cells are locally advanced cytoreductive surgery is recommended along with the right colectomy. If the carcinoid has metastasized to the liver, the recommended surgery is the right colectomy with cytoreductive surgery and hepatic resection.¹¹ As the cancer cells become more invasive and

It is more common to find a carcinoid tumor in a female than in a male, and usually occurs when the patient is in their 40s.⁷ When a patient is examined for other issues, 66 percent of appendiceal tumors that are classified as carcinoid, are found by accident.¹¹

progress to different locations in the body the recommended treatment will change.

Neoplasms of epithelial origin in the appendix have similar recommendations for treatment, regardless of the type of carcinoma diagnosed. For adenocarcinoma of the appendix that is nonperforated and localized, a right hemicolectomy is the preferred treatment. This radical approach

offers the best long-term outcome for the patient.^{4,11} The 10-year survival rate for patients that have been treated with a right hemicolectomy is 85 percent compared with only a 50 percent survival rate for those patients who were treated with just an appendectomy.¹¹



Perforated adenocarcinoma of the appendix requires more radical treatment. A right hemicolectomy would be recommended along with intraoperative intraperitoneal hyperthermic chemotherapy.⁵ This involves circulating heated solutions containing cancer-killing chemicals through the abdominal cavity for a couple of hours post-surgically. This treatment is known as hipectreatment or HPEC.³ Washing the intraperitoneal area with chemotherapy drugs is performed to eliminate any remaining cancer cells that may have been missed during surgery. If the adenocarcinoma has progressed with peritoneal carcinomatosis, the recommendation for treatment will include the right hemicolectomy, intraperitoneal chemotherapy and three cycles of IV chemotherapy to try to eradicate the cancer.¹¹

Surgery beyond the appendectomy to prevent recurrence of adenocarcinoma of the appendix is the recommendation in most cases. The right hemicolectomy is the same procedure that is recommended for colon cancer of the ascending colon. In this type of surgery the ascending colon is removed along with, in most cases, the hepatic flexure, as well as the cecum and appendix.¹ The reason for the radical excision of almost half of the large intestine is due to the way the blood is supplied to the organ, rather than because of spread of the disease. If parts of the colon are left with less than adequate blood supply it could induce dead bowel

which becomes fatal if not quickly removed surgically. The associated lymph nodes are tested, and if positive for cancer, they are removed. The ileum of the small intestine is then anastomosed to the remaining transverse colon.¹

The best approach for a good prognosis is surgery to remove all the cancerous tissue and to look for any seeding, or spread of cancerous cells in the abdominal cavity, which must be removed as well.⁶ If the cancer returns the recommendation is for surgical removal again, with intraperitoneal chemotherapy.¹¹

PROGNOSIS

Statistics vary when it comes to long-term survival rates for patients who are diagnosed with cancer of the appendix. Part of the reason for the lack of information is that this type of cancer is rare and therefore more difficult to track. Most statistics show that the prognosis is much better for patients who undergo right hemicolectomy as opposed to an appendectomy. Tumor size at the time of discovery is one of the most important factors in long term prognoses for this disease.² The smaller the tumor size usually equals the better the chance for long-term survival.

A follow-up study performed on seven patients who were diagnosed with adenocarcinoma of the appendix in 1999 to 2000 found that at the seven-year mark survival rate was 100 percent. This included one patient whose appendix was ruptured with metastasis of the cancer at the time of the original surgery. At the six-year mark, this patient developed metastasis to the liver and was treated with a liver resection.²

Another study conducted by TD Yan, LB Bijelic and PH Baker, found that the 10-year survival rate for those treated for cancer of the appendix (out of 402 patients with stage IV disease) resulted in 85 percent of those patients still alive. These patients were treated with cytoreductive surgery and intraperitoneal chemotherapy even if the disease was localized. This aggressive form of treatment was performed to give the best chances for a good outcome. The study is quick to point out, however, that the majority of patients who were included had tumors of low histological grade, which may have had an effect on the survival percentage at the 10-year mark.⁵

While the statistics from different studies show five and 10-year survival rates varying from 60 percent to 100 percent, it is clear that the more radical approach to treatment has improved the life expectancy of patients.

APPENDECTOMY PROCEDURE

Equipment

- Suction apparatus
 - Electrosurgical unit with dispersive electrode
 - Headlamp available
-

Instruments

- Minor instrument set
 - Major instrument set available
-

Supplies

- Prep set
 - Basic pack
 - Basin set
 - Gloves
 - 2 #10 blades
 - Sutures
 - Laparotomy drapes
 - Electrosurgical pencil
 - Dressing material
 - Culture tubes
 - Penrose drain
 - Irrigation solution
-

PREPARATION AND PROCEDURE

Patients will be administered general anesthesia and the patient will be prepped in the supine position. A shave may be necessary and prep will start from mid-chest to thighs and laterally as far as possible. The right lower quadrant will be outlined with towels secured with adhesive or towel clips and draped with a laparotomy sheet.

The McBurney's incision is usually used and the appendix is identified by following the cecal taenia to the appendiceal base. Mobilization of the cecum into the wound may be necessary. Once the appendix is identified, it is removed from the wound and grasped with a Babcock. The mesoappendix is then transected from the free end tip of the appendix toward the base by a series of double clamping, cutting and ligation with 3-0 absorbable ties. This procedure may be reversed if the appendix is adhered or otherwise distorted.

A clamp is placed near the base of the appendix, crushing it, and then it is removed and reapplied distally. If the surgeon prefers, the surgical technologist should prepare pursestring suture. Then the surgical technologist should replace the Babcock with a Crile grasping the tip of the appendix. A 3-0 absorbable suture on a small taper needle may be passed through the cecum and around the base of the appendix in a pursestring manner.

The crushed base of the appendix is then ligated with an 0 absorbable tie and is amputated with the electrosurgical pencil, scissors or a scalpel, depending on the surgeon's preference. The appendiceal stump is inverted within the lumen of the cecum followed by the tightening and tying of the pursestring suture. The surgical technologist should gently push the stump into the lumen with the Crile hemostat. As the pursestring suture is tightened, the surgical technologist will unclamp the hemostat and remove it. A basin should be in the field to collect the appendix and any contaminated instruments. A Penrose drain may be placed.

The appendectomy incision is closed in layers. Since the incisions are generally small, surgical technologists should be prepared to quickly perform counts.

POST-OP CONSIDERATIONS

Following the procedure, the patient will be transported to the PACS and monitored for the following complications: hemorrhaging, infections, stump rupture, sepsis or intestinal obstruction due to resultant adhesions. If it determined the operation was a success and the patient has no complications, he or she may return to normal activities within four to six weeks.

The removal of the appendix may also be performed via laparoscopic approach.

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CONCLUSION

Even though there are only a few thousand cases of appendiceal cancer diagnosed each year, tremendous advances have been made toward extending the life expectancy of those who do develop this disease. The five-year survival rate was around 50 percent 35 years ago and today those percentages have risen drastically. For someone faced with the odds of dealing with a cancer diagnosis of any kind, the hope of a cure or long-term survival can make a tremendous difference for them. The aggressive type of surgery performed on patients who are diagnosed with adenocarcinoma of the appendix may seem excessive, but statistics show that it drastically increases the chances of a living longer.

For adenocarcinoma of the appendix that is nonperforated and localized, a right hemicolectomy is the preferred treatment. This radical approach offers the best long-term outcome for the patient.^{4,11}



ABOUT THE AUTHOR

Katrina Craig, CST, graduated from San Joaquin Valley, Fresno, California, earlier this year.

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Single-site Laparoscopic Total Hysterectomy

FREDERICO JOSÉ SILVA CORRÊA, MD

The latest advancement of laparoscopic minimally invasive surgery in the last couple years is the single port (SPL), also known as a single-incision laparoscopic surgery (SILS) or laparoendoscopy single site surgery (LESS surgery).⁹ The LESS technique is laparoscopic surgery performed by only one incision, usually in the umbilical region. The laparoscope and tweezers are introduced through this single incision to perform the procedure. Initial studies have shown that the technique is reliable and applies to the areas of general surgery and urology.^{14,23} The use of LESS in gynecologic surgeries is recent and the number of cases reported in the literature remains low, respectively. Still, pioneering groups have observed promising results with LESS in both, simpler procedures such as salpingectomy and oophorectomy, and more complex such as hysterectomies and pelvic lymphadenectomy.^{4,20}

CASE DESCRIPTION

Patient, 44 years old, married, complaining of dysmenorrhea and chronic pelvic pain for about two years with progressive worsening. She presents hypermenorrhea and menorrhagia for one year. She was referred for hysterectomy with the diagnosis of diffuse adenomyosis. She had two normal pregnancies and two natural births. Her personal history includes a laparoscopy 11 years ago to treat fibroids and ovarian endometriosis. Her pap smear was negative for neoplastic cells.

On physical examination the patient was in good general condition, with body mass index of 29.6 kg/m². Genital examination showed a normal vulva and vagina. The bimanual digital pelvic examination showed an anteversoflexion uterus (AVF), increased in size, mobile and with painful mobilization. The ovaries were normal in size and location without pain in mobilization. The pouch of Douglas exam was painful but without palpable nodules. The patient underwent a transvaginal ultra-

LEARNING OBJECTIVES

- ▲ Determine what equipment is necessary when performing a laparoendoscopy single site total hysterectomy
- ▲ Identify the appropriate instruments needed for this operation
- ▲ Note the postoperative considerations and possible complications
- ▲ Discuss the history and timeline of LESS procedures
- ▲ Access the benefits of laparoendoscopic surgeries



Courtesy US Navy

sound examination that showed an AVF uterus, heterogeneous myometrium with echogenic areas, diffuse and isolated cystic areas in the anterior wall that is thickened. Uterine volume is 142cm³. Endometrium was echogenic, regular with 11mm thick. Normal ovaries. After the diagnosis of diffuse adenomyosis, clinical treatment introduced. It was done using continuous combined estrogen and progesterone contraceptive pills, continuous oral progesterone or anti-inflammatory drugs. However, no significant improvement of clinical symptoms was observed and side effects hormone therapy forced discontinuation of treatment. It was then indicated a total hysterectomy. After orientation, the patient opted for laparoscopic hysterectomy. The patient was offered the possibility of LESS surgery that was accepted by patient. Prior to the appointment and the procedure, the patient signed an informed consent form (ICF) for surgery and another ICF allowing the publication of the case.

The laparoscope 10 mm with flexible tip was introduced through the channel port and then a 5mm curved forceps and an ultrasonic scalpel was introduced into the other two channels.

OPERATIVE PROCEDURE

The patient went under general anesthesia with endotracheal intubation and was placed in a supine position with legs parted. After antisepsis, a vesical catheterization was performed. A disposable intrauterine manipulator was

introduced and a scalpel was used to perform a 2.5 cm longitudinal incision to open the peritoneal cavity. A LESS port disposable model was introduced and carried through the CO2 infusion to formation of pneumoperitoneum. After establishing the pneumoperitoneum pressure of 14mmHg, the patient was placed in lithotomy with Trendelenburg to displace and protect the rectum and bowel. The laparoscope 10 mm with flexible tip was introduced through the channel port and then a 5mm curved forceps and an ultrasonic scalpel was introduced into the other two channels.

With the entire abdominal cavity in view, the hysterectomy procedure begins. An ultrasonic scalpel is used to perform the ligation and section of the adnexal pedicles and round ligaments. The broad ligaments and peritoneum fold of the bladder are held as the bladder is lowered. The uterine arteries are identified, ligated and divided with an ultrasonic scalpel, followed by the opening of the vagina and removing the uterus. The vagina is anchored to the uterosacral and cardinal ligaments with a laparoscopic needle holder and an absorbable suture. Once this step is complete, the uterus and adnexa are removed and the closing of the vagina begins. Trocars remain in place and the abdomen is re-sufflated with CO2 and the surgeon checks for hemostasis. The pelvis is irrigated and suctioned and the pneumoperitoneum is released. The trocars are released and the umbilical incision was closed with stitches in the aponeurosis with polyglactin 910 and 4-0 suture.

POST-OP

This surgery was uneventful, and the patient recovered well after surgery with no complaints of significant pain and showed no immediate complications. The patient was discharged in good condition within 40 hours postoperatively.

OTHER POSTOPERATIVE CONSIDERATIONS

Patients are transferred to the PACU and monitored for fluid maintenance and pain. A liquid diet is recommended for 12 to 24 hours following the operation to assist with limiting nausea and slowing of gastrointestinal activity. The bladder may be drained if spontaneous voiding does not occur. After the patient is given a good prognosis, he or she may return to normal activities within a week.

Complications from this procedure can include hemorrhaging, failed LAVH and conversion to laparotomy, injury to major blood vessels, bowel injury, ureteral injury, bladder

VAGINAL AND LAPAROSCOPICALLY ASSISTED VAGINAL HYSTERECTOMY (LAVH)

Equipment

Allen stirrups
Electrosurgical unit
SCD pump
Video system
Laparoscopic irrigator/suction
Bipolar generator

Instruments

GYN laparoscopy set
Laparotomy instrument set
Abdominal hysterectomy set
D&C set
Camera

Supplies

LAVH supplies including any disposable or nondisposable laparoscopic supplies such as trocars, Veress needle, acorn cannula, endoscopic scissors, graspers, dissectors
Gloves
Surgeon-specific sutures
Blades
Basin set
Dressing material according to surgeon preference
LAVH drape

Operative Preparation

Anesthesia

- General anesthetic

Position

- Low lithotomy position
with Allen stirrups

Prep

- Abdominal and vaginal prep
- Patient is catheterized

Draping

- Drape sheet under the buttocks
- Leggings
- LAVH Laparoscopic drape sheet (may have attached leggings)

Practical Considerations for Surgical Technologist

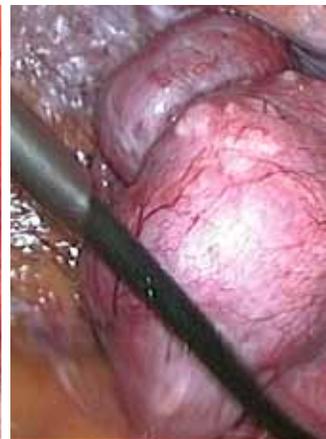
Check all equipment and supplies prior to patient's arrival



Uterus before hysterectomy



During laparoscopic hysterectomy



Total Lap Hysterecomy

PATIENT SAFETY – LITHOTOMY POSITION

Potential Hazards

Precautionary Action(s)

Crushing or shearing injury to the head

- Place arms on armboards
- If arms are positioned at the patient's sides, the hands must be observed during movement of the operating table.

