Contamination control: part 1 – preventing surgical site infections

Author : Laura Rosewell

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ABSTRACT

Infection control seeks to prevent patient harm by minimising the impact of infection on a patient. Although infection control protocols have been common in human medicine for many years, the veterinary profession has been slower to adopt these principles. Suggested reasons include a lack of local or national guidelines and insufficient published evidence that can be applied in practice (Stull and Weese, 2015).

The veterinary nurse plays a key role in infection control due to his or her involvement in preparation and cleaning of surgical and hospitalisation areas; surgical site preparation; and medical and surgical nursing. This article aims to discuss factors impacting on infection control and the ways in which an infection control strategy can be implemented. The first of this two-part article will focus on prevention of surgical site infections.

Surgical site infections (SSIs) are hospital-acquired wound infections that occur after a surgical procedure when the site is contaminated.

Figure 1. Surgical wear.

Contamination is commonly caused by endogenous sources (such as a patient's microbial flora found on the skin and in the body) or, less commonly, exogenous sources (such as surgical field contamination, including surgical team members, instruments and equipment; Dorion and Gruber, 2010).

SSIs commonly develop in the superficial tissues within 30 days of surgery; however, if implants are used, the infection can affect much deeper tissues and signs may not become evident until several months after the surgery (NICE, 2008).

Significant risk factors for SSIs include duration of surgery, number of people in the operating room and cleanliness of the surgical site (Eugster et al, 2004). For an SSI to develop, the numbers of infectious agents present must overwhelm a patient's natural defence system. Typically, this equates to greater than 105 organisms per gram of tissue in sites where no foreign material is present (Dorion and Gruber, 2010).

SSIs are associated with increased morbidity and mortality, increased length of hospitalisation and,

in turn, financial implications for the owner. Increases in multidrug resistant (MDR) infections, such as meticillin-resistant *Staphylococcus aureus*, have been seen in practice. These complicate treatment, causing poor outcomes and, in some cases, result in death of the patient (Stull and Weese, 2015).

The incidence of SSIs in vet practice varies from 0.8% to 18.1%, depending on the surgical procedure performed (Nelson, 2011). Over a five-year period, 82% of North American and European veterinary teaching hospitals reported one outbreak of hospital-acquired infection, and 45% reported multiple outbreaks.

Patient admissions were subsequently restricted in 58% of cases and 32% of these outbreaks required closure of the ward or hospital (Stull and Weese, 2015).

In human medicine, it is reported up to 70% of all hospital-acquired infections can be prevented by adherence to infection control protocols (Stull and Weese, 2015). With MDR infections and SSIs on the rise, introduction of infection control measures in veterinary practice is essential in reducing incidence of infection.

Surgical environment

The surgical environment consists of the preparation area, operating theatre, sterile store area and scrub area (Brooks, 2006). All areas should be easy to clean (that is, walls and ceilings coated in a waterproof material and corners coved to facilitate cleaning) and foot traffic should be reduced to surgical staff only where possible.

The operating theatre should be in an end room, with minimal furniture/fittings to avoid buildup of dust. Ventilation and heating must be made available, but those in use must not cause movement of air and dust, which could contaminate the surgical field (Brooks, 2006).

Sterile equipment should be kept in a closed cupboard accessible in the operating theatres, but not kept within the theatre itself. The scrub area should be placed near to the theatre, but not inside the operating theatre, and swing doors should separate the scrubbed area and operating theatre to allow ease of surgeon movement, thus reducing contamination risk (Brooks, 2006).

The preparation area should be placed next to the operating theatre and here all anaesthetic inductions, clipping of surgical site and initial skin disinfection should take place. All loose fur and other contaminants should be removed before the patient is transferred to theatre.

The surgical areas should be thoroughly cleaned before initial use, in between each procedure and at the end of the operating day. A weekly deep clean should also take place and all theatre cleaning equipment must be kept separate from that used to clean the rest of the practice (Brooks, 2006).

The surgical day should be planned in order of sterility, as the cleanliness of the surgical site will influence infection control measures required and the effectiveness of controlling infection in the surgical area (Packer and Devaney, 2010).

