SURGICAL PRINCIPLES AND OPERATING ROOM FLOW

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The Surgical Team Trainers


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**Mary Scherer, LVT:** Graduated from Michigan State University in Veterinary Technology in 1977. Mary has worked for 36 years at Michigan State University - Veterinary Hospital in small animal surgery. She obtained certification as a sterile processing unit technician in 2009.

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**Introduction**

The entire Operating Room (OR) TEAM is responsible for making each surgery PERFECT and SUCCESSFUL. Whether you have the role of surgeon, circulator or scrub technician, or whether you are an observing student or visitor, you are not present to watch or passively assist. An active contribution every single day, surgery after surgery will make the difference and can turn any operation into an efficient, effective, and successful event. Each one makes the difference.

It is important to create a structure of principles for your team in the OR as in any veterinary hospital. As you create your own principles, consider some important elements like the sense of pride for being part of a team, the need for efficient communication, the willingness to solve problems and conflicts.

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**Review of surgical principles**

**Surgical asepsis.** Surgical asepsis prevents wound contamination from microorganisms that originate from the patient, the operating room personnel, and the environment. The methods and practices that prevent contamination are described as surgical technique. Proper technique is not an individual action, but involves proper preparation of the facilities and the environment, surgical site, surgical and anesthesia team, and surgical equipment. Basic rules are straightforward and simple to implement.

The occurrence of wound infections and other hospital-acquired infections find origin not only during the process of surgery, but also before and after. Strict adherence to these rules is therefore crucial in every step of the surgical process. The cleaning and processing of instruments as an example, takes place outside the surgery, but is crucial in the aseptic process of the surgery.

Every member of the hospital team, being the surgeon to the cleaning staff carries responsibility in the achievement of aseptic procedures and the corresponding success of surgeries. In order to deliver quality patient care, all members of the surgical team must possess honesty and moral integrity enough to be able to recognize and correct breaks in aseptic technique. There must not be any hesitation to carry out this duty. The safety and the well-being of the patient must always be placed first (AST, 2008).
Antiseptics are substances that prevent or discontinue the growth or action of microorganisms on living tissue therefore preventing infection. Antiseptics are used for patient skin preparation as well as surgical scrubbing. Disinfectants are agents, usually chemical, used for the destruction of most pathogenic organisms on inanimate objects. Depending on the concentrations in which they are used disinfectants can become antiseptics and vice versa. When selecting a disinfectant, it is important to know what type of organism is to be killed and the intended use of the item to be disinfected. Guidelines to follow below are adapted from The Basics of Sterile Processing. There are 2 types of chemical disinfectants: 1) environmental, which are used on non-living surfaces and 2) high level, which are used for devices that will be in contact with patients (ex. scopes). Environmental disinfectants: Quaternary Ammonium Compounds, Halogens, Phenolics, Alcohols. Each High level disinfectant has a shelf life, a use life, and specific instructions for exposure time essential to properly disinfect medical devices: Glutaraldehyde (Cidex), Ortho-phthalaldehyde (Cidex OPA)

Care and Handling of Instruments. Proper Care and Handling of Instruments is important to increase the life of instruments and decrease the cost for repairs and replacement. Packaging is also very important. Acceptable packing materials currently in use are cotton woven textiles, single use nonwoven materials, plastic/paper combination packets and rolls, and rigid sterilization containers. Each packaging material has restrictions and benefits for specific packing needs and processes. Care must be taken to ensure instruments are not damaged during sterilization. Organizing the instruments by size, weight and distribution will ensure minimal disruption during packaging, sterilization and storage.