Pressure injury to skin, blood vessels and nerves

- Pad feet and ankles
- Be sure restraining devices are not restrictive
- Avoid excessive torsion, flexion or extension of any part of the patient's body
- The legs may not come in direct contact with the stirrups
- Adjust stirrups to an equal height and length
- Raise and lower legs slowly and simultaneously by two individuals

Back, knee and hip pain

- Buttocks should rest completely on the operating table
- Adjust stirrups to an equal height and length
- Raise and lower legs slowly and simultaneously by two individuals

Blood pressure changes

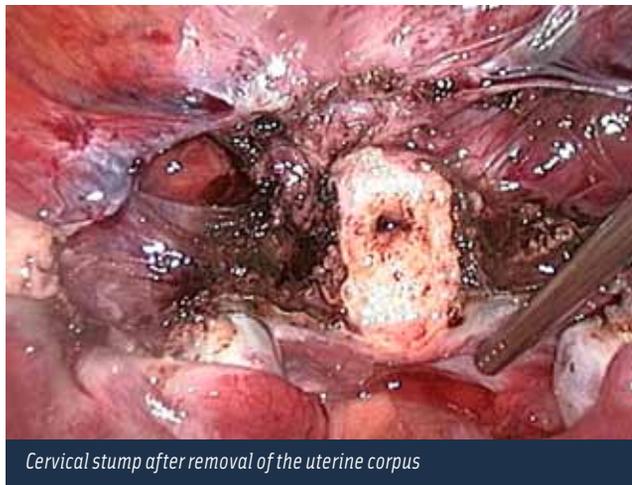
- Raise and lower legs slowly and simultaneously by two individuals

Venous stasis

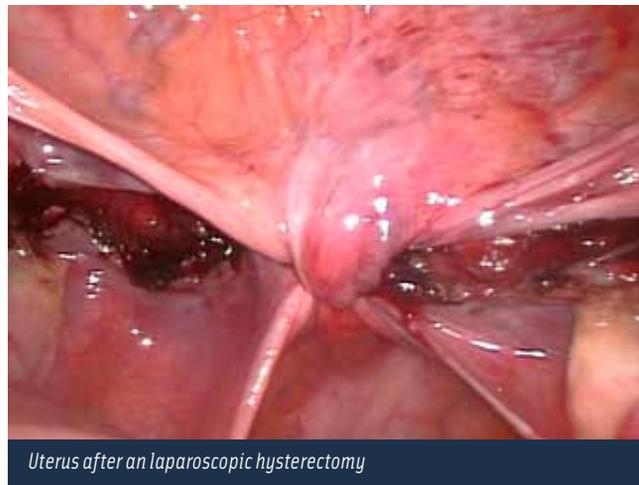
- Use antiembolic devices

Cardiovascular and respiratory compromise

- Restrict accompanying use of Trendelenburg's position
- Decrease leg height and hip flexion
- Return patient to the supine position as soon as possible



Cervical stump after removal of the uterine corpus



Uterus after an laparoscopic hysterectomy

injury, wound infection and hernias at trocar sites. A long-term complication from this surgery can include developing vesicovaginal or enterovaginal fistulas.

AN OVERVIEW OF LESS

The first laparoscopic surgeries were performed by single port. Wheeler reported more than 4,000 cases of rapid and effective surgical sterilization by laparoscopy with only a single trocar incision^{28,29} about 20 years after the first complex procedure by a single trocar that resulted in a supracervical hysterectomy in four patients.²² However, the technique did not become a standard procedure at that time. The initial difficulties related to a lack of appropriate instrumentation, which evolved into the LESS stagnation.

In recent years there has been an increase in the interest of surgeons for the surgery by single port. The development of specific instruments and equipment for the LESS has contributed in the evolution of the technique. Reproducibility and safety of new materials has allowed the improvement of skill and performance of procedures of greater complexity.²⁶ LESS surgery has been used in several procedures such as cholecystectomy, appendectomy, nephrectomy, colectomy, adrenalectomy, liver resection and bariatric surgery among others. Although, overall, fewer gynecological surgeries have been carried out by LESS.

Kosumi *et al*, in 2001, carried out laparoscopic ovar-

ian cystectomy for a single incision.¹⁵ Then, Ghezzi *et al*, reported a successful single port surgery for the surgical treatment of ectopic pregnancy in 10 patients.⁸ Lim *et al*, in 2009, reported the use of LESS in the treatment of 12 patients with benign adnexal tumor and had no complications.¹⁹ Also in 2009, Kim *et al*, also reported 24 cases of surgery with the LESS approach in adnexal tumors without intraoperative complications.¹³

In 2009, Lee *et al*, reported performing 24 laparoscopically assisted vaginal hysterectomies with LESS. Langebrekke *et al*, in the same year reported the first case of laparoscopic total hysterectomy through single incision.¹⁶ A camera and a multiple port device was used at the time. The suture of the vaginal vault was performed laparoscopi-

LESS surgery has been used in several procedures such as cholecystectomy, appendectomy, nephrectomy, colectomy, adrenalectomy, liver resection and bariatric surgery among others.

cally. In the following year, Yoon *et al*, reported performing supracervical hysterectomy by LESS with transcervical morcellation of the uterus.³¹

Kim *et al*, recently published a comparative study between LESS and conventional laparoscopy in cases of assisted vaginal laparoscopic hysterectomy.¹² The patients who underwent LESS surgery had a lower score on the visual analog scale of pain post-surgery at 24 and 36 hours.¹²

Yim *et al*, published a study comparing hysterectomy for LESS (52 patients) and conventional laparoscopic hysterectomy (105 patients).³⁰ The LESS group showed less intraoperative blood loss, shorter hospital stays and earlier introductions of solid diets. However, complications rates did not vary from each study. Chen *et al*. in 2011, published a randomized trial comparing LESS (50 cases) and conventional laparoscopic cases of laparoscopic assisted vaginal hysterectomy (50 cases).³ The authors concluded that there was no difference in operative time, blood loss, length of hospital stay and complication rate between the groups. However, the LESS group had less postoperative pain than the other group.

Jung *et al*, in a prospective randomized study of 68 patients who underwent conventional laparoscopy surgery or LESS, observed no significant difference in pain

... the surgical technique for single portal is feasible, safe and reproducible and opens new perspectives in the treatment of gynecological diseases with minimally invasive surgical procedures.

scores between groups. However, the LESS group used more analgesics than the laparoscopic conventional group.¹¹

A recent study by Escobar *et al*, demonstrated the use of LESS surgery in gynecological oncology surgeries.⁵ Twenty-one patients underwent pelvic and para-aortic lymphadenectomy staging for endometrial cancer and ovarian cancer. The authors concluded that the technique was feasible for such cases and that further studies should be conducted to assess the possible benefits of the new technique.

THE FUTURE

The possible advantages of using LESS surgery are related to reducing the number of auxiliary punctures. The effect of cosmetic (aesthetic) is a reality but can be quite questionable. The performance of only one umbilical incision of 20mm in LESS against the need

for more auxiliary incisions in conventional laparoscopy in theory reduces the inherent risks in such punctures (bleeding, perforation of viscera or vessel and infection). Other advantages are the least reported postoperative pain, faster recovery times and shorter hospitalizations. However, these advantages still require confirmation with more studies,⁶ but this specific case confirms that the surgical technique for single portal is feasible, safe and reproducible and opens new perspectives in the treatment of gynecological diseases with minimally invasive surgical procedures.

ABOUT THE AUTHOR

Frederico José Silva Corrêa, MD, is medical graduate from the Federal University of Goiás. His surgical specialities include gynecology and laparoscopic procedures.

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Sterile Processing

The Other Side of Surgical Services

SHANNON MAURER, CST

Behind every strong operating room is a strong sterile processing department (SPD). Sterile processing is an often overlooked division of surgical services, but it plays a critical role in patient care. Before an instrument can be placed on the back table or in a surgeon's hand, it must first be cleaned, decontaminated and sterilized. All of this occurs in the SPD, also known as the central service and supply department.

As contaminated instruments arrive in the SPD, they are cleaned of all material that would later hinder sterilization. This means scrubbing away bioburden such as dried blood and sputum. It also means prying bits of adhesive drape from the teeth of an Adson tissue forceps, or removing medication labels from a prep cup. Once this is accomplished, instruments are decontaminated and terminally sterilized. With the aid of machines, chemicals and good old-fashioned arm power, an SPD technician renders the items safe for handling without gloves. Then the instruments can be assembled, packaged and are resterilized for use.

The sterile processing department may provide instruments for an entire hospital as well as select medical facilities in the local area. On any given day, an SPD technician might package and sterilize a multitude of surgical instruments, implants, towels, glass syringes, sheets, sponges, cameras and microscope slides — all of which may require different cleaning and sterilization techniques. Every time an SPD tech prepares items for patient use, he or she follows standards and recommendations set forth by multiple agencies, including The Joint Commission (TJC), and the Association for the Advancement of Medical Instrumentation (AAMI).¹² Though SPD employees don't have

LEARNING OBJECTIVES

- ▲ Learn about the role of a sterile processing technician
- ▲ Outline the surgical technologist's role in sterile processing
- ▲ Identify what steps are needed when pre-cleaning instruments before and after surgery
- ▲ Examine which items are particularly susceptible to damage
- ▲ Consider the effect the sterile processing department has on the operating room



Dirty orthopedic instruments just after surgery



The same orthopedic instruments sprayed with enzymatic solution



*The same orthopedic instruments just two minutes after being sprayed.
The enzymatic solution helps dissolve most of the visible bioburden*

direct patient contact, their role in patient care is vital. Some may argue that the SPD is the first line of defense against all surgical site infections (SSIs).

THE ROLE OF A STERILE PROCESSING TECHNICIAN

What happens within the SPD is more complex than just washing contaminated items and assembling instrument trays. SPD technicians and surgical technologists understand many of the same principles: infection control, microbiology, instrumentation and asepsis. And while a surgical technologist must retain this knowledge, an SPD technician's expertise also includes selecting appropriate decontamination methods; selecting packaging material that protects instruments while allowing for optimal sterilization; choosing appropriate sterilization parameters; and handling items in a manner that preserves sterility. An SPD technician's main duties include being responsible for checking surgical instruments for functionality; conducting routine care and testing of sterilization equipment; properly rotating sterile supplies; and completing regular quality control assessments of the department's processes, products and personnel. Whenever the OR receives new instrumentation, SPD technicians must learn how to properly decontaminate and sterilize those instruments. The intricacy of some surgical instruments, the complexity of the manufacturers' processing instructions and the evolving needs of the OR, are just a few of the many challenges that an SPD technician encounters on a daily basis.¹²

INSIDE THE STERILE PROCESSING DEPARTMENT

When used instruments arrive in the SPD, they enter through the decontamination area. The decontamination area is separated from the rest of the department by a wall to minimize the spread of contaminants to other areas. An SPD technician dons appropriate personal protective equipment (PPE) before handling any instruments brought into the decontamination area. At a minimum, decontamination PPE includes a sleeved, impervious gown or apron, and gloves, but when there is risk of splashing or contaminant aerosolization, a mask, eye protection and a hair cover are worn.²

Before instruments can be decontaminated, or made safe to handle without PPE, they must be cleaned. Cleaning and decontamination are crucial steps in sterile processing because sterilants (such as steam) will not penetrate debris left on instruments.³

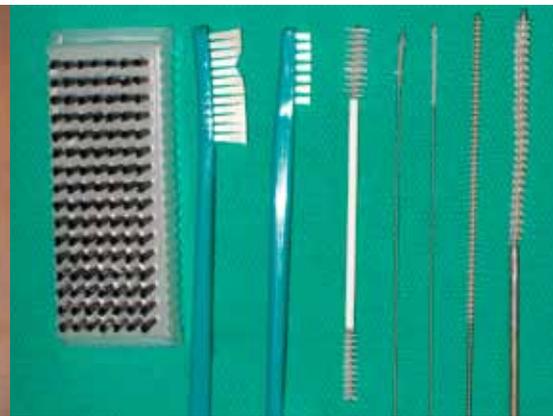
Cleaning removes visible bioburden and foreign material, and how an instrument is cleaned depends on many factors. The instrument manufacturer's written instructions, the type of contaminant, the shape and design of the instrument, the amount of visible gross debris and the type of cleaning solution used are all considerations



A brush cleaning the lumens of a laparoscopic probe with holes



The tip of that same brush after going through the lumens. The brush reveals some of the bioburden that had been hidden inside the lumens



A sampling of brushes used in the decontamination area of sterile processing. Some brushes, like the slender ones, are designed specifically for cleaning lumens

before cleaning.²

An SPD technician may opt to soak or spray the instruments with an enzymatic solution to loosen bioburden. Prior to arrival in the SPD, instruments should be disassembled, if possible, to allow the enzymatic solution to come in contact with hidden surfaces. An SPD technician scrubs away excessive external debris and uses a slender brush, followed by a water flush, to clear all lumens. Foreign material, such as fragments of adhesive drape and bone cement, are removed as well.

Mechanical cleaning, such as the use of an ultrasonic

To uphold the practices of patient safety, an SPD tech must be able to identify hundreds of instruments and follow guidelines from multiple agencies, including one's place of employment.

cleaner, may be used in place of or in conjunction with, manual cleaning if the instruments are free of excessive bioburden. However, an ultrasonic cleaner is appropriate only for non-delicate instruments, and for instruments that can withstand being submerged in liquid.¹⁸

The SPD technician then decontaminates the instruments, which makes them safe to handle without PPE. An SPD technician has numerous factors to consider before selecting a

decontamination method: Are the instruments semi-critical or critical devices? Should they be subjected to high-level disinfection or sterilization? Can they withstand exposure to high temperatures and submersion? Should they be decontaminated manually or mechanically?

Mechanical decontamination equipment, such as a washer-sterilizer, is preferred over manual methods of decontamination.⁵ Washer-sterilizers resemble large dishwashers and use a combination of chemicals, heat and saturated steam to decontaminate instruments. To keep each instrument set intact, and to prevent individual items from being misplaced, an SPD technician will keep instruments in their original pan when loading them into the washer-sterilizer. Delicate instruments, however, are often placed in a separate pan to keep them from being crushed by heavier instruments.

Once the instruments have been decontaminated, they are ready to be inspected, assembled, packaged and sterilized. To prevent cross-contamination, these tasks occur in a separate area of the SPD called the "clean area." Washer-sterilizers can be installed in the wall that separates the decontamination area (the "dirty area") from the clean area. The washer-sterilizer will have two doors — one through which the SPD technician loads dirty instruments, and one directly opposite from it where the decontaminated instruments are unloaded into the clean area. This layout keeps the dirty area and clean area functionally and physically separated — a standard of practice highly recommended by both the Centers for Disease Control and Prevention (CDC) and AAMI.^{2,14}

An SPD technician assembles instrument sets using a countsheet — the same countsheet used by the surgical technologist and circulator to track instruments during surgery. The instruments are checked for functionality and damage,

and defective instruments are removed from service. Exposure indicators are placed with the instruments to show if sterilization parameters have been met. Instrument sets are then either sealed in a rigid container or wrapped. Individual items that aren't a part of a set are either peel-packed or wrapped separately.

To uphold the practices of patient safety, in addition to being able to identify hundreds of instruments, an SPD tech must know and follow guidelines from multiple agencies, including his or her place of employment. Everything an SPD tech sterilizes must remain sterile until it's opened in the OR. Instruments must be assembled and packaged in a manner that allows steam and chemical sterilants to penetrate the packaging material and contact all surfaces inside the wrapper. Packaging material must be able to withstand tears and punctures, be opened in the OR easily and aseptically, allow for the use of tamper-evident seals and protect the sterile contents from microorganisms.²

After instruments are properly decontaminated, assembled and packaged, they can be sterilized. Steam sterilization is the most popular — and preferred — method of sterilization because it doesn't use potentially harmful chemicals. The CDC recommends this method for all items that can withstand heat and moisture.¹⁴

To prepare for steam sterilization, an SPD technician loads items onto a metal cart which is rolled into a large sterilizer. Before being pushed into the sterilization chamber, each item is stamped with a lot sticker to show when it was sterilized, which sterilizer was used and which cycle of the day the item was run in. In the event of a recall, all items from that particular load cycle will be removed from sterile storage and reprocessed.