Surgical procedures are classified as:

- clean – an uninfected, uninflamed surgical site that does not enter into the gastrointestinal, respiratory or urogenital tracts
- clean-contaminated – controlled entry into the gastrointestinal, respiratory or urogenital sites and no or minimal spillage
- contaminated – open, fresh, accidental wounds, spillage from the gastrointestinal, respiratory or urogenital tracts or a major break in sterility
- dirty – infected wounds, aged or devitalised tissue, surgery of the oral or anal areas (Sheetz et al, 2012)

Clean surgery should be performed first and dirty surgery last. Where possible, dirty procedures should not take place in the operating theatre.

Surgical team

Surgical wear

Traditionally, surgical staff have worn clean, non-sterile scrub suits, a theatre hat and dedicated theatre shoes (or disposable overshoes) and, in some cases, a surgical mask (**Figure 1**). However, limited evidence is available on the effect wearing non-sterile theatre dress has on SSI incidence (McMillan, 2014; NICE, 2008).

A systematic review found no significant difference in SSI incidence when surgical staff wore/did not wear surgical masks (Lipp and Edwards, 2002). However, the National Institute for Health and Care Excellence (NICE, 2008) human medical guidelines state all theatre staff should wear specific, non-sterile theatre wear in any area where operations take place.

Scrubbing up

Hand decontamination seeks to minimise contamination risk from the surgeon’s normal skin microbial flora and/or transient organisms on the skin. Several methods and products are available for use in hand decontamination. Transient microbes can be removed with soap and water; antiseptic solutions such as povidone-iodine, chlorhexidine gluconate or alcohol rubs are required to remove residing microbes, reach deep crevices or hair follicles (NICE, 2008).

Chlorhexidine provides lasting inhibition of bacterial growth; alcohol rubs readily kill bacteria, but do not remove organic matter, so the skin must first be cleaned. No significant differences in incidence

of SSIs have been found when comparing a traditional skin scrub (with povidone-iodine and chlorhexidine) to an alcohol gel rub (Parienti, 2002).

It is recommended a scrubbing brush is no longer used on the skin as this damages it. Instead, an initial scrub at the start of the operating day using an antiseptic such as chlorhexidine and the fingernails cleaned using a single-use brush or nail pick should be performed, and this process repeated any time the hands become soiled (NICE, 2008).

It is conventional for the surgical team to remove all hand jewellery, nail polish and false nails/nail extensions prior to scrubbing up. A systematic review found no significant difference in the incidence of SSIs when comparing a group wearing rings to a group where rings were removed. In addition, a comparison between groups wearing no nail polish, freshly applied nail polish and four-day-old nail polish found no significant difference in SSI incidence (Arrowsmith and Taylor, 2012).

NICE (2013) acknowledged further investigation into this was warranted; however, it is recommended all hand jewellery and nail polish is removed prior to surgery.

Gowning and gloving

It is advisable to wear a sterile gown while in the surgical area, to prevent the risk of contamination to both staff and patient. Although limited evidence is available on the effect this has on SSI incidence, it is suggested wearing sterile gowns may help maintain theatre discipline, which, in turn, may reduce SSI risk. No significant difference in SSI incidence has been found between cloth/reusable gowns and single-use gowns (Garibaldi et al, 1986).

Use of surgical gloves is widely accepted as a staple in reducing risk of surgical infection. Modern surgical gloves are sterile, single-use and disposable; they are commonly made of latex, although alternatives are available for latex allergy sufferers. Double-gloving has been suggested to reduce contamination from glove puncture where puncture risk is high or where contamination would have severe consequences – for example, surgery involving orthopaedic implants (McMillan, 2014).

Although it has been concluded insufficient evidence exists to confirm the correlation between glove puncture risk and SSI incidence, NICE (2008) recommends considering double-gloving in surgeries where puncture risk is high, or where the consequences of contamination are severe.

Comparisons of gloving methods have found significant increases in glove cuff contamination when using the open gloving method, so closed gloving is recommended (Jones et al, 2010).

