IS ASEPSIS REALLY A REQUIREMENT?

The goals of aseptic technique are to prevent cross contamination during surgery and to minimize the amount of micro-organisms in the surgical environment, thereby preventing their entrance into the surgical wound and the associated morbidity. Maintaining asepsis is considered the standard of care for veterinary surgical procedures and has a direct impact on patient outcome. In most field clinic settings, there is a general lack of access to veterinary care and the logistical difficulty in providing patient follow-up, making strict adherence to aseptic technique and best surgical practices even more critical.

MINIMUM REQUIREMENTS FOR ASEPTIC SURGERY

Broad guidelines for surgical care that are attainable in most spay-neuter programs have been established and found to be attainable in a variety of field clinic settings. In most cases, these represent the minimum requirements necessary to maintain asepsis; however, veterinary surgeons should strive to practice above these requirements whenever possible to decrease the chances of wound contamination and surgical complications. Programs operating below this threshold of care place their professional reputations, that of similar organizations, and most importantly, the welfare of their patients at unnecessary risk. Should these requirements be impossible to attain, re-analysis of the program mission and resource allocation is warranted.

Operating Environment

The minimum requirements for a functional operating environment include areas designated for animal housing, anesthesia and patient preparation, a surgeon scrub sink, an operating room, and a patient recovery area. Additional areas that may enhance efficiency and promote infection control include dressing rooms, supply rooms, an instrument pack preparation room, and a designated area for donning sterile gowns and gloves. Closed doors between clean operating environments and contaminated areas of the facility will aid in infection control and the promotion of aseptic technique.

When designing a surgical facility careful attention should be paid to traffic flow patterns to ensure maximum efficiency and minimize opportunities for disease transmission. Traffic flow through the surgical clinic should be thought of as unidirectional and the environment should be laid out such that the desired flow pattern is the most direct path for personnel and animals to follow.

When a separate working unit isolated from general facility traffic is not available to serve as an operating room, the following points should be considered in order to promote asepsis and minimize the chances of cross contamination and the occurrence of post-operative infections:

1. Select an area of sufficient size for necessary personnel and equipment
2. Create physical and/or visual barriers to control and minimize traffic flow
3. Establish a clean, uncluttered environment (e.g., remove wall posters, discard perishable items, cover ceiling fans; place a clean tarp over surfaces that cannot be removed or cleaned prior to use)
4. Select an area with constant humidity and temperature and good air flow
5. Utilize equipment and surfaces that are amenable to cleaning and disinfection (e.g., smooth, non-porous) or cover surfaces with clean, disposable drape material.
Surgical Instruments
Aseptic surgery cannot be achieved unless each surgical instrument that contacts body tissues or blood is sterile at the time of use. There are three distinct components to the proper instrument preparation: cleaning and decontamination, packaging, and sterilization.

Cleaning and decontamination
Removal of organic contamination (e.g., blood and mucous) through cleaning and decontamination of reusable surgical instruments must be undertaken prior to attempts at sterilization. Organic contamination of items may inactivate or prevent penetration of chemical germicides as well as increase the bio-burden of the equipment such that sterilization is not possible. If allowed to dry on surgical instruments, blood, body fluids and saline can result in corrosion, rusting and pitting which can also impede the sterilization process. Cleaning with a pH neutral, low-foaming, free-rinsing detergent and water is an effective and cost-efficient means of removing organic material. If not removed for decontamination and re-packaging immediately after use, surgical instruments can be immersed in a detergent-warm water solution (80°F-110°F) until processing.

Packaging
After appropriate cleaning, decontamination and drying, surgical instruments must be packaged for processing. Woven cotton muslin (minimum thread count 140), non-woven SMS (spunlace-meltblown-spunbonded) materials, woven cotton/polyester-blend fabrics, or paper-plastic peel packages are usually sufficient. When reusable woven textiles are used, they should be laundered between each use to rehydrate the material and prevent superheating during the sterilization process which can inhibit sterilization. Although probably unnecessary when non-woven materials are utilized, double-wrapping surgical packs will help prevent bacterial contamination and extend shelf life of the sterilized pack.

Sterilization
Liquid Chemical Sterilization (“Cold sterile”)
Liquid chemical sterilization is a common technique utilized in veterinary practices and field clinic settings. The active ingredients in commercially available liquid chemical sterilants include glutaraldehyde, peroxycetic acid, hydrogen peroxide, ortho-phthalaldehyde and phenol/phenate. It is possible to achieve sterilization with these chemicals; however, specific conditions must be met with each use:

1. Items to be sterilized must be clean and dry prior to immersion
2. Complex instruments must be disassembled prior to immersion
3. Proper immersion times must be observed; sterilization can be achieved in 6 to 12 hours
4. Instruments must be rinsed with sterile water and dried with sterile towels prior to use
5. Sterilant must be changed after one “cycle” of use

Direct immersion of surgical instruments in other solutions (e.g., alcohol, chlorhexidine, boiling water) is not an appropriate use of liquid chemical sterilization and will not result in sterilization.