Steam sterilization is divided into two segments: exposure time (when items are subjected to time, temperature, pressure and steam) and dry time (when all moisture is removed from the load). Not all instruments require the same exposure and dry times, and not all types of steam sterilization require a dry cycle. Some instruments may be damaged if sterilized beyond the manufacturer's recommended guidelines.

After a load has been steam sterilized, it is extremely hot. In fact, if it's immediately removed from the sterilizer and exposed to cooler air, moisture will form on the instruments and on the outside of the packaging material. Condensation can occur with any packaging material — rigid containers, wrappers or peel-packs. Moisture that forms on the out-



A washer-disinfector is loaded with dirty surgical instruments. Once the door is closed and a cycle is selected, the instruments will be mechanically decontaminated



A sterile processing technician wraps a small drill

side of the package acts as a channel for microorganisms to enter. In rigid containers, the condensation that forms on the outside will drip through the filter and allow contaminants to reach the inside contents.² For this reason, SPD technicians allow the load to cool for a minimum of 30 minutes, although factors such as room temperature, humidity, the density of the load and the density of the instrument trays may lengthen cooling time.² Since cooling time affects how quickly the OR will receive sterile items, SPD technicians must balance the needs of the OR with correct sterile processing technique.

SPD technicians also are responsible for properly trans-

porting and storing sterile instruments. Though transport practices may differ from one facility to another, organizations such as AAMI have specific recommendations about the transport of items through the SPD, to other departments and to outside facilities. Incorrect handling and storage can damage the protective wrapping or container, and cause damage to the instruments.²

THE SURGICAL TECHNOLOGIST'S ROLE IN STERILE PROCESSING

Since sterile processing occurs apart from the OR, there is a tendency for surgical technologists and SPD technicians to function as separate entities, each with their own mission. Their paths may never cross, but they share a common goal. The surgical technologist's role in sterile processing is crucial in ensuring patient safety. Without ever leaving the OR, a surgical technologist plays a critical part in the cleaning, decontamination and sterilization process.

PRE-CLEANING INSTRUMENTS DURING AND AFTER SURGERY

One of the duties of a surgical technologist during surgery is to clean the instruments. It becomes second nature to wipe instruments clean after they are used. Yet after the final counting of sponges and sharps, instruments often are thrown back into the tray. The lumens of Frazier suction tips, which were never flushed during surgery, are left full of blood that quickly will congeal to a paste-like consistency. Heavily-soiled items, such as weighted speculums and hysterectomy forceps, will remain caked with dried blood.

When instruments arrive in the SPD in this condition, they already have been subjected to the harmful effects of bioburden. After about 20 minutes, a component in blood begins to cause damage that can lead to pitting, rusting and cracking of stainless steel instruments.⁶ Bodily fluids and tissues become more difficult to remove after they dry. When an instrument needs to be sterilized and returned quickly to the OR, pre-cleaning items will assist in the process. Pre-cleaning can be the difference between resorting to immediate-use sterilization in the OR, and receiving a terminally sterile instrument set from the SPD.

Suggestions for pre-cleaning:

1. Wipe instruments clean and keep lumens flushed throughout surgery. Soiled instruments that will not be reused should be allowed to soak in a basin of sterile water for the remainder of the procedure.⁵
2. Immediately after surgery, spray instruments with an



A few of the many items a sterile processing technician can use to protect instruments and wrappers from being damaged during and after sterilization. Shown are assorted tip protectors, a disposable paper tray liner, disposable paper corner protectors and non-disposable silicone corner protectors



A sterile processing technician pushing a cart of unsterile instruments into a steam sterilizer



A sterile load of instruments after being removed from the sterilizer. The indicator tape has changed color

enzymatic solution. Enzymatic sprays designed for this purpose will begin to loosen bioburden.¹⁶

3. Before transporting instruments to the SPD, cover them with a damp towel. Keeping instruments moist prevents blood from hardening and makes the cleaning and decontamination processes less time-consuming.^{6,16}
4. Place heavily-soiled instruments in a basin of sterile water. When instruments are coated in blood, soaking them in a small amount of sterile water can jumpstart the cleaning process. Due to the risk of spillover and splashing, transporting instruments in a basin of water is not recommended.⁵
5. Flush endoscopes before leaving the procedure room. This keeps fluids and small debris from adhering to the intricate channels of the endoscope. Thoroughly flushing an endoscope and wiping down its exterior immediately after use is highly recommended by the Centers for Disease Control and Prevention, the US Food and Drug Administration and the Department of Veterans Affairs.¹¹

EXAMINE RIGID CONTAINERS AND WRAPPED ITEMS BEFORE USE

Wrapped items are particularly susceptible to damage because the wrapper can tear during handling. As heavier wrapped items are dragged across shelves and carts, the weight of the items crushes the outer wrapper. When the wrapper meets resistance — such as a sharp edge of a cooling rack or an uneven surface — it snags, creating a tear or puncture that may go unnoticed until the item is opened for surgery. Heavy, large instrument sets are more susceptible to punctured wrappers since the sheer density can prevent adequate drying and allow moisture to remain in the pan or on the wrapper. For this reason, it is recommended that instrument sets weigh no more than 25 pounds.^{4,13,14,15}

Although sturdy, rigid containers aren't indestructible, over time a lid may become bent or a latching mechanism will stop working properly. If the lid and base don't form a tight, even seal, or if the filter mechanisms are damaged, the sterility of the instruments inside can't be guaranteed. A lid that is difficult — or impossible — to remove may indicate that the lid was forced into place in the SPD. If a surgical team member pries a damaged lid off a container, the items inside can become contaminated. Because sterility cannot be guaranteed in these circumstances, manufacturers recommend that damaged rigid containers be removed from service immediately.^{1,7,9,17}

Sterility is affected by the quality of the wrapping material or rigid container, how a sterile item is stored and handled and how often a sterile item is handled.⁸ SPD technicians have many products they can use as an extra layer of pro-

On any given day, an SPD technician might package and sterilize a multitude of surgical instruments, implants, towels, glass syringes, sheets, sponges, cameras and microscope slides — all of which may require different cleaning and sterilization techniques.

tection to sterile items, such as plastic trays specially made to transfer heavy instrument sets, absorbent tray liners and protective caps for sharp tray corners.¹⁶

Despite all of these precautionary measures, instrument sets still can be contaminated. Whether by manufacturer defect or by human error, rigid containers and wrappers can fail to preserve the instruments inside. Before introducing an instrument into the sterile field, surgical technologists must look at the instrument's packaging material to make sure there is no damage or contaminants. If it is not intact, they should not use the contents. The SPD should be told about any rigid container or wrapper that is damaged. New materials may need to be ordered or the method of processing instruments may need to be evaluated.

Suggestions for examining containers and outer wrappers:

1. Before opening any rigid container or wrapped item, ensure all tamper-evident seals are intact and sterilization process indicators have changed color. If a seal is broken, or if the indicators are unchanged, do not use the instruments. They are considered unsterile.^{10,13}
2. Before opening a rigid container, examine the seal between the lid and the bottom. If the lid is loose, dented or looks like it has been forced into place, do not use the instruments. The same applies if the lid is being held in place by sterilization tape. If the container isn't sealed properly, its contents are considered unsterile.¹³
3. After opening a rigid container, single-use filters need to be removed and inspected for moisture and holes. If holes are found, instruments should not be used. Once a filter has been punctured, dislodged or otherwise dam-

aged, the contents of a rigid container are considered unsterile.¹³ If a filter is missing, the contents are considered unsterile.

4. After removing an item from a wrapper, examine the wrapper for holes. After taking a sterile item from its wrapper, the surgical technologist should hold the item while a nonsterile team member inspects the wrapper for holes. (Holes are more easily seen if the wrapper is held up to the light.) After the wrapper passes the inspection, the instrument set may be placed on the sterile back table.

Surgical technologists are consistently involved in sterile processing whether they are aware of it or not. Surgical instruments pass through many hands on their journey through the SPD and the OR, and how they are treated will affect their sterility. Paying attention to the integrity of wrappers and rigid containers is crucial to maintaining a sterile field. Even simple actions, such as spraying soiled instruments with a wetting solution, improves instrument turnover time and helps break down contaminants. Although these steps may be time-consuming, they go a long way toward preserving instrumentation and protecting the surgical patient.

ABOUT THE AUTHOR

Shannon Maurer, CST, became a surgical technologist while in the US Air Force, and passed the national certification exam before completing her enlistment. Since then she has worked in surgical services, sterile processing and pathology. She recently earned her master's degree in writing and is working on a nonfiction book for middle-grade readers. Shannon and her husband, who currently serves in the military, are stationed in Virginia with their cat, Phoebe.



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Mammoplasty to Treat Macromastia

Restoring function and self-esteem to women who suffer from enlarged breasts

LEAH-MARIE GUILL, CST

The patient is a 40-year-old woman with a history of early breast growth who has struggled with back pain for years. The pain has become significantly worse in the past few years and she has developed neck and shoulder pain as well. The patient has increased difficulty running, and has chronic rashes at the inframammary fold in spite of meticulous care. The patient has recently developed numbness and tingling in both of her hands due to the increased weight on her brachial plexus from her breasts. The patient is currently wearing a bra cup size of 38 or 40 E and wishes for a breast reduction. Breast demonstrate 3+ ptosis.

A mammogram was performed in 2011, which returned negative. The patient is a nonsmoker and works out regularly. Bilateral breast hypertrophy was found to be both the preoperative and postoperative diagnosis.⁹

PATHOPHYSIOLOGY

Reduction mammoplasty is performed to re-establish a functional and proportional bust to the patient's body. Reduction is indicated in patients who suffer from secondary health problems relating to their macromastia. These secondary health complications can include diminished blood circulation, sleep apnea (from the weight of the breasts), skin chaffing, kyphosis and indentations to the shoulders caused by the bra straps supporting the tissue. The definitions for enlarged breasts are <500gm (454gm=1 pound) per breast while gigantomastia is defined as <1,000 gm increase per breast.⁵

LEARNING OBJECTIVES

- ▲ Examine the reasons why patients would opt for a mammoplasty
- ▲ Review the relevant anatomy and physiology related to this procedure
- ▲ Identify the surgical technique used to perform a mammoplasty
- ▲ Determine what instruments and equipment is necessary to have available for breast reduction
- ▲ Compare and contrast the benefits of a mammoplasty to treat macromastia



Before



After



Before



After

The most common time in a woman's life for large breast development is during the larche or pubertal breast development stage. However, enlarged breasts can occur due to genetic predisposition, following the birth of a child, during menopause or after weight gain. All of these factors produce hypertrophy within the adipose fat tissue of the breast. The degree of hypertrophy of the breast tissue is dependent of the weight added and has a variable range from mild (>300gm) to moderate (300-800gm) to severe (<800gm).¹ As the breasts enlarge, the suspensory ligaments, also known as Cooper's ligaments, are unable to support the

weight and the degree of breast ptosis increases. The degree of breast ptosis is determined by the degree to which the nipple has fallen below the patient's inframammary fold.²

Prior to surgery, a medical history is taken which includes the patient's age, number of children she has borne, future planned pregnancies, breastfeeding practices with each child, known allergies, pain and numbness and family history of breast cancer. Because of the debilitating size of their breasts some patients may suffer from depression, self-esteem issues and anxiety.⁷ A mammogram and a routine breast exam are required prior to surgery.⁸

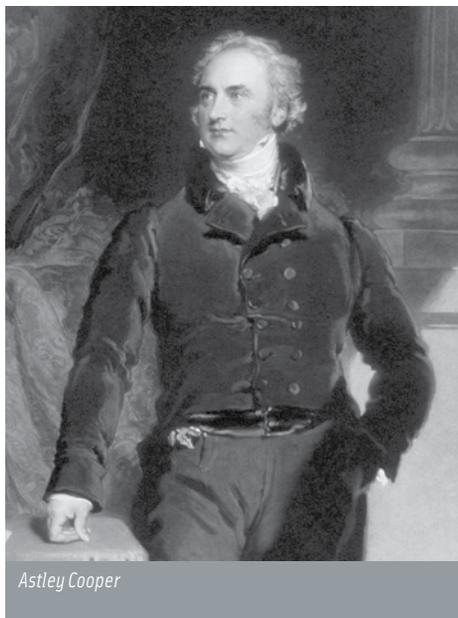
RELEVANT ANATOMY AND PHYSIOLOGY

The nipple-areola complex (NAC) and the blood supply relating to it are the priorities when performing this surgery. The breast is supplied arterially from the medial aspect by the internal mammary artery and laterally from the lateral thoracic artery and the 3rd-7th intercostal perforating arteries.⁶

Drainage of the venous blood is performed by the superficial vein system under the dermis. The primary lymph drainage system is the retromammary lymph plexus found in the pectoral fascia.

Beginning at the skin and descending to the rib cage, the breast skin is made of three layers: the epidermis, the dermis and the hypodermis. The thickness of the hypodermis will vary from patient to patient and body region. The nipple and areola are constructed of a modified and specialized myoepithelium that is responsible for contraction in response to stimuli.⁴ Breast sensation is controlled by the peripheral nervous system. The PNS innervates the anterior and lateral cutaneous branches of the 4th-6th intercostal nerves.⁶ Researchers believe sensation to the nipple derives largely from the lateral cutaneous branch of T4.³

The adipose tissue of the breast is a lipid rich fatty layer containing glandular, milk-producing tissues. The breast contains lobules and the lactiferous glands, which widen to form an ampulla at the nipple. The ratio of fatty tissues and glandular tissues varies from patient to patient.



Astley Cooper

Breastfeeding and the onset of menopause increase the fatty tissue and diminish the glandular tissue.³

Suspensory ligaments, as described by Astley Cooper in 1840, run in the subcutaneous layer of adipose tissue throughout

the breast. This tissue is integrated with the small Cooper's ligaments, which extend obliquely to the skin surface and from the skin to the deep pectoralis fascia.

The pectoralis fascia lies superior to the ligaments and covers the pectoralis major muscle as a thin superficial membrane. The pectoralis major muscle originates at the anterior surface of the sternum and inserts into the anterior surface of the medial half of the clavicle.

The chest muscles lay inferior to the breast and the pectoralis fascia. These muscles are composed of the pectoralis major, the pectoralis minor, intercostal muscles of the ribs and can cover portions of the anterior serratus muscle. These chest muscles can be traumatized by

Beginning at the skin and descending to the rib cage, the breast skin is made of three layers: the epidermis, the dermis and the hypodermis.

the posture adopted by the patient who is suffering from enlarged breasts. As the weight of the breast sags the tissue, the pectoralis major and minor can suffer from shearing forces while the patient is standing, compression injury while lying supine and tension forces while kneeling on all fours. These injuries and forces can make exercise painful and unbearable.

Lastly, the portions of the ribcage the breast can lay on are the 2nd, 3rd, 4th, 5th and 6th thoracic ribs. These ribs provide the structural support for the mammary glands.⁶

EQUIPMENT

The patient's legs are dressed in anti-embolism knee high stockings and sequential compression devices to prevent the formation of a deep venous thrombosis. The patient's feet are placed in foam booties and the Velcro secured loosely across the arch. The electrosurgical unit is located at the foot of the bed and set to 40/40 blend. This unit also houses the smoke evacuator that is used during the dissection of the fatty and glandular tissues.