Sterilization of the instruments follows the decontamination process. It is the process by which all forms of microbial life, including bacterial spores are destroyed. Items that come in contact with the sterile internal tissues of the body must be sterile. There are several methods of sterilization. The chosen method depends on the nature of the item to be sterilized. Steam sterilization and gas (ethylene oxide) are the most common, while hydrogen peroxide plasma/vapor (its use at this time is highly impeded in veterinary medicine due to regulations), and peracetic acid are the other methods commonly used. Every method of sterilization should be monitored routinely to guarantee that sterility has taken place. There are four types of monitoring systems: administrative monitoring, mechanical monitoring, chemical monitoring, and biologic monitoring. Shelf life of a sterilized item is often debated. This is due to a number of factors that could affect sterility of the items: type of packaging material, configuration of material, how often item is handled, exposure to an increased number of personnel, storage in an open or closed area, condition of storage area, method of sealing, dust covers, etc.

Preparing the patient begins before admittance to the surgical prep area. It begins with a complete history and physical exam. Client communication is important to ensure that the risks and complications are explained and permission for any necessary blood work or testing can be
completed prior to surgery. This ensures safety for the patient and the owner’s satisfaction after completion of the surgery. Check skin for dermatology issues. Elective procedures should not be performed if multiple skin lesions are present. These lesions likely contain bacteria that could contaminate the surgery site and/or incision. Once the patient is admitted into hospital, the patient’s identity, surgical procedure to be performed and surgical site should be verified again. The purpose of prepping the skin for surgery is to remove transient microorganisms and reduce resident flora for the duration of the surgery. The antiseptic agent used should work in a short period of time, with the least amount of tissue irritation, and inhibiting rapid rebound growth of microorganisms. Agents commonly used are: alcohols, chlorhexidine gluconate, idodophors, and chloroxylenols.

Pre-Surgical Hand preparation. A variety of methods for surgical hand preparation are available. Aqueous solutions containing either povidone-iodine (PVP) or chlorhexidine gluconate (CHX) have been standard for many decades, but alcohol-based hand rubs (AHR) have been described for surgical hand-preparation for more than a century. Techniques involving aggressive cleaning of the skin with alkaline medicated soaps, like CHX scrubs will have deleterious effects on the skin's local defense mechanisms. Moreover, besides not having shown additional effect on bacterial reduction, techniques involving brushes and scrubbing cause small excoriations and therefore damage to the skin; which in turn increases the risk of skin colonization by pathogenic species. Current recommendations are to use soft sponges, if any, for hands and forearms, only if visibly soiled and brushes for fingertips.

Gowning and Gloving. The purpose of gowning and gloving is to serve as a barrier between the sterile and unsterile areas. After the surgical scrub is performed, sterile gown and gloves are worn to cover skin as much as possible to prevent contamination and create a barrier (Berry 2000). Gowns and gloves should be opened on a surface away from other sterile supplies so dripping water from the scrub person’s arms does not contaminate them.

Sutures

Suture Material. The suturing of any tissue first starts with an appropriate suture material selection. The goal of selecting appropriate suture material is to provide secure wound closure while minimizing morbidity. Suture is chosen based on its characteristics and suture-tissue interaction.

Some basic principles to consider when choosing a suture material are:
- Is the suture at least as strong as the normal tissue through which it is being placed?
- Are the rates at which the suture loses strength and the wound gains strength compatible?
- Does the suture biologically alter the healing process?
Do the mechanical properties of the suture closely match those of the tissue being closed?

Factors to consider:

- **Ideal suture** (Adequate tensile strength, Nonelectrolytic, Noncapillary, Nonallergenic, Noncarcinogenic, Comfortable to use, Good knot security, Minimal tissue reaction, Absorbable at a dependable rate, Easily sterilized, Not corrosive or toxic)

- **Absorbable vs non-Absorbable**
  - Rapidly absorbable: Polyglycolic acid (Dexon), Polyglactin 910 (Vicryl), Poliglecaprone 25 (Monocryl)
  - Slowly absorbable: Polidioxanone (PDS), Polyglyconate (Maxon), Glycomer 631 (Biosyn)
  - Non-absorbable: Silk, Polypropylene (Prolene, Surgipro), Nylon (Nurolon, Surgilon, Ethilon, Monosof, Dermalon), Polyester (Ethibond, Mersilene, Ticon), Polytetrafluoroethylene (ePTFE) – Gore-Tex, Stainless Steel

- *Please note that within the same group, sutures may also differ in being braided vs monofilament vs multifilament; for example in the nylon group: nurolon is braided vs ethilon is monofilament.