Dry Heat Sterilization
Dry heat sterilization can be achieved through the use of dry heat sterilizers (also known as hot air ovens or hot air sterilizers). Their portability and low cost (<$100 USD) may make these devices seem attractive for field clinic use. Although dry heat has good penetration and will not corrode delicate or sharp metal instruments, their use is only recommended for materials that are damaged by or impenetrable to moist
heat. Due to their small size, dry heat sterilizers are generally extremely limited in the amount of instruments that can be sterilized in one cycle and, since they rely on the use of dry heat rather than steam, require prolonged run cycles (170°C [340°F] for 60 minutes, 160°C [320°F]) for 120 minutes, and 150°C (300°F) for 150 minutes). In addition, dry heat sterilizers do not result in even distribution of heat, therefore, effective sterilization of all contents is not reliable.

**Steam Sterilization**

Some practitioners rely on pressure cookers to sterilize surgical instruments in field clinic settings. These devices generally have lower pressure thresholds resulting in longer run cycles in order to achieve sterilization. In order to ensure effectiveness and operator safety, the same procedures for preparing and packaging instruments as discussed above must also be followed, instruments must not contact the water in the bottom of the cooker, and time and pressure measurements should not begin until the entire cooking chamber has filled with steam. The amount of instruments and surgical packs that can be sterilized in a pressure cooker at once generally render this method impractical for most field clinics.

Gravity displacement steam sterilization (e.g., use of an autoclave) is the most common method of surgical instrument preparation. In settings where there is no electricity, inexpensive ($300-600 USD) stovetop sterilizers requiring only a source of heat can be utilized; similar to pressure cookers, these generally have extremely limited load capacities. The ability of any steam sterilizer to achieve sterilization is dependent upon its ability to move air through the unit and its contents; proper packaging and loose loading of the unit are essential to achieve this goal. Mechanical settings (i.e., time, temperature, and pressure) of the sterilizer must be carefully monitored to ensure sterilization. The precise settings required for sterilization will vary based on the piece of equipment to be sterilized and the sterilizer itself (Table 1). After the sterilization cycle is complete, materials should be allowed to dry and cool thoroughly before removal. When handled prematurely, stacked on top of one another, or placed on a cool surface, residual steam vapor can cause moisture to penetrate the packaging resulting in the loss of sterilization.

<table>
<thead>
<tr>
<th>Item</th>
<th>Temperature</th>
<th>Time</th>
<th>Pressure(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruments</td>
<td>250°F</td>
<td>15-30 minutes</td>
<td>15-17 psi</td>
</tr>
<tr>
<td></td>
<td>270°F</td>
<td>12-15 minutes</td>
<td>27-30 psi</td>
</tr>
<tr>
<td></td>
<td>275°F</td>
<td>12-25 minutes</td>
<td>27-30 psi</td>
</tr>
<tr>
<td>Textiles</td>
<td>250°F</td>
<td>30 minutes</td>
<td>27-30 psi</td>
</tr>
<tr>
<td></td>
<td>270°F</td>
<td>12-25 minutes</td>
<td>27-30 psi</td>
</tr>
<tr>
<td></td>
<td>275°F</td>
<td>12-25 minutes</td>
<td>27-30 psi</td>
</tr>
<tr>
<td>Flash sterilization(^b)</td>
<td>270-275°F</td>
<td>3-10 minutes</td>
<td>27-29.4 psi</td>
</tr>
</tbody>
</table>

\(^a\)For every 1,000 feet of altitude, add an additional 0.5 psi above 15 psi (normal atmospheric pressure at sea level)

\(^b\)Item should be unwrapped and placed in a perforated metal tray

**Surgeon Preparation**

Surgeon preparation encompasses the donning of appropriate attire for the procedure (including caps, masks, gowns and gloves) and the surgical hand scrub. Although the use of sterile gowns is often left to surgeon discretion in veterinary practice, the use of caps, masks, and single-use sterile gloves for every procedure is an achievable best practice.

The surgical hand scrub has three primary goals: to remove debris and transient microorganisms, to reduce the resident microbial count and to inhibit rebound growth of microorganisms. Antimicrobial
soaps containing alcohol, chlorhexidine, iodine/iodophors, phenolic compounds or some combination of these active ingredients are most common in veterinary surgical programs (Table 2). Disposable plastic brushes, soap-impregnated sponges, brushless scrub solution, and waterless scrub solutions and rubs are all acceptable and effective. It is important to note that not all brushless, waterless, antiseptic rubs or gels have equivalent efficacy, contact time required for surgical antisepsis is generally greater than that for purely hygienic purposes, and the technique for product application is different than that used for traditional scrub solutions.