Behaviour in theatre

It is advisable for staff to change out of scrubs once leaving the surgical area and back into freshly laundered scrubs when re-entering the surgical area. This contributes to maintaining theatre

discipline, which, in turn, reduces SSI risk. Theatre staff should keep their movements in and out of the surgical area to a minimum (NICE, 2008).

Footfall and noise in the operating theatre should be reduced as much as possible; SSI incidence increases with a greater number of people present in the operating theatre. In addition, complicated or prolonged surgeries are associated with increased SSI risk, therefore distraction of the surgical team should be avoided wherever possible (Eugster et al, 2004).

Surgical site preparation

Figure 2. The fur is clipped in line with the hair growth, with a clean, sharp pair of clippers.

Preparation of the surgical site seeks to reduce contamination risk from the patient's transient/natural skin flora. Preoperative bathing using an antimicrobial solution is advisable in cases of elective orthopaedic surgery to remove excess skin scales, gross contamination and external parasites. This may be carried out at home by the owner or in the surgery if owner compliance is considered a risk (Bowers, 2012).

Hair should be removed to prevent contamination of the surgical site with foreign material and allow proper skin disinfection. It is widely accepted fur should be clipped as immediately prior to surgery as possible (though this may not be possible in emergency or severely unstable patients, where anaesthesia should be kept as short as possible) to avoid increased bacterial colonisation at the surgical site.

The fur should be clipped using a clean, sharp size 40 clipper blade to shave the fur as close to the skin as possible (**Figure 2**). The fur should be clipped along the natural line of the hair to prevent

clipper rash and small cuts, which can provide an entry point for microorganisms (Bowers, 2012).

Skin disinfection should be carried out with an antiseptic such as chlorhexidine, povidone-iodine or isopropyl alcohol. No significant differences have been found between chlorhexidine, alcohols and povidone-iodine on SSI incidence (Alexander et al, 1985; Brown et al, 1984); however, chlorhexidine has superior residual activity and is effective in the presence of organic matter, whereas povidone-iodine and alcohols are not. Alcohols have improved activity when used with chlorhexidine, but are not suitable for use on open wounds or mucous membranes (Bowers, 2012).

The skin should be prepared initially with a freshly-prepared lathering scrub solution in a sterile container; this reduces the risk of bacterial multiplication in dilute solutions (particularly Pseudomonas species; Bowers, 2012). Lint-free swabs should be used in place of cotton wool to avoid residual fibres being left on the skin; gloves should be worn while preparing the patient to avoid contamination of the scrub solution from the handler's skin (Bowers, 2012).

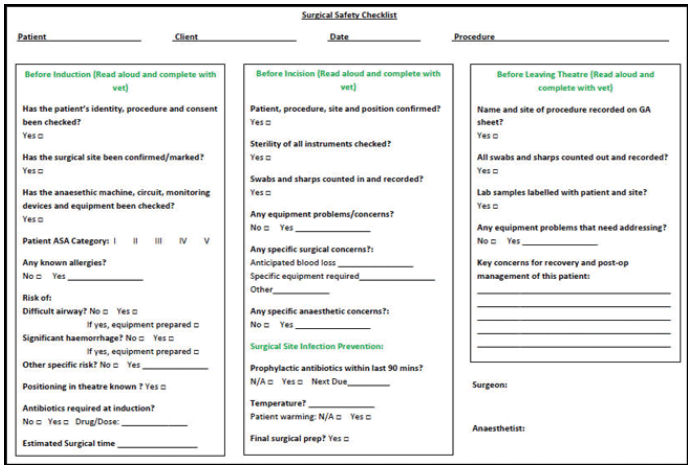
A final skin scrub should take place prior to surgery – often this is performed on moving the patient into the operating theatre, but it is important any procedures taking place in the preparation area receive a final scrub also. This should be performed using sterile swabs or sponges held using sterile forceps. Alternatively, use of pre-made sterile sponge applicators that contains 2% chlorhexidine and 70% isopropyl alcohol should be considered as they are rapid-acting, broad-spectrum and maintain antimicrobial activity for 48 hours (Hibbard, 2005).