POSITIONING AND POSITIONING AIDS

The patient is placed supine on a reversed surgical bed. The patient's gown is reversed and a bair hugger drape is taped to the gown and to the edges of the table. This draping technique is used to prevent an adverse adhesive reaction of the skin. The dispersive electrode for the electrosurgical unit is applied to the thigh, avoiding any bony prominences, joints, implants, tattoos or scars. Two safety straps are used to secure the lower extremities to the bed 2 to 4 inches above and below to the knee. Once the patient is induced, her arms are rested comfortably on ratcheted armboards that have been prepared using a 90-degree wedge covered with one egg crate and a towel. This is then secured to the armboards using three bands of surgical tape. The arms are placed in an abducted position to relax the pectoralis muscles during surgery and minimize traction on the brachial plexus. It is crucial that the arms and the padding are tightly secured to the armboards, as the patient will be placed in a sitting position intermittently throughout the procedure. A second egg crate is then placed over the patient's arm, covering from elbow to wrist and a gauze is used to circumvent all the padding. This is then secured with two bands of tape. Special attention is paid to the IV site, ensuring the IV clamps and flanges do not press into the patient's skin once draped. Finally, a pillow is placed under the patient's knees to relieve low back strain.

Once the patient is secured, she is placed in a sitting position by use of the mechanical bed. The surgeon adjusts the shoulders, arms, hips and torso until they feel the patient is sitting straight and level. The patient is returned to the supine position and the surgeon marks the skin using a skin marker and the skin preparation begins.

SKIN PREPARATION AND DRAPING

The patient's skin is prepped beginning at the nipples, extending from the neckline to the level of the iliac crests and down to the table at the sides with an antibacterial soap slightly diluted with sterile water from the back table. A chlorhexidine gluconate/isopropyl alcohol skin preparation can also be used. The axilla is included in the prep. The surgical site is then blotted to remove excess skin preparation solution so the draping can begin. The sur-

geon and the assistant drape off the patient using four blue towels and a large drape that has been cut into thirds. The drape is used to affix the blue towels to the sides and across the midline of the patient. A disposable drape is used to cover the lower half of the patient and is extended over the lower extremities while a top sheet is placed at the neck and secured to two IV poles by the anesthesia provider.

PROCEDURE

The inferior pedicle technique is used for this patient. This technique features both an arterial and venous blood supply for the nipple-areola complex by allowing it to remain attached to the chest wall. Following the removal of the

Suspensory ligaments, as described by Astley Cooper in 1840, run in the subcutaneous layer of adipose tissue throughout the breast.

requisite quantities of tissue (glandular, adipose, skin), the nipple-areola complex is transposed higher upon the breast hemisphere; thereby the inferior pedicle technique produces an elevated bust and nipple-areola complex with breasts that are proportionate to the woman's body.

Along the incision line, the breast tissues are infiltrated with a local anesthetic with epinephrine to reduce bleeding. Using a sterile skin marking pen pressed into the breast, the new size of the areola is marked. An eschmark is used to provide a temporary tourniquet around the pendulous tissue during the initial incisions. Using a 15 blade on a number 3 knife handle an incision circumscribes the areola, leaving the areola attached to the inferior pedicle. With an Adson forceps with teeth and a number 10 blade, the skin is deepithelialized from the thick flap, as this flap will later be moved superiorly during the breast lift. Clamps are applied to the tails of the removed skin to provide traction during the de-epithelization. The tourniquet is removed and the de-epithelization is completed to the inframammary fold of the breast. The thick pedicle flap is then excised from the peripheral breast tissue with a Teflon bovie tip. Laheys are used to retract the tissues superiorly during the dissection. It is important to maintain anatomical position of the pedicle tissue during resection of the lateral and medial



Before



After



Before



After



Before



After

wedges or the pedicle could become compromised through unintentional undermining. Beginning medially, the first wedge of fatty and glandular tissue is dissected from the body using the electrosurgical unit and removed from the field to be weighed. This process is repeated for the lateral side. Once the two largest flaps are removed, the upper breast flap is elevated off the pectoral fascia and thinned. This tissue is also weighed.

Once the appropriate amount of tissue has been removed for each breast, the upper “keyhole” flaps are approximated at the midline and tacked in place using a 1-0 polypropylene suture. The incision lines are temporarily stapled closed using a skin stapler and the patient is placed in the semi-Fowler sitting position to evaluate



A surgeon performs breast reduction surgery

the new breast size, shape and symmetry. If more tissue is to be removed, the areas are marked and the staples are removed using a Kelly forceps and placed in the lid of a specimen cup to prevent them from being left behind in the wound.

Breast topography and the location of the nipple-areola complexes are unique to each woman. The desirable average measurements are 21 to 23cm distance from sternal notch to nipple and a 5 to 7cm distance from nipple to the inframammary fold.

The breast is reconstructed by rotating the medial and lateral breast tissue from the upper flap and approximating them to the incision at the inframammary fold. The operative site is now copiously irrigated, hemostasis was achieved and a 15F fluted draining tube is placed through

the lateral incision and secured to the patient with a 3-0 suture. Irrigation contains a triple antibiotic solution of bacitracin, gentimycin and kefazolin. The two breasts were definitively checked for size and shape match. The incisions are closed with 4-0 polyglactin 910 suture subcutaneous sutures. Before final closure with a 4-0 poliglecaprone 25 suture, a skin marker is used to create the outline for the opening through which the areola and nipple will be brought up to the surface and secured. The tissue is excised with a 15 blade and handed off the field to be weighed with the other removed tissue. The nipple and areola are brought through the new opening and are secured without undue tension subcutaneously with 4-0 polyglactin 910 suture. The orientation of the nipple has

been previously marked with two marks for the superior portion and one mark for the inferior. Final closure with a 4-0 poliglecaprone 25 suture on a P3 needle is performed in a subcuticular fashion. This procedure is then repeated on the contralateral breast. Final viability of the nipples is checked.

Once all sutures and bulbs for the drains are placed, the drapes are removed and the remaining blood and fluids wiped from the patient. Dressings (5x9”) are placed along the inframammary fold incision and nipple, covered with unfolded gauze and two abdominal pads (one with a “Y” incision for the drain) and secured with the patient’s soft cotton bra. A binder is then placed to secure all dressings.

For this case, the patient was then reversed, extubated and taken to the recovery room in stable condition. All sponge and needle counts were reported as correct at the end of the case.

FREE NIPPLE-GRAFT TECHNIQUE

In this procedure, the nipple is transposed as a tissue graft without a soft tissue pedicle. This is done on women whose breasts require such a large resection of tissue that the vascular pedicle is unreliable. Tobacco smokers and diabetics may also require free nipple grafting. A grafted nipple has little sensitivity and no lactation capabilities. Dressings for the free nipple graft involve a bolster dressing. The dressing is comprised of gauze wrapped around saline soaked gauze and secured above the nipple using 4-0 non-absorbable sutures around the nipple and tied over the dressing.

REDUCTION MAMMOPLASTY

Equipment

- ▲ Padded footrest for modified sitting position
- ▲ Suction
- ▲ Fiber-optic headlight and light source
- ▲ Electrosurgical unit with needle tip and extension tip

Instruments

- ▲ Plastic instrumentation set
- ▲ Basic or minor procedures tray

Supplies

- ▲ Basic pack
- ▲ Basin set
- ▲ Gloves
- ▲ Blades: several #15 scalpel blades
- ▲ Drapes: folded towels and transverse sheet or folded towels and chest drape
- ▲ Suture: surgeon's preference
- ▲ Drains: none of surgeon's preference
- ▲ Dressings: surgeon's preference
- ▲ Drugs: local anesthetic of surgeon's choice, if used
- ▲ Miscellaneous:
 - Sterile skin marking pen with ruler
 - Syringes: Luer-lok control with 25- or 27-gauge needles, bulb syringe
 - Suction tubing
 - Elastic bandage
 - Skin staples and staple remover
 - Medical scale (for weighing breast tissue)
 - Laparotomy sponges
 - Areolar template

- Liposuction supplies (if requested – reduction only)
- Banked blood (if requested)
- Autotransfusion system (available)

Operative Preparation

- ▲ Anesthesia
 - general
- ▲ Position
 - Patient is supine, with each arm abducted to a 90-degree angle on a padded armboard
- ▲ Prep
 - Chest and breast: The area from the chin to the hips and the entire width of the patient is prepped, including the axillae
- ▲ Draping
 - The drapes are applied to expose the entire chest and may be secured with skin staples

Practical Considerations

- ▲ The intended incision lines and landmarks are marked with a skin marking pen with the patient in Fowler's position. This is accomplished to the induction of the anesthesia, possibly before the patient is brought to the operating room.
- ▲ The patient may require a transfusion and may be requested to donate a unit of blood in advance of the procedure.

The nipple is then monitored for blood supply during the days following the procedure.

POST-OPERATIVE CARE

Following the procedure, the patient is instructed to resume normal life activities, avoiding strenuous physical activity, and upper body pulling and pushing. Patients wear a cotton sports bra and will remove dressings in four days. The cotton bra placed during surgery should be worn at all times during the

The breast is reconstructed by rotating the medial and lateral breast tissue from the upper flap and approximating them to the incision at the inframammary fold.

first month after surgery and can serve as a comfort measure during the healing phase. Surgical patients may go home the same day or stay the night depending on pain levels and preoperative health. The drainage tubes that were placed bilaterally are removed in the physician office around postoperative day seven. Patients are instructed to watch for progressive, usually unilateral swelling or increasing pain and nausea as these can be symptoms of subcutaneous bleeding. Surgical scars will fade to white and become less noticeable over a 12-month period of time.

COMPLICATIONS

Post-operative complications can include seroma, wound dehiscence, asymmetrical persistence, hematoma and necrosis. The most severe complication is nipple necrosis. Loss of nipple sensation occurs in about 5% of patients. Complications are more readily seen in women who are obese, tobacco smokers and those that require a large-volume resection of the parenchyma.

Mammograms for these patients will become easier as there is less mass to be examined. Scarring from the procedure can cause blurry or cloudy images in MRIs. However, due to the amount of tissue removed, the patient reduces their chances for breast cancer by 20 to 40%.

RESTORING FUNCTION AND SELF-ESTEEM

For these women, even sleeping can be uncomfortable and breathing can be impaired. Women with overly large breasts often have difficulty finding clothing which fits their increased bust line. Many times women with very large breasts often feel self-conscious of their breasts in social situations.

Following reduction surgery, many women are able to return to active lifestyles, purchase clothing off the shelves and engage in activities that would have otherwise caused excruciating pain, numbness, back/neck aches. These activities can include, but are not limited to, running, biking, climbing, cleaning, sitting straight up and traveling. The self-esteem and function gained by breast reduction surgery has not only a lifestyle but a lifetime effect on those affected by macromastia.



ABOUT THE AUTHOR

Leah-Marie Guill, CST, became a surgical technologist after working as a veterinary assistant and fell in love with the surgical procedures and advancements she observed. As well as main-

taining her CST credential, she holds an Associate Degree in Surgical Technology and a Bachelor of Science from the University of Idaho in Physical Education with an emphasis in Biology. She currently works as a private assistant for a plastic surgeon in Boise, Idaho, where she resides with her husband and three-year-old son, Freddie.

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JCAHO PENDING

Damage Control Surgery

Medical professionals work quickly to save patients with penetrating wounds

TONY FORGIONE, CST, LPN

The term “Damage Control” surgery was first penned in 1993 by Rotondo, et al,¹⁶ in their work on penetrating injuries to the abdominal cavity. Damage control surgery is defined as a three-phased process. The first phase involves surgical intervention with the intention of controlling hemorrhage and decreasing the possibility of contamination. The second phase has the patient admitted to an Intensive Care Unit. In this phase the patient is resuscitated and hemodynamically stabilized. In the final phase, the patient will return to the operating room sometime within 24 to 48 hours later. This surgery will involve a more definitive repair or reconstruction of damaged tissue.⁵

This is not an entirely new phenomenon. Zachary, et al, reported that during World War II it was mandated that all colon injuries were to be treated with a colostomy. This resulted in a 20% decrease in mortalities.⁷

The concept of damage control surgery actually takes place well before the patient arrives at the hospital. The Emergency Medical Technicians (EMT) arriving at the scene assesses the situation during the pre-hospital care of the patient. Their analysis of the situation, the nature of the injuries and their initial treatments starts the process in motion. The rapid transportation of the patient to the Emergency Department (ED) is critical. During this time, there needs to be a detailed description of the injuries and the treatments provided on scene communicated to the receiving hospital.

LEARNING OBJECTIVES

- ▲ Define the three phrases of damage control surgery
- ▲ Identify the equipment and instruments ORs need to have on hand for emergency procedures
- ▲ Describe the specific techniques of hemorrhage control
- ▲ Learn about the role the surgical technologist plays when assisting during emergency operations
- ▲ Review how to identify injuries and the steps to prevent contamination in such areas

Communication between the EMTs and the hospital ED allows them to marshal the personnel and supplies needed when the patient arrives. Once the patient enters the ED, doctors and nurses administer intravenous fluids and perform a Focused Abdominal Sonography in Trauma (FAST) exam. A FAST exam is a noninvasive test using portable sonography to detect hemorrhage in the peritoneal cavity.⁴ The FAST exam “Is performed during the American College of Surgeons Advanced Trauma Life Support secondary survey while the patient is in the supine position.”³ The

Douglas which is downward transverse view 4 cm superior to the symphysis pubis.² Positive results will have the patient immediately booked for surgery.

While the patient is in the ED, the operating room will be in communication with the emergency department nurse manager to keep them informed as to the patient’s progress. Once it has been determined that the patient will need surgery, one of the attending surgeons will officially book the procedure, while at the same time ordering blood products from the blood bank.



Courtesy US Army

Once the case has been booked, the surgical team is mobilized. Most Level 1 hospitals will either have a casecart of emergency supplies readily available in the OR or there will be supplies and instruments set aside for emergency procedures.

Once the case has been booked, the surgical team is mobilized. Most Level 1 hospitals will either have a casecart of emergency supplies readily available in the OR or there will be supplies and instruments set aside for emergency procedures. These supplies are sent to the OR and set aside for such trauma procedures.

Due to the nature of damage control surgery, the surgical technologist will need to set up the surgical field quickly. In many instances while the patient is being booked for the procedure, he or she is actually in the process of being transported to the OR. The surgical technologist will need to priori-

exam involves the use of a hand-held transducer focused on different areas of the thoracoabdominal region. The ED doctor will start with a pericardial view to observe the sagittal subxiphoid look of the heart. The next view is the right abdominal quadrant between the 11th and 12th rib interspace. The third view involves the left upper quadrant of the abdomen through a posterior axillary line of the 10th and 11th rib interspace. The last view is at the Pouch of

tize what equipment and instruments will be needed for this type of procedure. For instance, regular 4x4 Raytex sponges will not be needed for this procedure. It is useful to keep a pack of 10 to use as a “sponge on a stick” by tri-folding one and clamping it on a Forrester sponge clamp. These can be used as a temporary means of controlling bleeding if a blood vessel ruptures. The instrumentation for this procedure will involve a laparotomy instrument set along with a



A staff sergeant is operated on during a live hands-on field exercise in a mobile field surgery operating room at JBLM

Courtesy US Army

variety of hand-held abdominal retractors, vascular instruments. A Bookwalter retractor should be available in the room if needed.