- **Size:**
  - USP (Smallest 11-0 - Largest 7) vs Metric (suture diameter in tenths of millimeter).
    - * Please note that Stainless steel is sized according to Brown and Sharpe (B and S)
      - 18 G (USP 7)
      - 41 G (USP 7-0)
  - Proper suture selection also involves choosing an appropriate size based on the tissue. Guidelines include:
    - Skin= 4-0 to 2-0
    - SQ= 4-0 to 3-0
    - Fascia=3-0 to 0
    - Muscle=3-0 to 2-0
    - Viscera=5-0 to 3-0
    - Sm. Vessel ligation=4-0 to 3-0
    - Lg. vessel ligation=2-0 to 1-0
    - Tendon=3-0 to 0

- **Surgical staplers.**
  - They can be:
    - Metallic clip (tanatalum, titanium, 316L stainless steel)
    - Absorbable clip (Polyglactil 910 and polydioxanone)
**Skin Suture Patterns.** Skin sutures are placed using an instrument tie. The needle holder is grasped using a palm grip. The needle should be grasped ½ to 1/3 of the distance between the suture and the needle tip. The steps above are performed by wrapping the long end of the suture around the closed jaws of the needle holder and grasping the short end of the suture with the needle holder and pulling tight. When placing skin sutures, there are a few different patterns that can be chosen. The most common are simple interrupted, continuous, vertical mattress, horizontal mattress and continuous subcuticular pattern.

*Simple interrupted* sutures are performed by entering perpendicular to the skin 3-5 mm from the wound edge. The needle is driven into and across the wound to enter the opposite edge and brought back through the skin. The knot is tied as directed above.

*Continuous* sutures are made by performing an interrupted stitch, but only the free suture end is cut before the needle is reintroduced and directed diagonally across the wound to exit the skin on the other side. The suture is then brought across perpendicular to the wound edge and reintroduced on the first side again with each bite. Once the entire wound is closed, a loop is made with the last pass of suture, and this loop is grasped by the needle holder to tie the knot. Continuous sutures are able to be applied more quickly than interrupted, but they are not as strong as interrupted and have the potential to strangulate blood supply.

*Vertical mattress* sutures provide wound support and decrease dead space. The needle is introduced 5-10mm from the wound edge and a deep bite of tissue is taken before exiting the skin in the same position on the opposite wound edge. The needle position is then reversed in the needle holder, and the needle is reintroduced 1-3mm from the second side of the wound and a smaller bite of tissue is taken before exiting on the first side of the wound. The disadvantage of this suture is the risk of strangulation of the dermal blood supply.

*Horizontal mattress* sutures are good for distributing wound tension across larger wounds. The needle is introduced 5-10mm from the wound edge and exited on the opposite side of the wound. The needle is then reintroduced on the second side of the wound but 3-5mm along the wound edge from the exit point. The suture exits in the same position on the first side of the wound and the suture is tied. The disadvantage of this suture is the risk of strangulation of the dermal blood supply.

*Continuous intradermal (subcuticular)* sutures are performed by introducing the needle 10mm distal to one wound end and bringing it out, inside the wound, within the dermis. The free end of suture is tied. Horizontal bites of dermis are then taken from alternating sides of the wound working towards the other end of the wound.

**Suture removal.** The time to suture removal depends on the location and the degree of tension the wound was closed under. This varies between situations, but as a general rule sutures are typically removed between ten and fourteen days. To remove sutures, one tail of the suture should be grasped with forceps and pulled gently towards one side to the wound, elevating the knot. The opposite side of the suture should then be cut with stitch-cutters or fine suture scissors.
immediately under the knot. The suture can then be pulled out of the tissue by pulling towards the opposite side of the wound.