The target/concentric circles scrub pattern has traditionally been used when preparing skin (Bowers, 2012); however, reports suggest use of the back and forth scrub pattern may provide more thorough skin disinfection at the site of incision (McMillan, 2014).

Prophylactic antibiotics

The topic of prophylactic antibiotic administration has received much press. It is recommended prophylactic antibiotics be administered to clean surgeries involving the placement of an implant, clean-contaminated surgery, contaminated and dirty surgeries. Antibiotic prophylaxis should not be administered in clean, uncomplicated surgeries where no implants are used (NICE, 2008).

Methods of improving standards



Surgical Safety Checklist

Patient _____ Client _____ Date _____ Procedure _____

Before Induction (Read aloud and complete with vet)

Has the patient's identity, procedure and consent been checked?
Yes ☐

Has the surgical site been confirmed/marked?
Yes ☐

Has the anaesethic machine, circuit, monitoring devices and equipment been checked?
Yes ☐

Patient ASA Category: I II III IV V

Any known allergies?
No ☐ Yes _____

Risk of:
Difficult airway? No ☐ Yes ☐
If yes, equipment prepared ☐
Significant haemorrhage? No ☐ Yes ☐
If yes, equipment prepared ☐
Other specific risk? No ☐ Yes _____

Positioning in theatre known ? Yes ☐

Antibiotics required at induction?
No ☐ Yes ☐ Drug/Dose: _____

Estimated Surgical time _____

Before Incision (Read aloud and complete with vet)

Patient, procedure, site and position confirmed?
Yes ☐

Sterility of all instruments checked?
Yes ☐

Swabs and sharps counted in and recorded?
Yes ☐

Any equipment problems/concerns?
No ☐ Yes _____

Any specific surgical concerns?:
Anticipated blood loss _____
Specific equipment required _____
Other _____

Any specific anaesthetic concerns?:
No ☐ Yes _____

Surgical Site Infection Prevention:

Prophylactic antibiotics within last 90 mins?
N/A ☐ Yes ☐ Next Due _____

Temperature? _____
Patient warming: N/A ☐ Yes ☐

Final surgical prep? Yes ☐

Before Leaving Theatre (Read aloud and complete with vet)

Name and site of procedure recorded on GA sheet?
Yes ☐

All swabs and sharps counted out and recorded?
Yes ☐

Lab samples labelled with patient and site?
Yes ☐

Any equipment problems that need addressing?
No ☐ Yes _____

Key concerns for recovery and post-op management of this patient:
_____
_____
_____
_____
_____

Surgeon:

Anaesthetist:

Figure 3. Surgical safety checklist.

Appointment of an infection control officer should be considered when developing, enforcing and maintaining infection control protocols. Though in human hospitals this would be a formally trained individual, in veterinary practices this role can be fulfilled by a veterinary surgeon or nurse with an interest in infection control (Stull and Weese, 2015). This individual, with practice support, should establish protocols for subjects such as hand hygiene; use of personal protective equipment; patient management; and cleaning and disinfection, and provide staff training on such topics (Stull and Weese, 2015).

Use of wound auditing is of importance when seeking to implement an infection control strategy, as it provides a means to search historical records and identify patterns and trends in SSI incidence. Environmental cultures of surgical areas should be considered on a regular basis to ensure disinfectants used are sufficient and to identify any gaps in cleaning standards.

Use of surgical safety checklists (**Figure 3**) may help identify patient-specific risks that may affect their risk of obtaining an SSI, as well as identifying their need for antibiotic prophylaxis.

Conclusion

Infection control is a vast topic and one that affects all members of the team. This feature has focused on the prevention of surgical site infections. Effective environmental cleaning and preparation, patient preparation, as well as the correct skin cleaning, dress and behaviour of the surgical team, are all part of preventing SSIs. The establishment of a dedicated infection control officer and adherence to infection control protocols may help improve surgical safety.

The second part of this feature will focus on barrier nursing and preventing the spread of infectious disease.

Contamination control: part 2 – a vet nurse's critical role

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