Also during this time, the circulating nurse is gathering and preparing any positioning supplies, such as ensuring there is a Foley catheterization kit in the room, and making sure the room temperature is set between 75°F to 80°F. A warm room, along with warm blankets and warming devices, will help prevent the patient from experiencing hypothermia during the procedure.

Since this is an emergency operation, the surgeon may wish to waive the instrument count in order to expedite the start of the procedure. However, during the preoperative phase of anesthesia, every effort should be made to obtain an accurate count of items routinely counted as stated in the hospital policy of counted items. Some of the items counted should include laparotomy sponges, suture needles, hypodermic needles, vessel loops, Pen Rose drains, cautery tips and scratch pads.

Once the patient is put under using a rapid induction

anesthesia and is intubated, the surgeon will want to prep from the suprasternal notch down to the midhighs and laterally to each side of the patient to the operating table.² Draping the patient will involve exposing as much of the prepped site as possible. In many instances, the surgeon will either use a large fenestrated laparotomy drape or two split sheets.

The American College of Surgeons, Advanced Trauma Operative Management, describes damage control surgery as a procedure that starts with a midline vertical incision from the xiphoid process, around the umbilicus, down to the symphysis pubis. The surgeon will attempt a rapid entry into the peritoneal cavity which means hemostasis is not an issue at this point. Once the abdomen is exposed, the surgery will involve four major components. The first component is to control hemorrhage; the second is to identify the injuries; the third is to control any contamination from the bowels or biliary tree; with the last component as repairing of injuries.²

HEMORRHAGE CONTROL

As mentioned earlier, control of hemorrhage is the initial goal of damage control surgery. As part of the preparation, the OR may have a means of collecting pooled blood from the patient. This blood may be washed and filtered and re-administered to the patient as a solution to replenish the patient's blood loss. Many operating rooms will have the blood bank initially set up 10 units of Type O blood – or the same amount of the patient's blood type, if known – and have them typed and cross matched for the patient.

Once the blood is available, the surgeon will pack the abdominal cavity with laparotomy sponges. The surgical technologist should have approximately 30 laparotomy sponges ready for initial packing of the abdominal cavity. The surgeon will pack the four quadrants of the abdominal cavity starting in the quadrant where the most bleeding or

damage to organs is suspected.⁶

There is a specific technique for packing the abdomen. Once the peritoneal cavity has been entered, the surgical technologist will hand up a large abdominal wall retractor to the assisting surgeon on the left side of the patient. The surgeon will retract the abdominal wall to expose the spleen. Once any blood or clots have been removed, a pack can be placed in the deep regions of the left upper quadrant. Care should be taken to protect the spleen while this maneuver is occurring. The final packing in this quadrant will be placed over the spleen.

The retractor will then be used on the abdominal wall to expose the right upper quadrant. The surgeon will transect the falciform ligament to allow maximum exposure of the liver. Again, any blood and clots will need to be removed and packing placed. Packs are placed above and below the



Tony Forgiore, CST, LPN, (left) scrubs during damage control surgery

Photo courtesy of Tony Forgiore

liver while a surgeon is compressing the liver to ensure tamponade if necessary.

In order to pack the rest of the abdominal cavity, the surgeon will need to control the small intestines. There are numerous ways to achieve this result. One method involves the use of a bowel bag. The clear bag is large enough to accommodate the entire small intestines and usually has a drawstring tie at one end. The small bowel is loosely placed in the bag, along with wet laparotomy pads or wet towels to ensure the bowel remains moist. Another technique for controlling the bowel involves the use of surgical towels. One towel is placed on either side of the incision, while the small intestines are eviscerated onto the towel and a second towel is used to wrap the contents. As with the bowel bag, the towels will be moistened.

Whichever method is used, the surgeon most likely will have to transect the ligament of Treitz. This allows for maximum mobilization of the small bowel. Once the small intestines have been controlled they can be easily maneuvered to allow packing other portions of the abdomen. The wrapped bowel can be gently retracted cephalad to allow examination of the mesentery and the retroperitoneum.

The next packing procedure will involve the colon. A hand-held retractor is used to expose the right colon which is medially retracted to allow packs to be placed. The procedure is repeated for the left colon.³

INJURY IDENTIFICATION

In order to identify possible damage, the surgeon will begin to carefully remove the packs. The first packs removed will be from an area where there is little possibility of injury and the surgeon will work toward the most seriously injured area. When the packs are removed, they are inspected for any evidence of fresh blood. Fresh blood will indicate active bleeding and a more thorough search of the area will need to occur. The surgical technologist should be prepared by having sutures pre-loaded on passers, a couple of 3-0 sutures loaded on needle holders and a number of clamps available. By following the surgeon, the technologist will be able to determine if vascular instruments will be needed to be opened and placed on the sterile field.

While removing the packs, the surgeon will inspect the area as well as the organs for signs of injury. It is also during this aspect of the procedure that more definitive control of the vascular structures takes place. The surgical technologist needs to have vessel loops ready as well as a couple of Forrester sponge sticks loaded with a folded absorbent



A Babcock clamp is used during a bowel injury procedure

Photo courtesy of Tony Forgione

Due to the nature of damage control surgery, the surgical technologist will need to set up the surgical field quickly. In many instances while the patient is being booked for the procedure, he or she is actually in the process of being transported to the OR.

sponges. These can be used to apply direct pressure to the inferior vena cava proximally and distally to any observed lacerations allowing time to obtain the necessary clamps and non-absorbable suture needed to repair the damage.

RETROPERITONEAL EXAMINATION

As part of the inspection process, the surgeon will evaluate the retroperitoneum for any potential damage or bleeding. The retroperitoneum is divided into zones. Zone I, the centromedial area, is bordered by the diaphragm to just pass the bifurcation of the aorta. Care will be taken by the surgeon to examine the many vascular structures, the pancreas and the small intestines.

There are two Zone II sections of the retroperitoneum, which includes the lateral superior aspects of the abdomen. The structures in this area are the kidneys and adrenal glands. These will be examined and control of the renal artery will be established with vessel loops.

Zone III is the pelvic area. Exploring this area occurs only in the instance of a penetrating wound. It is not recommended that this region needs to be explored in the presence of blunt trauma. In many instances, control of bleeding can be accomplished through the use of external compression.

CONTROLLING CONTAMINATION

Another primary concern is contamination from an injured bowel. The surgeon will run the bowel to identify and control any damage that may lead to future infection. Using the first two fingers of each hand, the surgeon will start at the pyloric junction and inspect both sides of the small intestines for any injuries. The surgical technologist needs to have a number of Babcock clamps on the Mayo stand along with 3-0 stitches loaded on needles holders. The surgeon, upon coming to a laceration, can apply the Babcock clamps to temporarily control the bleeding. The surgeon will continue to inspect the bowel until the ileocecal valve is reached. Next, the ascending, transverse, descending and the sigmoid colon will be visually inspected for damage. Temporary control can be accomplished either through the use of more Babcock clamps, or through the use of a skin stapler.

Once the bowel has been inspected, the surgeon will perform more definitive repairs to any damaged portions. The surgical technologist will need either an appropriate number of 3-0 absorbable gut sutures and 3-0 pop-off sutures available or a linear stapler with reloads in order for the surgeon to do a small bowel resection if necessary. For many injuries to the small intestine, the surgeon may only need to sew over the damaged area with silk sutures. If the damage to the colon is too large to repair, the surgeon will most likely remove the damaged portion during a temporary colostomy.¹

During this phase of surgery, the aorta will be inspected for signs of injury or laceration. The surgeon may use manual compression to help control hemorrhaging until a vessel loop can be wrapped around the aorta proximal to the injury. Many surgeons will use the left lateral rotation or Mattrox maneuver, which allows for direct access to the lateral aspect of the aorta. The Mattrox maneuver mobilizes the splenic flexure and permits the kidney, pancreas and spleen

to be retracted medially. This approach also exposes the celiac trunk as well as the superior and inferior mesenteric arteries.

Exposure of the Inferior Vena Cava (IVC) can be accomplished through a technique known as the Cartell-Braacch maneuver. This technique involves dissecting the cecum. Ascending colon and hepatic flexure allows the medial shifting of the colon to expose the bifurcated aorta and the IVC.³

While the surgical team is performing their role, the anesthesia provider is constantly evaluating the patient's hemodynamic stability. Unstable patients are not candidates for more definitive reconstruction of damaged tissue or organs. These patients are prepared for closure.

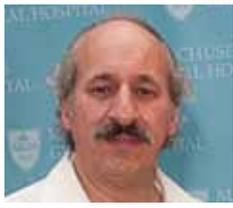
In many instances, due to the nature of the rapid and aggressive resuscitation methods used during the procedure, the patient will be temporarily closed. Studies have shown that approximately 45% to 70% of penetrating trauma patients are unable to endure a primary closure of the fascia.⁹ There are a number of ways to temporarily close the abdominal incision. Of primary concern to the team is that the viscera have been contained and that there will be a limited chance of further contamination. One of the methods available is to pack the wound with either wet laparotomy sponges or wet towels. The wound is left open and one or two antimicrobial incise drapes are placed over the incision. Another method is to use a Vacuum-Assisted Closure System (VAC dressing) is placed and secured in the wound. No matter which method is used, the surgical technologist will need to inform the circulating nurse if there was anything left packed in the wound. This is especially important when lap sponges are packed and left in the abdominal cavity. The circulator will verify this with the surgeon and note it in the operative record. When the patient does return to the operating room these sponges will need to be accounted for to ensure the sponge count has been reconciled.

COMPLICATIONS

Postoperatively, the patient will be sent to an Intensive Care Unit (ICU) where the patient will be more fully stabilized. Complications can include uncontrollable hemorrhaging, hypothermia, coagulopathy, acidosis and fatal infections.⁸ Once the patient has been cleared of any acidosis or coagulopathy issues, he can be returned to the operating room for a more definitive inspection and repair of damaged tissues. This will usually take place within 48 hours from the initial surgical procedure.

CONCLUSION

Damage control surgery has proved to be an efficient and rapid method of controlling profuse bleeding as a result of a penetrating injury. The surgical technologist will need to use all his/her skills and experience to ensure the surgical team has all the instruments and supplies needed to successfully tasks necessary for the procedure. Since damage control surgery is a fast-paced and chaotic event that pushes all members of the surgical team to their limits, the surgical technologist needs to maintain the highest level of surgical conscience to ensure the patient receives the optimal care he or she deserves.



ABOUT THE AUTHOR

Tony Forgione, CST, LPN, has almost 40 years of experience as a surgical technologist. His career has spanned from the US Navy to the Massachusetts General Hospital, where he continues to work. Tony is

also the Supervisory Operating Room Nurse for the International Medical Surgical Response Team (IMSuRT), a federally mandated disaster team. In his capacity with IMSuRT, Tony has deployed to Ground Zero in New York City, New Orleans, and Galveston, Texas, for Hurricanes Katrina and Ike. He also has been deployed to earthquake-damaged areas in Iran and Haiti.

Tony is currently the surgical technology instructor at Quincy College, where he enjoys introducing and preparing students to a career he has found incredibly rewarding.

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TRAINING AS A NAVAL TECH

Tony Forgione, CST, LPN

Training as a surgical technologist in the US Navy was an intensive, hands-on, high-energy affair. We spent long hours in class learning theory and practicing new skills. Our introduction to the operating room involved hand washing instruments, folding linen drapes and gowns and wrapping items to be sterilized. We also learned how to run the autoclaves and even how to make and sterilize saline. When we got to scrub, we had our instructor with us for the first procedure to make sure we knew our duties. Then we were on our own.

One of the early procedures I scrubbed, alone, on my very first day was an elective general surgery procedure that rapidly evolved into an emergency situation. While the surgeon was rapidly evacuating blood clots and controlling bleeding, I learned very quickly that as the surgical technologist I had to control my emotions and anxieties and channel all my efforts to ensure that the surgeon had instruments and supplies he needed to deal with the situation at hand.

During the Vietnam era, when I was stationed at Bethesda Naval Hospital, there was no concept of damage control surgery. Current practice, at that time, had the surgeon and his team not only attempting to control bleeding, but also attempting to definitively repair damaged tissue. The results were not always positive.

Our operating room team was involved in many cases of wounded sailors and soldiers who were returned to the states to receive more definitive care for their injuries. Many of them were repeat visitors to the operating room.

One soldier I remember vividly. He experienced extensive abdominal injuries as a result of combat. He repeatedly came to our operating room for debridement of a large gaping abdominal wound. The goal of the surgeons was to progressively reduce the open wound to a size more conducive for skin grafting. Our team worked many hours during repeated visits to help this young man. He had numerous setbacks with infections, but he always remained positive and was very thankful for all our efforts. Unfortunately, I was transferred to another facility before his surgical interventions were completed. I always have wondered if our efforts proved to be successful.



**HUMAN
ORGAN
FOR
TRANSPLANT**

**HUMAN
ORGAN
FOR
TRANSPLANT**

Organ Procurement

JAMES STEELE, CST

Life - a viable, unpredictable gift that some take for granted while others savor every moment of. For those that consider themselves part of the latter category it is of no surprise that life can change without notice. It can come at a check-up with your doctor telling you that your kidneys are failing and that you may have to be put on dialysis. Or the cough you had all summer is actually a mass on your lung. Or perhaps in degenerative terms, it is your son or daughter that failed to have an organ develop.

The need for new organs is the key to cure these ailments and other diseases that obscure the health of communities around the globe. More commonly, these organ transplants are done in highly populated cities with skilled teams waiting to step into an OR suite, confident that they're working with highly trained, tenured nurses and surgical technologists that routinely conduct these operations with flawless technique and efficient procedures. Before the critical patient is rolled into the operating room and hours before the sought-after organ is transplanted, an intricate web of communication, surgical coordination and empathetic discussion occurs to bring the life-changing moment to fruition. This step is called procurement. For most largely populated cities, procuring is a routine procedure that goes hand-in-hand with a transplant surgery.

LEARNING OBJECTIVES

- ▲ Identify which organs can be donated from a live donor and which organs can be donated from a dead donor
- ▲ Examine the role the surgical technologist plays in an organ procurement operation
- ▲ Review the procedures for warm and cold dissection of a liver
- ▲ List the equipment and instruments needed for such procedures
- ▲ Analyze the concerns and possible derailments for organ procurement

But, sometimes there are cases when a much-needed organ is nowhere within city limits and could be hundreds of miles away in a less-populated town, with a less-experienced crew waiting to assist the in-route procurement team. For these team members, the procedure they are about to embark on is fraught with unfamiliar surgeon's, nurses and support staff, contradicted by their usual life of sustaining procedures and replaced with that of taking a life. This macabre thought can create anxiety, confusion and lead to a vague responsibility upon the resident staff, and perhaps, even a refusal to take part in the operation. For those who have experienced this alienating feeling, you're not alone.

For more than half a century, the procurement of organs has allowed doctors to give their patients another chance to live.

THE HISTORY OF PROCURING

As professionals new and old, clad in attire reflective of a kind of surgery that has evolved for more than 100 years, surgery specialists have participated in operations that span from head to toe in order to mend patients. Removing organs and then possibly allowing death to take its toll is not in our language. For more than half a century, the procurement of organs has allowed doctors to give their patients another chance to live. By definition, procurement is the surgical removal of tissue or a viable organ from either a live or dead donor and transplanted into another patient.¹ The scope of procurement is vast and diverse, determined by the needs of the recipient and the match of a donor. This article will focus on clinically dead donors determined by brain death and the procurement of the liver, the second most commonly procured organ.