**Table set up and roles of surgeon, assistant, scrub tech and circulating nurse to improve efficiency and speed**

**Instrument table organization**
- The instrument table should be height adjustable
- The surgery pack should not be opened until the patient is on the surgery table and the patient has been draped in
- A large water permeable drape should cover the entire table. The drape is opened by gently grasping the exposed underneath surface of the drape and unfolding the ends first, followed by the sides.
- Once open, non-sterile personnel are not to reach over the table
- Instruments are positioned on the table so that they can be readily retrieved
- Grouping similar instruments together and in their order of use facilitates their use
- The most used instruments should be placed at the front and specialty instruments should be placed towards the back of the table.
- The layout of the instruments is determined by the scrub nurse preference
- Sponges are counted before the patient is opened and before the patient is closed
- Contaminated instruments or soiled sponges are not placed back on the instrument table

**Room etiquette and Verbal/Nonverbal Communication.** Room etiquette requires professional teamwork to provide safe and quality patient care through maintaining asepsis in a quiet, efficient, and attentive surgical environment. Team members should direct all actions and communication toward the overall goal of positive patient outcomes.

The concept and importance of ‘non-technical’ skills now recognized in human hospitals has been modified from military and aviation programs. These skills include interpersonal, cognitive, and personal resource skills involving behaviors, attitudes, and actions such as leadership, assertiveness, verbal and nonverbal communication, situational awareness, decision-making, teammate support, feedback processes, and maintaining an encouraging team atmosphere. Literature is available assessing the impact of non-technical skills on patient outcomes, technical skill performance, emergency situation preparedness and response, liability claims and staff workload.

Our team started with a very clear list of non-technical skill expectations and an overall vision of “team”. Debriefing has been very important in our learning process, culture change, and creation of a trusted environment. As an understanding of the team culture and its dynamics progress,
new goals and skill sets develop and trust deepens which ultimately creates more efficiency and better patient care.

Verbal communication

- Professional communication involves politeness, respect and honesty.
- Limit operating room (OR) verbal communication to that necessary for the patient and procedure at hand.
- Maintain a quiet OR environment to ensure orders are heard accurately.
- Speak clearly, state concerns in question format, and always ask for clarification if unsure.
- Repeating orders, especially regarding patient information, medications, dosages, and OR counts is extremely important for accurate protocols and safety.

Nonverbal communication

- Equally influences the overall OR environment with body language and facial expressions contributing to professional communication.
- Communication, particularly at the surgical table, is often nonverbal.
- Surgeons communicate to the scrub nurse through several universal hand signals. This allows the surgeon to maintain focus on the surgical field and reduces OR noise.

Roles in the OR

Anesthesia Provider. The anesthesia provider is an indispensable member of the perioperative team. Adequate communication between the surgeon and the anesthesia provider is essential and protects the patient. Communication regarding the start and end of surgery, the need for particular analgesic procedures or other interventions should be communicated with the anesthesia team.

Circulator. The circulator is vital to the smooth flow of events before, during, and after the surgical procedure. To some extent, the circulator controls the physical and emotional atmosphere in the room, which allows other team members to concentrate on tasks without distraction. The circulator is vital to the provision of care that includes, but is not limited to the following:

- Directing and coordinating all activities related to the care and support of the patient in the OR
- Knowledge of surgery
- Creation and maintenance of a safe and comfortable environment for the patient by implementing the principle “demonstrates strong surgical conscience”.
- Provision of assistance to any member of the OR team in any manner
  - Knows organization of work and relative importance of the factors involved in accomplishing it.
  - Ensures that sterile team is supplied with every item necessary to perform the surgical procedure efficiently.
o Must know all supplies, instruments, and equipment; be able to obtain them quickly; and guard against inadvertent hazards in use and care.

o Must be competent to direct scrub person

o Identification of any potential environmental danger or stressful situation. This role requires constant flexibility to meet unexpected and to act in an efficient, rational manner at all times.

o Maintenance of communication link.

First Assistant. The first assistant helps maintain visibility of the surgical site, control bleeding, close wounds and apply dressings. The first assistant handles tissues and uses instruments.