Table 2. Characteristics of Common Surgical Antiseptics

<table>
<thead>
<tr>
<th>Antiseptic</th>
<th>Concentration</th>
<th>Pros</th>
<th>Cons</th>
<th>Contact time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol</td>
<td>60-95%</td>
<td>Broad spectrum bactericidal</td>
<td>Variable efficacy against non-enveloped viruses</td>
<td>1-5 min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Good fungicide</td>
<td>No residual activity</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rapid killing activity</td>
<td>Loss of efficacy in presence of organic debris</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Minimal residual activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inexpensive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorhexidine gluconate</td>
<td>0.5-4%</td>
<td>Broad spectrum bactericidal</td>
<td>Poor efficacy against enveloped viruses</td>
<td>2-6 min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strong residual activity</td>
<td>Ineffective against non-enveloped viruses</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains efficacy in presence of organic debris</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Para-chloro-meta-xyleneol (PCMX)</td>
<td>0.5-4%</td>
<td>Broad spectrum bactericidal</td>
<td>Variable efficacy against non-enveloped viruses</td>
<td>30 sec. – 2 min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ineffective against non-enveloped viruses</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Residual effects unclear</td>
<td></td>
</tr>
<tr>
<td>Povidone iodine</td>
<td>0.75-2% (free iodine)</td>
<td>Broad spectrum bactericidal</td>
<td>Variable efficacy against non-enveloped viruses</td>
<td>2-10 min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderate fungicide</td>
<td>Prolonged time to effect</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sporicidal</td>
<td>Loss of efficacy in presence of organic debris</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Some residual activity</td>
<td>Staining of skin</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tissue toxicity</td>
<td></td>
</tr>
</tbody>
</table>

For the high volume surgeon, it is acceptable to perform a complete surgical scrub at the beginning of the surgical period with additional scrubs occurring only after breaks in aseptic technique and after procedures lasting greater than 60 minutes in length. In most cases, a minimum of 5 minutes of antiseptic contact time is recommended for the initial scrub with subsequent scrubs ensuring at least 2 minutes of contact time. Proper hand preparation is not a substitute for the use of sterile surgical gloves. Sterile surgical gloves are not intended for re-use and cannot maintain their integrity with re-sterilization; similarly, non-sterile examination gloves cannot be effectively sterilized for use.

**Patient Preparation**

Patient preparation encompasses the removal of hair and scrubbing of the planned surgical site along with the application of appropriate barrier drapes. The goals of patient preparation are the same as those described above for the surgeon. In addition, the use of surgical drapes serves as both a physical barrier against microbes and as visual establishment of the sterile field, a factor of special significance in field clinic settings, when the operating area is not delineated by the walls of a sterile operating room.
Hair removal in veterinary patients can be performed through the use of electric clippers, depilatory creams, or straight blades. Clipped hair should be removed from the environment with a vacuum or adhesive lint roller. Antiseptic agents useful in preparing the surgical site are similar to those described for surgeon preparation. Multiple protocols for the application of antiseptics have proven effective (e.g., alternating antiseptic scrub with alcohol or saline rinse, antiseptic scrub followed by sprays or paints, antiseptic spray alone, wiping skin dry after scrubbing, leaving skin to air dry, etc.). Once the scrub of the surgical site is complete, it should be allowed to dry thoroughly prior to draping. Although the effectiveness of barrier drapes in protecting human patients is debatable, their role in veterinary surgery seems more obvious given the relatively high risk of hair or fecal contamination of the surgical site.

**MEDICAL AND SURGICAL SUPPLIES**

Each piece of equipment that comes into contact with a surgical patient can harbor pathogens and transmit disease if not properly sanitized between patients. Biological contamination and transmission of both bacteria and viruses have been demonstrated through needles, syringes, intravenous (IV) tubing lines, and laryngoscope blades and handles that have not been thoroughly disinfected.

The human healthcare industry calls for the complete sterilization of items that come into contact with the vascular system or sterile body tissue (e.g., IV catheters, IV tubing), disinfection of items that contact mucous membranes (e.g., laryngoscope blades, masks) and thorough cleaning of items that contact intact skin (e.g., electrocardiogram leads, blood pressure cuffs) in between each use. Items such as endotracheal tubes, breathing circuits, filters, needles, and syringes are considered single-use items. Many of these single-use items are commonly reused in veterinary medicine; in these cases practitioners should follow the recommendations based on level of patient contact described above.

**CONCLUSION**

Aseptic technique, including the use of sterile surgical instruments, and proper preparation of both the surgeon and patient need to be addressed as part of the effort to ensure good patient outcomes and strong community support for every field clinic. Maintaining asepsis during surgery is a mandatory practice and achievable in almost any environment.