Other organs that a deceased donor can provide are heart, lungs, kidneys, intestine, pancreas as well skin and bone. Live donors can donate a kidney and portions of their liver.² Around the 1960s, the procurement of organs performed on deceased patients were done on those who had suffered a cardiac death. In present day, the procedure

is also done on patients who have suffered a brain death as determined by a neurologist or neurosurgeon, and only after all life-saving efforts have been exhausted to revive the patient, is the patient considered brain dead.³

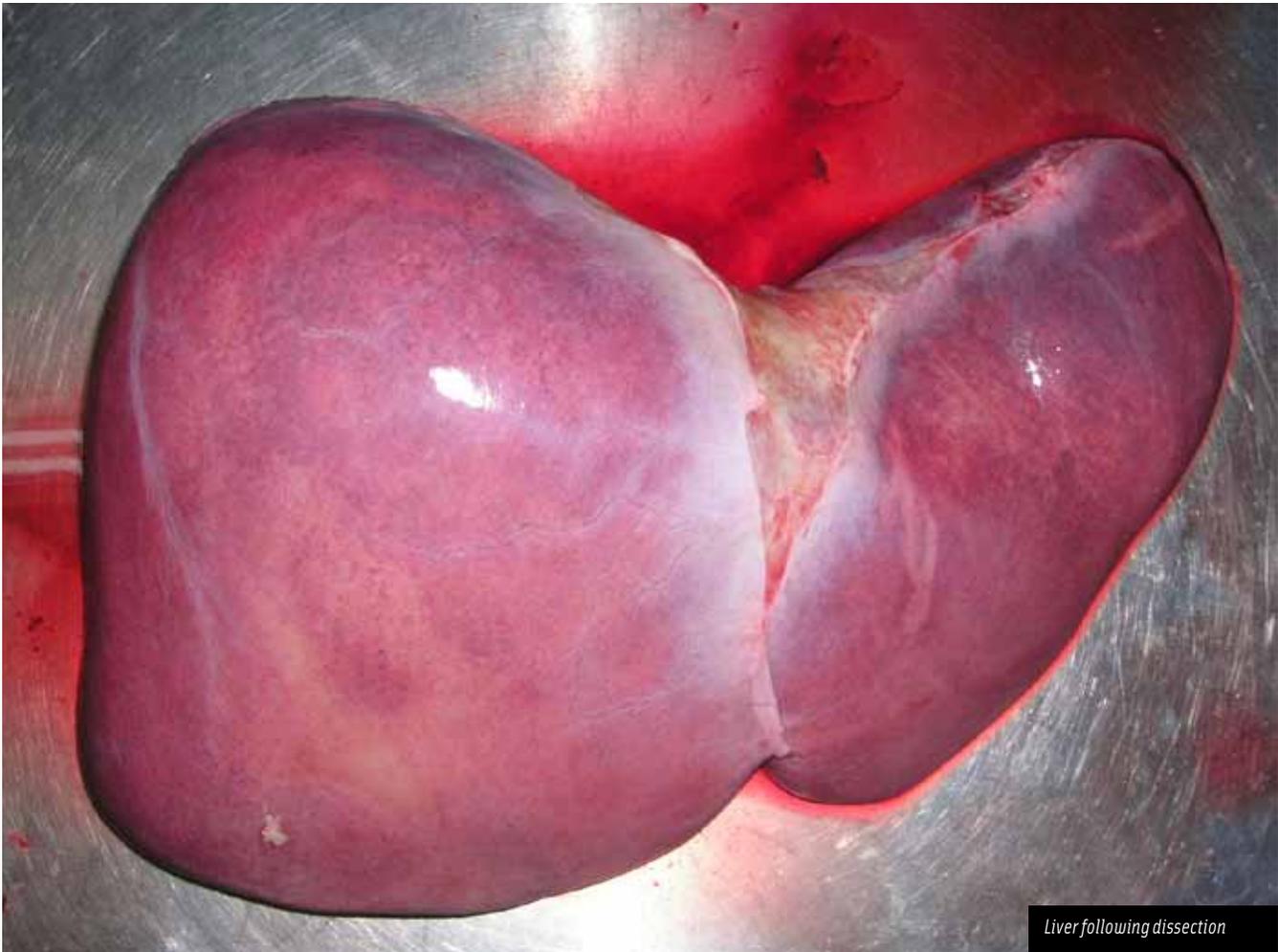
Organ Donation Contraindications

Being able to donate an organ following death is as intricate as becoming a recipient awaiting his or her match. The ability to transplant can be miraculous and daunting. There are three categories that can quickly eliminate an organ from being transplanted. They include: severe trauma, any type of malignancy outside of the Central Nervous System (CNS) and active infections.⁴ The first indication is solely limited to the organ itself. Trauma to the area is an immediate cause for concern. The second, malignancy other than primary tumors to the central nervous system, will also disqualify the organ. Lastly, active infection is the most important diversion criteria because of the extent it can reach beyond the organ itself. Some examples include Hepatitis, sepsis and viral encephalitis. Multiple tests enable the waiting procurement team to determine the above contraindications and coordinate with the waiting surgical team and procurement liaison.

ORGAN CENTER OF ORGAN PROCUREMENT (OPO)

Behind the bright spot lights and intricate dissection of the patient on the operating table, is another crew. This team of expert nurses and logistics personnel will never lay a surgical hand onto the patient, but they have a large role in ensuring that the procedure is accomplished successfully. The Organ Center of the Organ Procurement Network/United Network for Organ Sharing has been in the business of organ allocation since its name changed from the Kidney Center in 1984.⁵ The Organ Center, or OPTN — as it is sometimes known, is the logistical platform that many procurement companies operate under. Working alongside the Department of Health and Human Services, OPTN is available 24 hours a day, 365 days a year, running a computerized program that places recipients with donors, coordinating organ transportation and acting as resource to the US transplant community.⁶ The responsibilities of the network involve not only matching recipients with donors and tracking available organs but it is also in charge of following the trends and needs of organs across the US.

Utilizing state of the art software, OPTN aggressively follows a protocol that allows for faster organ placement and



more efficient tracking methods. Before the newer system was implemented in 2005, the non-electronic method of tracking an organ and reviewing a chart between the network and an on-call transplant center was drawn out and painstaking. This process averaged only 2.5 organ offers per hour. Now, with a more precise way of managing care, that average has almost doubled to 5.5, and sometimes 6.1.⁷ Overshadowing the amazing advancement of the department's coordinated efforts is the daily management of transplant centers across the country in ensuring the logistical steps in getting every viable organ to the nearest OR.

THE TICKING CLOCK

To lose someone is a horrible and painful ordeal but to have one more day with them, even if they were unresponsive, is a joy that can be a blessing in disguise. For many donors, this is how the clock starts to tick.

Engaging a patient into the transplant system is determined upon if the patient is preregistered or has voiced a want to become a donor in case of their passing. The latter is decided upon by a selected family member or set of family members that act as the patient's liaison if the patient no longer can decide for himself/herself. Depending upon the hospital, most facilities have an established relationship with donor facilities in their region, making immediate contact with such a facility once the family makes the decision. After established contact is made with the donor facility, a representative will travel to the hospital and begin a complex matrix of key steps to get the patient to the OR for procurement. The first and most important of these steps is to meet the donating family and discuss the process in the best and most understandable way possible. Then a series of labs, CT scans and MRIs are ordered for testing in the next 12 hours to determine the patient's donating status.



Questions asked during this stage detail the specific health of the patient and the kind of life that he or she lived. Was this patient a smoker? If so, there is an immediate refusal of lungs. Was this patient a diabetic? Have they experienced any trauma in his or her life? The questions are asked until all medical conditions are covered. Multiple lab draws are conducted to check blood and platelet counts, liver function tests and more. While this is taking place, there is constant communication with the waiting procurement team, giving the anticipating surgeon enough information to make a successful decision on what organs to procure. Contact is also being made with patients and his or her surgeons awaiting such organs, as well as coordinating anticipated arrival times and possible deferring consequences.

Once the representative is satisfied with the results of all the lab tests, the surgical team is activated. Most traveling procurement teams will arrive at the facility within six to eight hours, depending on their location. A study done

by the American Journal of Transplantation reports that between 2002 and 2008, the mean travel distance of most abdominal organs and those surgeons was 223 miles.⁶ Most states will coordinate with in-state teams so the distance is less extensive. The adherent risks to arriving on time or not arriving at all, however, fall on Mother Nature's shoulders. Another study conducted by The Journal of Transplantation indicated that through a surveyed group of surgeon's, only 16% of them felt "very safe" during procurement travel.⁷ The reason for this lowered response? Nature and the speed as to which a team must respond to a facility. Aircraft malfunction, heavy fog, snow, rain or ice can defer a team from arriving.

Once that team does arrive, the resident OR crew is anticipating a quick transition into a waiting surgical suite. Anesthesia Concerns and Procedure

Critical to the viability of the procured organs are the perfusion they must receive pre- and intra-operatively. Inhalation and neuromuscular blocking agents are the med-

ication of choice to help prevent reflex movement during the procedure.⁸ Sustaining a normal blood pressure, heart rate and proper oxygen volume is also intensely dependent upon the anesthesia provider for the first half of the procurement surgery. This is known as the warm dissection—preparing an organ while it is still receiving perfusion. The latter half of the procedure is called the cold dissection—the steps taken when perfusion has ceased.

The following procedure is for the procurement of the liver from a clinically dead patient.⁹ Ensuring correct organ recovery as it pertains to importance (ie, liver first, followed by heart, lungs, etc) is dependent upon need, not the specific organ itself.

WARM DISSECTION

The preparation of the OR needs to include placement of two electrocautery (Bovie) pads and two suction lines. The patient's arms are normally tucked and the complete torso from pubis to clavicles is exposed, shaved and prepped in a surgically sterile manner. A midline incision is extended from the pubic bone to the xyphoid. The round ligament is divided between two Kelly clamps, ligated with a 2-0 silk tie, all while ensuring that the liver is assessed. If there is no contraindication for a transplant, the thoracotomy will occur.

The pre-sternal skin is opened with the Bovie, up to the jugular notch, allowing for proper dissection and palpation of the sternum. Following a blunt dissection, a sternum saw

The warm dissection ends with the cross clamp that is near the aorta. Exsanguination is performed by opening of the right atrium, allowing the blood to pool in the pleural cavity suctioned by pool tips.

is passed to the surgeon for a sternotomy. The sternotomy should be performed from cranial and brought distally to ensure that the left innominate vein is not injured. A modified Balfour retractor is used to retract the abdominal wall

for the best possible exposure. The Balfour is considered modified due to its extensions. Utilizing the Bovie, the left triangular ligament of the liver is dissected. The surgeon performs this action by retracting the left lateral liver lobe with his or her right thumb. While retracting the liver away from the diaphragm, the surgeon divides the falciform ligament up to the Inferior Vena Cava (IVC), which gives more mobility to the liver. This is also performed with the Bovie, and special attention will be given to ensure that the IVC is not opened. The surgical technologist should have a pair of Metzenbaum scissors available in case of any adhesions that may be stuck to the inferior and lateral surfaces of the liver, needing sharp dissection. Sharp dissection is used instead of electrocautery due to the chance of tearing the liver capsule. The surgeon palpates the ventral border of the foramen of Winslow in order to identify a possible accessory or replaced right hepatic artery.

Identifying and dissecting the Common Bile Duct (CBD) follows. Using a sweetheart retractor, the surgeon exposes the hepatoduodenal ligament by retracting the liver laterally. Under visualization of the duct, the CBD is dissected after opening the peritoneum, which sits near the duodenum. In order to prevent injury to the portal vein, a right angle clamp is guided around the CBD toward the hepatoduodenal ligament. A 2-0 silk tie is then placed around the CBD.

In some cases, it is advisable at times to wait until cold dissection begins to cut the CBD because it sometimes can have the similar appearance as an artery. If concern is warranted, a 18-24 gauge needle should be used to aspirate the tree to ensure proper anatomy. This action, however, this is used in a worst case scenario. For the purpose of this article, the CBD is correctly identified, and the procedure continues.

Once the silk tie is placed around the CBD, it is knotted and cut with the Metzenbaum scissors medially. Using a Bovie, the gallbladder is opened and flushed with a bulb syringe until the fluid become clear. Identifying a replaced or accessory left hepatic artery is done by exploration of the hepatogastric ligament and opening of the bursa by dividing the lesser omentum. The small bowel is then packed in a blue towel and retracted to the left side. The surgeon mobilizes the right colon, extending into a Kochers maneuver so the duodenum is mobilized to the left for uncovering the infrahepatic IVC and the abdominal aorta. These maneuvers are carried through with a Bovie.

The surgical technologist should have a right angle clamp and Debaquey forceps available as the surgeon continues around the aorta and dissects for any lumbar arteries that may appear. Once all lumbar arteries are identified clamped and cut, two umbilical tapes are placed around the now-mobile distal aorta, which is secured by clamps. At this time, the procurement circulator hand the surgical technologist catheters attached to IV bags. These are to ensure that these two tubes are purged and free of air. They will be used to flush the circulatory system with a fluid known as University of Wisconsin fluid.

Critical to the viability of the procured organs are the perfusion they must receive pre- and intra-operatively. Inhalation and neuromuscular blocking agents are the medication of choice to help prevent reflex movement during the procedure.⁸

The Inferior Mesenteric Vein (IMV) is most commonly used for access into the portal system. The surgeon retracts the blue towel pack toward the diaphragm, locating the IMV. A 2-3 cm segment will be dissected using the Debaquey forceps and the Bovie. A 2-0 silk tie is used following dissection to ligate the distal segment and is left uncut to help retract the vein with a mosquito or Kelly clamp. Another 2-0 tie is placed around the cranial segment of the vein. A cranio-posterior incision is made in a 45-degree angle with Metzenbaum scissors between the two ties and the portal catheter is inserted into the IMV, ligated with an airtight knot. The intra-abdominal approach begins following the flush of the catheter with about 10 to 12 ml of heparin saline. The surgeon uses the Bovie to dissect the ventral peritoneum of the esophagus. The isolation of the esophagus can normally be performed by just the surgeon's two fingers. The surgical technologist needs to have umbilical tape ready to place around the esophagus for retraction. The tape is used to expose the supraceliac aorta located between the aorta and spine.

Once the tape is placed, the surgical technologist will pass the aorta clamp to the surgeon who will place it around the aorta in preparation for the cross clamp. The towel pack is retracted to expose the distal aorta and bifurcation, and another umbilical tape is placed around the distal aorta right above the bifurcation. The surgeon will use Mayo or Metzenbaum scissors to cut the aorta, following confirmation of the infusion of hep saline by the anesthesia provider. The aortic catheter is placed inside the aorta and tied with the cranial umbilical tape that was placed around the aorta earlier. The surgeon will then open the parietal pleura, which gives access to the cavity to allow for blood collection.

At this time, the surgical technologist should:

1. Ensure that flush lines are free of air;
2. Have an ice bucket available with slush; and
3. Make sure the pool tips are attached to the suction tubing.

The warm dissection ends with the cross clamp that is near the aorta. Exsanguination is performed by opening of the right atrium, allowing the blood to pool in the pleural cavity suctioned by pool tips. The flush lines are opened and slush ice is packed into the abdominal cavity, ensuring it reaches behind the liver and kidneys. Cold dissection can begin after perfusion is completed.