Knowledge and skill level:

o Knowledge of anatomic structures. Tissue manipulation and retraction requires knowledge of anatomic structures that are seen and what are not able to be seen. (Example: retraction of the sciatic nerve.)

o Psychomotor Dexterity
  o Precise, purposeful movement at the sterile field is important for the maintenance of the sterile field and the protection of the patient and team.
  o Efficiency is important to facilitate the procedure.

o Procedure knowledge and Techniques:
  o The first assistant needs to know each step that will be encountered during the surgical procedure. Anticipate. Clear knowledge of functional steps, but also indications for the procedure.
  o Surgical – Site Management for both physiological and aesthetic reasons.

Job Responsibilities of the First Assistant

o Position, prep, and drape the patient

o Handle instrumentation

o Provide exposure

o Provide hemostasis

o Handle tissue

o Suture (In human surgery only, in veterinary surgery it is important to have the knowledge of suturing to better understand the surgeon.)

o Recognize surgical hazards

o Respond appropriately to emergency situations

Scrub Tech

o Responsible for establishing and maintaining the integrity, safety, and efficiency of the sterile field throughout the surgical procedure.

o Knowledge of and experience with aseptic and sterile techniques qualify the scrub person to prepare and arrange instruments and supplies and to facilitate the surgical procedure by providing the required sterile instruments and supplies.
- Anticipate plan for, and respond to the needs of the surgeon and other team members by constantly watching the sterile field.
- Manual dexterity and physical stamina are required.
- Other important assets include: stable temperament, ability to work under pressure, a keen sense of responsibility, and a concern for accuracy in performing all duties.

Both the scrub nurse and first assistant must have working knowledge of all surgical instrumentation and are responsible for appropriate use and care. Instruments are generally grouped according to their mechanism of action. We mention a few of the main groups, however, many specialized instruments exist for orthopedic, cardiac, microvascular, and ophthalmologic surgery, among others. Before assisting in any surgery the surgical assistant and scrub nurse must be familiar with all instrumentation and surgical equipment.

A brief and debrief of the surgical team should be used to walk through the steps of each surgery to increase efficiency and highlight patient concerns needing extra attention or deviating from usual protocol. A follow up meeting after the surgery to discuss and evaluate performance will help to identify areas for improvement.

Knowledge of Instruments. Instruments can be classified by dividing into categories:

**Cutting and dissecting instruments** are used to divide tissues, sutures, bandages, etc. These instruments have a sharp surface, either a blade or a point. This category includes knives, scissors, saws, rongeurs, osteotomes, drills, chisels, raspatories (used for the separation of the periosteum), Volkmann curettes, biopsy needles, diathermy pencils, etc.

**Grasping instruments** are used to grasp, pickup, hold and manipulate tissues, tools and materials. They can be applied for retraction, blunt dissection and hemostasis or occlusion of tubular structures - such as bowels or ducts – to prevent content leakage.

**Surgical clamps** have a locking mechanism, which may be spring handles alone or combined with ratchet catches. The ratchet lock design has finger rings, Jaw designs vary, depending on the specific purpose of use: smooth for delicate tissue such as intestine or serrated for hemostasis, either with or without teeth. Traumatic (artery forceps) or atraumatic clamps (e.g. Dieffenbach serrafine, Satinsky forceps) may be selected.

**Retractors** are used to hold tissues and organs aside to improve exposure, visibility, and accessibility of the surgical field. Hand-held retractors (rake retractors, plain retractors, e.g. Roux, Langenbeck, or visceral retractors) are held by the assistant. They cause minimal tissue damage because the assistant maintains tension on the tissues only as long as necessary. When applied properly, self-retaining retractors (Weilander self-retractor, Gosset self-retaining retractor, etc.) are of great help, but care should be taken not to damage the tissues when they are placed and removed.
Suction tips are connected to a vacuum used to remove blood and irrigation fluid from the body. Poole suction tips allow maximal removal of fluid from the abdomen or thoracic cavity, whereas Frazier and Yankauer tips provide fluid removal from more precise locations such as a joint.