COLD DISSECTION

To begin this process, the surgical technologist needs to make sure there are four liters of UW solution at 4 degrees Celsius to be used to flush both the portal and arterial lines that you feed earlier. The flush quality is determined by the color of the fluid returning through supradiaphragmatic IVC. The fluid becomes more transparent with time and completely replaces any blood. At this time, ice slush begins to be removed and allowed for dissection of the liver and its structures. Identification and dissection of the Gastro-duodenal artery (GDA) starts cold dissection. Following the dissection of the GDA and ligation of the artery with a 2-0 silk tie, the celiac artery is followed back to the aorta, using the aortic clamp for orientation as to where to cut the aorta. The surgeon dissects and cuts the portal vein now that visual ability is heightened with the already dissected CBD and GDA performed. The above and following vein and artery dissections are all performed with Metzenbaum scissors, ensuring that 2-0 silk ties are available for any ligation that may need to occur.

The remaining vascular structures that the surgeon will dissect are:

- a. Superior Mesenteric Vein (SMA)
- b. Suprarenal aorta
- c. IVC following the dissection and removal of the inferior portion of the lateral diaphragm.

This step is done around the right triangular ligament of the liver and is continued between the liver and right kidney, usually dividing the adrenal gland. The liver can then be placed in the right thoracic space, allowing for maximum exposure of the hepato-duodenal ligament, which is now divided. The last construct to hold the liver in the abdomen is the aorta, which the surgeon incises and divides away from the spine and diaphragmatic muscle. The liver is free and taken out of the abdomen, and is flushed and packed for transport.

TRANSPORT AND CONTRAINDICATIONS

The amount of contraindications for a liver procurement is less than one might expect to find. Most tests and studies are conducted prior to the operation, enabling the surgical team to decide whether the availability of the organ is worth the time to remove it. Intra-operatively, any interaction with the bowel in which it becomes incised and its contents are emptied is when the case is then considered contaminated and abruptly canceled.

Transportation of the organs is a defined process of flush and slush, bound in multiple plastic bags and buckets that are properly marked and identified with side specifics and organ name. All organs are then placed into coolers on more ice for preservation.

CONCLUSION

Surprisingly as of the last 10 years, organ recovery and survival rate has increased tremendously. Patients who accept a major organ transplant now have a general one-year survival rate better than 90%.¹⁰ The numbers have risen due to the advancement of technology and a desire to learn such integral procedures from surgical team members. For hundreds of community hospitals that go through this rare and exhilarating procedure, surgical professionals need to realize that procurements are not something out of a Frankenstein horror film but of something far greater. You are changing someone's life in a distant city or even state in a way that no words can express. You are giving them the chance to live again.

AUTHOR BIO



James Steele, CST, has been a surgical technologist for almost 10 years, specializing in general surgery and cadaver procurements. He has been a published author for many years, both as a freelance and fiction writer. James has been both Vice President and sat on the Board of Directors for the Oregon Association of Surgical Technologists. He currently works at Three Rivers Medical Center and lives in Grants Pass, Oregon, with his wife and two daughters.

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CE Exams

Alternatives to Blood Transfusions

1. Who was called the “bloodless surgeon of Vienna”?
 - a. Dr. Denton
 - b. Dr. Lorenz
 - c. Dr. Witness
 - d. Dr. Kipnis
2. When was the first bloodless open heart surgery performed?
 - a. 1952
 - b. 1926
 - c. 1962
 - d. 1936
3. ___ can be accomplished without using whole blood or blood plasma.
 - a. Volume replacement
 - b. Transfusions
 - c. Surgery
 - d. Cell replacement
4. Neupogen is a man-made form of protein that stimulates the growth of ___ in the body.
 - a. red blood cells
 - b. tissue
 - c. blood flow
 - d. white blood cells
5. Recombinant human erythropoietin is a ___ used to stimulate the bone marrow to produce more red blood cells.
 - a. synthetic hormone
 - b. tool
 - c. method
 - d. all of the above
6. A few of the intraoperative surgical techniques and instruments that are available are:
 - a. Gamma knife
 - b. Electrocautery
 - c. Argon Beam
 - d. all of the above
7. Argon gas prevents _____.
 - a. burning
 - b. oxidation
 - c. cell loss
 - d. blood transfusions
8. Dr. Reichstein said that one of the greatest skills a surgeon can possess is _____.
 - a. to assist in surgery prep
 - b. to hold the patient’s hand
 - c. the prevention of blood loss
 - d. to calm the patient
9. Intraoperative blood salvage is also known as the _____.
 - a. cell saver
 - b. circulator
 - c. filter
 - d. blood saver
10. The cell salvage method along with acute normovolemic hemodilution may be acceptable to many including those who object due to _____.
 - a. religious reasons
 - b. sporting beliefs
 - c. both a and b
 - d. none of the above

Alternatives to Blood Transfusions continued

11. Electrocautery is a safe procedure that is routinely used in surgery to remove ____.
- unwanted tissue
 - blood cells
 - harmful tissue
 - both a and c
12. Oxygent is a (n) ____ designed to augment oxygen delivery in patients.
- technique
 - life-saver
 - intravascular carrier
 - oxygen tool kit
13. The use of pharmaceutical agents, intravenous fluids and improved diagnostic procedures and surgical techniques can prevent and lessen ____ associated with surgery.
- pain
 - anemia
 - vision problems
 - hot flashes
14. Dr. Lorenz developed a reputation for his ability to treat ____.
- clubfeet
 - hip dysplasia
 - broken legs
 - none of the above
15. The three most commonly used vasodilators are:
- Sodium nitroprusside
 - Nitroglycerin
 - Trimethaphan
 - All of the above

A Crash Course in Microbiology: A Review of Pathogens and Disease

- 1. How many terms are there in the Linnaean system?**
 - a. 6.
 - b. 7
 - c. 8
 - d. 9
- 2. Mitochondria are considered the powerhouse of ____.**
 - a. organisms
 - b. cell
 - c. membranes
 - d. tissue
- 3. DNA is composed of two strands of alternating ____.**
 - a. sugars and phosphates
 - b. guanine and thymine
 - c. cells and tissue
 - d. membranes and nitrogenous bases
- 4. During telophase, membranes appear around each group of separated chromosomes forming new ____ completing the division of the cell.**
 - a. nucleus
 - b. spindle fibers
 - c. membrane structure
 - d. nuclei
- 5. There are four types of passive transport including:**
 - a. osmosis
 - b. diffusion
 - c. filtration
 - d. all of the above
- 6. Streptococci means that bacteria cells appear in ____.**
 - a. pairs
 - b. clusters
 - c. chains
 - d. boxes
- 7. All viruses are capable of ____.**
 - a. damage
 - b. infection
 - c. mutation
 - d. none of the above
- 8. Prions are unique because they lack a ____.**
 - a. genome
 - b. cell structure
 - c. pair of membranes
 - d. infectious material
- 9. ER exists in two forms:**
 - a. bumpy and hard
 - b. smooth and hard
 - c. rough and smooth
 - d. Asymmetrical and smooth
- 10. ____ only applies to the formation of sex cells.**
 - a. mutation
 - b. meiosis
 - c. anaphase
 - d. separation

Taking Control of Infection Control

- 1. The CDC estimates that there are as many as ___ SSIs each year.**
 - a. 650,000
 - b. 550,000
 - c. 500,000
 - d. 1,000,000
- 2. The first component of the E3 discipline is ___.**
 - a. empowerment
 - b. education
 - c. energy
 - d. engagement
- 3. IPLS came to the conclusion that a combination of elements is crucial to reducing the number of SSIs at healthcare facilities. They do NOT include ___.**
 - a. leadership
 - b. communication
 - c. collaboration
 - d. social activities
- 4. ___ is a great tool to help staff members see where their facility and department stands in the fight against SSIs.**
 - a. Data sharing
 - b. Newsletters
 - c. Facebook posts
 - d. Team work
- 5. Surgical conscience is the belief that there is a responsibility toward the ___ to be consistent, accurate, and safe.**
 - a. oneself
 - b. patient
 - c. both a and b
 - d. neither a or b
- 6. According to the Association for Professionals in Infection Control and Epidemiology, Inc, there are an estimated ___ hospital acquired infections annually in the US.**
 - a. 99,000
 - b. 500,000
 - c. 1.7 million
 - d. 3.7 million
- 7. Healthcare institutions should empower their staff by creating a(n) ___.**
 - a. culture of accountability
 - b. respectful environment
 - c. open-minded atmosphere
 - d. positive workplace
- 8. Strong and effective communication can be linked to successful ___ in the surgical suite.**
 - a. team work
 - b. collaboration
 - c. surgery
 - d. practices
- 9. Examples such as job shadowing, departmental open houses, briefing and debriefing meetings can help create a(n) ___ atmosphere among team members.**
 - a. open communication
 - b. collaborative
 - c. unity
 - d. none of the above
- 10. When staff members are ___ in their position, they care about the well-being of the patient, their team members and themselves.**
 - a. energetic
 - b. enthused
 - c. engaged
 - d. satisfied

The Modern Day C-section

- 1. According to the National Center for Health Statistics, the C-Section rate has climbed more than 50% since ____.**
 - a. 1973
 - b. 1986
 - c. 1996
 - d. 2000
- 2. For the Caesarean section, the ____ section is the procedure most commonly used.**
 - a. lower uterine segment
 - b. upper uterine segment
 - c. bladder
 - d. mid-section
- 3. Though rarely performed today, the classical Caesarean section involves the ____ which allows a greater space to deliver the baby.**
 - a. longitudinal incision
 - b. midline longitudinal incision
 - c. midline lateral incision
 - d. none of the above
- 4. When an obstetrician determines a Caesarean may be necessary, the following may be present ____.**
 - a. failed labor induction
 - b. cord prolapse
 - c. placental previa
 - d. all of the above
- 5. A(n) ____ may result in a denser block, allowing some sensation at the surgical site.**
 - a. spinal block
 - b. epidural
 - c. anesthesia
 - d. IV drugs
- 6. After anesthesia is administered, the positional effect on cardiac output is of major importance in avoiding maternal ____ and maintaining fetal well-being.**
 - a. clotting
 - b. cramps
 - c. hypotension
 - d. dizziness
- 7. A laparotomy drape is placed on the ____.**
 - a. right leg
 - b. chest
 - c. upper thigh
 - d. abdomen
- 8. The peritoneal incision should not extend past the ____.**
 - a. midline
 - b. belly button
 - c. bladder
 - d. all of the above
- 9. The baby's head is delivered through the ____ incision.**
 - a. uterine
 - b. midline
 - c. lateral
 - d. peritoneal
- 10. Post-delivery, the ____ is the most important layer to close since it is the support layer for the abdomen.**
 - a. peritoneal layer
 - b. fascia layer
 - c. stomach cavity
 - d. uterine layer

The Modern Day C-Section continued

11. An average hospital stay for a Caesarean patient is approximately ____.
- 24 hours
 - 1 to 3 days
 - 2 to 4 days
 - 5 to 7days
12. Complications with a Caesarean procedure may include ____.
- surgical injury
 - wound infection
 - endometritis
 - all of the above
13. A stat emergency C-section is performed in a true obstetrical emergency, where complications of pregnancy onset suddenly during the process of labor and quick action is required to prevent the ____ in the mother, the baby or both.
- illness
 - complications
 - death
 - all of the above
14. A repeat Caesarean section is performed when a patient has had a previous Caesarean section and is typically performed through the ____.
- old scar incision
 - open wound
 - uterus
 - lateral incision
15. C-section rates are on the rise for a variety of reasons including ____.
- rising obesity rate among expectant moms
 - increase in multiple births
 - mom's choice
 - all of the above

A Facial Rejuvenation Short-scar Face-lift/Simple MACS

- 1. The traditional rhytidectomy encompasses the ___ region.**
 - a. temporal
 - b. frontal
 - c. parietal
 - d. occipital
- 2. The buccinator muscle lies between the maxilla and the ___.**
 - a. trapezius
 - b. levator scapulae
 - c. zygomatic arch
 - d. mandible
- 3. The zygomatic arch controls the facial expressions of the ___.**
 - a. face
 - b. mouth
 - c. eyes
 - d. nose
- 4. For a simple MACS procedure, the patient is placed in a ___ position.**
 - a. lateral
 - b. seated
 - c. supine
 - d. all of the above
- 5. Which instrument spreads the tissue to the deep temporal fascia?**
 - a. Sen retractor
 - b. sutures
 - c. Metzenbaum scissors
 - d. Adson forceps
- 6. An elastic wrap should be worn for how many days following the surgery?**
 - a. 5 days
 - b. 2 days
 - c. 15 days
 - d. 7 days
- 7. A(n) ___ is used to control bleeding during the operation.**
 - a. Adson forceps
 - b. Metzenbaum scissors
 - c. Electrosurgical pencil
 - d. Senn retractors
- 8. A short-scar face-lift can be performed under ___.**
 - a. general anesthesia
 - b. IV sedation
 - c. local anesthetic
 - d. all of the above
- 9. The osseocutaneous ligaments support the ___ against the force of gravity.**
 - a. skin
 - b. facial structures
 - c. both a and b
 - d. neither a and b
- 10. Possible complications of a simple MACS include:**
 - a. swelling
 - b. bruising
 - c. scarring
 - d. all of the above

Adenocarcinoma of the Appendix

- The appendix is a small ___ that extends off the cecum of the large intestine.**
 - muscle
 - organ
 - gland
 - ligament
- The function of the appendix is not fully understood, but some believe ____.**
 - it helps balance the intestinal tract
 - it plays a special function in the immune system
 - only b
 - both a and b
- Appendix cancer is rare, affecting as few as ___ Americans each year.**
 - 850
 - 1,020
 - 600
 - 200
- The majority of ___ that are classified as carcinoid are found by accident.**
 - appendiceal tumors
 - noncarcinoid tumors
 - adenocarcinoid tumors
 - malignant tumors
- In initial stages of cancer in the appendix, pain usually occurs in the ____.**
 - upper left quadrant
 - lower right quadrant
 - stomach
 - lower right thigh
- An appendectomy is usually performed if the carcinoid tumor is less than ___ in size with no metastasis.**
 - 1 cm
 - 11 cm
 - 2 cm
 - 0.5 cm
- If the carcinoid has metastasized to the liver, the recommended surgery is ___ with cytoreductive surgery and hepatic resection.**
 - colectomy
 - hemicolectomy
 - right hemicolectomy
 - right colectomy
- An appendectomy procedure includes usage of the following:**
 - suction apparatus
 - basin set
 - electrosurgical pencil
 - all of the above
- This incision is usually used to begin the removal of the appendix:**
 - Crile
 - McBurney's
 - Longitudinal
 - Cherney
- Depending on the surgeon's preference, the crushed base of the appendix is amputated with (a) ____.**
 - scissors
 - scalpel
 - electrosurgical pencil
 - any of the above

Adenocarcinoma of the Appendix continued

11. The removal of the appendix may also be performed via (a) ____.

- a. Laparoscopic approach
- b. Laparotomy
- c. Fistulotomy
- d. Open Cholecystectomy

12. If cancer has not spread past the original site and has not invaded the organ, it is considered to be ____.

- a. carcinomic
- b. carcinoma in situ
- c. malignant
- d. benign

13. Malignant tumors in the ____ that occur outside of the lymphatic tissue are considered extranodal lymphomas.

- a. Stomach
- b. brain
- c. both a and b
- d. neither a or b

14. During an appendectomy, the surgical technologists should gently push the stump into the ____ with the Crile hemostat.

- a. stomach
- b. lumen
- c. intestine
- d. heart

15. In which procedure is the ascending colon removed along with the appendix?

- a. right hemicolectomy
- b. right colectomy
- c. colectomy
- d. all of the above

Single-site Laparoscopic Total Hysterectomy

- Advantages of laparoscopic surgeries include ____.**
 - shorter hospital stay
 - shorter recovery time
 - fewer complications
 - all of the above
- The patient needs to be placed in the ____ position for a single-site laparoscopic hysterectomy.**
 - supine
 - lithotomy
 - reverse Trendelenburg
 - Kraske
- A ____ is used to perform ligation of the round ligaments.**
 - electrosurgical pencil
 - scissors
 - ultrasonic scalpel
 - curved forceps
- Trocars remain in place as the surgeon checks for ____.**
 - hemostasis
 - instruments
 - blood pressure
 - hemolysis
- Complications from this procedure can include ____.**
 - bowel injury
 - loss of appetite
 - nausea
 - loss of vision
- With some of the studies that have been conducted, one of the biggest benefits for patients undergoing LESS procedures is ____.**
 - less operation time
 - less blood loss
 - less prep time
 - less postoperative pain
- Following the procedure, the patient is monitored for ____.**
 - fluid maintenance
 - pain
 - nausea
 - all of the above
- If spontaneous voiding does NOT occur following the operation, the ____ may be drained.**
 - wound site
 - bladder
 - bowels
 - stomach
- During the procedure, a ____ incision is performed to open the peritoneal cavity.**
 - lateral
 - distal
 - longitudinal
 - inferior
- The pneumoperitoneum is released after the pelvis is ____ and suctioned.**
 - washed
 - irrigated
 - suctioned
 - scrubbed

Sterile Processing: The Other Side of Surgical Services

1. **An SPD technician's expertise includes:**
 - a. decontamination methods
 - b. packaging material
 - c. sterilization parameters
 - d. all of the above
2. **PPE includes:**
 - a. sleeved gown
 - b. jeans
 - c. contacts
 - d. booties
3. **To loosen bioburden, the SPD technician may opt to soak or spray instruments with ____.**
 - a. water
 - b. enzymatic solution
 - c. antibacterial spray
 - d. Clorox
4. **Mechanical cleaning may be used in conjunction with ____ cleaning.**
 - a. spray
 - b. soak
 - c. manual
 - d. scrubbing
5. **A washer-sterilizer is a form of what kind of decontamination?**
 - a. Manual
 - b. Automatic
 - c. Mechanical
 - d. None of the above
6. **To prevent cross-contamination, decontaminated instruments are placed in the ____.**
 - a. clean area
 - b. dirty area
 - c. OR
 - d. hallway
7. **A countsheet is used to track instrument sets an SPD tech ____.**
 - a. cleans
 - b. sterilizes
 - c. packs
 - d. assembles
8. **The CDC recommends which method to sterilize items that can withstand heat and moisture?**
 - a. Hot wash
 - b. Manual
 - c. Steam
 - d. Scrub
9. **Exposure time during steam sterilization features how many elements?**
 - a. 5
 - b. 4
 - c. 2
 - d. 6
10. **After about 20 minutes, a component in blood begins to cause damage that can lead to ____ of instruments.**
 - a. rusting
 - b. cracking
 - c. pitting
 - d. all of the above

Sterile Processing: The Other side of Surgical Services continued

- 11. What can make the difference between resorting to immediate-use sterilization and receiving terminally sterile instruments sets?**
- Count sheets
 - Proper handling
 - Pre-cleaning
 - Scrubbing
- 12. Wrapped items are particularly susceptible to damage due to:**
- layers
 - tearing
 - waning
 - weight
- 13. Before a tech opens any rigid container, they should check to ensure seals are intact and sterilization process indicators haven't changed ____.**
- shape
 - form
 - color
 - size
- 14. By flushing endoscopes before leaving the procedure room, this helps keep debris clear of the endoscope ____.**
- channels
 - tubing
 - covering
 - opening
- 15. Contaminated instruments should be covered with a ____ when transported to the SPD.**
- lid
 - plastic bag
 - damp towel
 - sheet

Mammoplasty to Treat Macromastia

- 1. Reduction mammoplasty is performed to re-establish a functional and ___ bust to the patient's body.**
 - a. shapely
 - b. proportional
 - c. full
 - d. round
- 2. Enlarged breasts can occur due to:**
 - a. Genetic predisposition
 - b. Following child birth
 - c. During menopause
 - d. All of the above
- 3. The degree of breast ptosis is determined by the degree to which the nipple has fallen below the patient's ____.**
 - a. inframammary fold
 - b. mammary fold
 - c. retromammary lymph
 - d. mammary artery
- 4. For a mammoplasty, the patient is placed in the ____ position.**
 - a. lateral
 - b. reverse
 - c. supine
 - d. bilateral
- 5. The patient's arms are placed in a(n) ___ position to relax the pectoralis muscles during surgery.**
 - a. supine
 - b. abducted
 - c. superior
 - d. inferior
- 6. Which technique features both an arterial and venous blood supply for the nipple-areola complex?**
 - a. Lateral pedicle
 - b. Inferior aerial
 - c. Inferior pedicle
 - d. Anterior approach
- 7. Post-operative care includes removing drainage tubes around day ___ following surgery**
 - a. 4
 - b. 5
 - c. 6
 - d. 7
- 8. The first wedge of fatty and glandular tissue is dissected from the body using ____.**
 - a. Adson forceps
 - b. 10 blade
 - c. Bovie tip
 - d. Electrosurgical unit
- 9. The breast is reconstructed by rotating the ___ and ___ breast tissues from the upper flap.**
 - a. lateral and inferior
 - b. lateral and medial
 - c. lateral and abducted
 - d. medial and bilateral
- 10. The surgeon continues to evaluate the size, shape and ___ of the breast throughout the operation.**
 - a. symmetry
 - b. fullness
 - c. Bleeding
 - d. height

Mammoplasty to Treat Macromastia continued

11. If a woman has breasts that require a large resection of tissue, a ___ technique may be used.
- pedicle
 - nipple-graft
 - inframammary fold
 - contralateral
12. ___ can be a sign of subcutaneous bleeding.
- Unilateral swelling
 - Increasing pain
 - Nausea
 - All of the above
13. Surgical scars usually will begin to fade and become less noticeable within ___.
- 12 days
 - 12 months
 - 16 months
 - 8 months
14. The primary lymph drainage system is the ___.
- retromammary lymph plexus
 - hypodermis
 - inframammary lymph
 - internal mammary system
15. ___ run in the subcutaneous layer of adipose tissue throughout the breast.
- Vertical ligaments
 - Pectoralis fascia
 - Suspensory ligaments
 - Intercostal nerves

Damage Control Surgery

- There are three phases of damage control surgery. The first one is:**
 - repairing damaged tissue
 - identifying injuries
 - controlling hemorrhaging
 - repairing injuries
- A left lateral rotation allows for direct access to the lateral aspect of the ____.**
 - abdominal wall
 - aorta
 - kidneys
 - bowel
- A FAST exam uses a portable sonography to detect ____ in the peritoneal cavity.**
 - hemorrhaging
 - excess fluids
 - wounds
 - contamination
- Once the patient is intubated, the surgeon will prep from the suprasternal notch down to the midhighs ____.**
 - proximally
 - superior
 - laterally
 - medially
- Direct pressure can be applied to the inferior vena cava ____ and ____ to any lacerations during injury identification.**
 - distally, laterally
 - inferior, superior
 - proximally, distally
 - proximally, medial
- The surgeon will attempt rapid entry into the ____.**
 - peritoneal cavity
 - right midhigh
 - right abdominal cavity
 - left upper quadrant
- The surgeon will pack the abdominal cavity with ____ following confirmation of blood supply.**
 - laparotomy sponges
 - bowel bag
 - scratch pads
 - surgical towels
- The retroperitoneum is divided into three zones. Zone II includes:**
 - kidneys
 - adrenal glands
 - small intestines
 - both and b
- When inspecting the bowel for injury, ____ can be used to temporarily control bleeding.**
 - retractors
 - sutures
 - Babcock clamps
 - Forrester sponge stick
- A retractor is used on the abdominal wall to expose the ____.**
 - left quadrant
 - right upper quadrant
 - abdominal cavity
 - spleen

Damage Control Surgery continued

11. Packs are placed above and below the ___ while a surgeon is compressing it to ensure tamponade.
 - a. spleen
 - b. liver
 - c. small intestines
 - d. abdominal wall

12. When identifying injuries, the surgical technologist needs to be prepared by having ___ on passers.
 - a. clamps
 - b. sutures
 - c. retractors
 - d. sponges

13. Instrumentation for emergency surgeries include:
 - a. abdominal retractors
 - b. suture needles
 - c. cautery tips
 - d. all of the above

14. Complications of damage control surgery include:
 - a. hemorrhaging
 - b. hypothermia
 - c. acidosis
 - d. all of the above

15. In World War II, damage control surgery was used to treat ___.
 - a. head wounds
 - b. colostomies
 - c. abdominal gunshot wounds
 - d. appendicitis

Organ Procurement

- 1. Procurement is the surgical removal of ___ from either a live or dead donor and transplanted into another patient.**
 - a. tissue
 - b. organ
 - c. both a and b
 - d. neither a or b
- 2. Live donors cannot donate which organ?**
 - a. Kidney
 - b. Lung
 - c. Liver
 - d. Live donors can't donate any organs
- 3. The ___ is responsible for matching recipients with donors all across the United States.**
 - a. organ center
 - b. Health and Human Services
 - c. FDA
 - d. local hospitals
- 4. In a published study by the American Journal of Transplantation, the mean travel distance of most abdominal organs was ___.**
 - a. 23 miles
 - b. 222 miles
 - c. 223 miles
 - d. 13 miles
- 5. The sternotomy should be performed from cranial and brought ___ to ensure that the left innominate vein is not injured.**
 - a. laterally
 - b. medial
 - c. distally
 - d. inferior
- 6. The surgeon divides the falciform ligament up to the IVC to provide ___.**
 - a. space
 - b. mobility
 - c. less trauma
 - d. additional pathways
- 7. The surgical technologist should have a pair of ___ in case of any adhesions that may stick to the inferior and lateral surfaces of the liver, which results in sharp dissection.**
 - a. Bovie
 - b. Bulb syringe
 - c. DeBakey forceps
 - d. Metzenbaum scissors
- 8. The IMV is most commonly used for access into the ___.**
 - a. liver
 - b. portal system
 - c. abdominal sac
 - d. hepatogastric ligament
- 9. Once tape is placed, the surgeon places a clamp around the ___ in preparation for the cross clamp.**
 - a. aorta
 - b. liver
 - c. diaphragm
 - d. kidney
- 10. After the surgeon opens the parietal pleura, the surgical technologist should ___.**
 - a. ensure flush lines are free of air
 - b. have an ice bucket available with slush
 - c. check that pool tips are attached to the suction tubing
 - d. all of the above

Organ Procurement continued

11. In warm dissection, exsanguination is performed by opening the ____.
- right atrium
 - left atrium
 - aorta
 - liver
12. One of the remaining vascular structures a surgeon will dissect during a cold dissection of the liver is ____.
- abdomen
 - diaphragm
 - suprarenal aorta
 - portal vein
13. Organ recovery has increased greatly with patients who receive a major organ transplant now having a ____ survival rate better than 90%.
- three year
 - one year
 - six months
 - one month
14. In cold dissection of the liver, the last item the surgeon incises and divides away from the spine and diaphragmatic muscle to free the liver is ____.
- abdomen
 - SMA
 - Aorta
 - IVC
15. In warm dissection, a midline incision is extended from the pubic bone to the ____.
- aorta
 - liver
 - xiphoid
 - round ligament

Answers CE CREDIT PKG 23: 15 CONTINUING EDUCATION CREDITS

AST Member No: _____

Name: _____

Address: _____ City: _____ State: _____ Zip: _____

Telephone: _____ Email: _____

CE Credit PKG 23: 15 CONTINUING EDUCATION CREDITS

The fee is \$24. This package is only available to AST & ASA members.

Check Enclosed or Credit Card: Visa MasterCard AmEx (due to PCI compliance AST **cannot** accept credit card payment information by fax or E-Mail, you can mail or call in your credit card information).

Card# _____ Expiration Date _____ Signature _____

Alternatives to Blood Transfusions

a	b	c	d	a	b	c	d	a	b	c	d	Mark one box next to each number. Only one correct or best answer will be selected for each question.		
1.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	7.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	13.	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
2.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	14.	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
3.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	9.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	15.	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
4.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	10.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					
5.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	11.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					
6.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	12.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					

A Crash Course in Microbiology: A Review of Pathogens and Diseases

a	b	c	d	a	b	c	d		Mark one box next to each number. Only one correct or best answer will be selected for each question.
1.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	7.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	9.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
4.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	10.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					
6.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					

Taking Control of Infection Control

a	b	c	d	a	b	c	d		Mark one box next to each number. Only one correct or best answer will be selected for each question.
1.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	7.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	9.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
4.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	10.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					
6.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					

The Modern Day C-Section

a	b	c	d	a	b	c	d	a	b	c	d	Mark one box next to each number. Only one correct or best answer will be selected for each question.			
1.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	7.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	13.	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	14.	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	9.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	15.	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	10.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						
5.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	11.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						
6.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	12.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						

A Facial Rejuvenation: Short-Scar Face-Lift/Simple MACS

a	b	c	d	a	b	c	d		Mark one box next to each number. Only one correct or best answer will be selected for each question.	
1.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	7.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
2.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
3.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	9.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
4.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	10.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
5.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						
6.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						

Adenocarcinoma of the Appendix

a	b	c	d	a	b	c	d	a	b	c	d	Mark one box next to each number. Only one correct or best answer will be selected for each question.			
1.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	7.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	13.	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	14.	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	9.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	15.	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	10.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						
5.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	11.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						
6.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	12.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						

Single-Site Laparoscopic Total Hysterectomy

a	b	c	d	a	b	c	d		Mark one box next to each number. Only one correct or best answer will be selected for each question.	
1.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	7.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
2.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	8.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
3.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	9.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
4.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	10.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
5.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						
6.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>						

Sterile Processing: The Other Side of Surgical Services

a b c d	a b c d	a b c d	Mark one box next to each number. Only one correct or best answer will be selected for each question.
1. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	7. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	13. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
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3. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	9. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	15. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
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6. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	12. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		

Mammoplasty to Treat Macromastia

a b c d	a b c d	a b c d	Mark one box next to each number. Only one correct or best answer will be selected for each question.
1. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	7. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	13. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
2. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	8. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	14. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
3. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	9. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	15. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
4. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	10. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
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6. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	12. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		

Damage Control Surgery

a b c d	a b c d	a b c d	Mark one box next to each number. Only one correct or best answer will be selected for each question.
1. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	7. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	13. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
2. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	8. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	14. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
3. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	9. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	15. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
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5. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	11. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
6. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	12. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		

Organ Procurement

a b c d	a b c d	a b c d	Mark one box next to each number. Only one correct or best answer will be selected for each question.
1. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	7. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	13. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
2. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	8. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	14. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
3. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	9. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	15. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
4. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	10. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
5. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	11. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		
6. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	12. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		