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The equine theatre suite design and implementation

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ABSTRACT: A well-designed surgical suite should provide a safe environment for patients and personnel, by reducing the number of microorganisms introduced into the surgical field and the operating suite. This, in combination with evidence-based protocols, will minimise the possibility of surgical-site infections.

Introduction

Horses are a significant source of microbial contamination. These microorganisms may be endogenous, i.e. originating from within the horse's body, or exogenous, which are found on the horse's skin and coat due to contamination from the environment in which the horse lives. Exogenous microorganisms are usually the biggest potential source of contamination of the surgical field and the design of the surgical suite, along with the implementation of gold-standard hygiene techniques, should ensure safe and effective peri- and intra-operative patient care.

Air-movement patterns should be considered, when planning the surgical suite, in order to reduce airborne contamination. Sliding doors can be incorporated where appropriate as this reduces the generation of air currents, which is important in the prevention of nosocomial (hospital borne) infections, (Harsoor & Bhaskar, 2007). Two identical theatre suites should be designed: one theatre is used for orthopaedic procedures, with the exception of treating septic synovitis; all other surgeries are performed in the second theatre suite.

Lighting in the orthopaedic theatre should be designed so as to reduce reflection, thus allowing better visibility of the screen used in arthroscopic procedures (Corley & Stephen 2008). The second theatre should incorporate high windows to allow entry of natural light, which gives more comfortable working conditions, especially for long periods. It has also been noted by Al-Benna, (2012) that natural light improves staff morale. The windows should be sealed units, to prevent entry of contaminated air, which would increase potential infection rates (Al-Benna, 2012).

Induction/recovery boxes

Two induction and recovery boxes are normally incorporated into the suite. This allows one horse to recover whilst a second horse is anaesthetised when there is a high case load of surgeries. These rooms are usually both square, however there is debate about the ideal shape of the recovery box. Corley and Stephen (2008) described a horse standing with its head supported in a corner as having a fifth point of support. However, it is also possible that these corners could lead to trapping of the patient's head in awkward positions during recovery, and for this reason it is advised that they should be rounded to prevent this risk.

The walls and floor should be padded with compressible rubber which is non-slip to reduce the incidence of injury to both personnel and patients. The material of the walls and floors should also facilitate easy cleaning to prevent the risk of surgical site infections. A padded hinged partition can be implemented during induction, giving personnel greater control and safety as the horse assumes recumbency. The open end of the partition should be attached to the wall with a rope which goes over the patient's head and not across its chest. Corley and Stephen (2008) explain that this prevents possible jugular occlusion and catheter damage as the horse lowers its head when sedated and drops into recumbency during

DOI: 10.1080/17415349.2015.1058199

induction. The partition can be secured against the wall during patient recovery to prevent injury.

Dimmable lights should be used in the recovery area to reduce patient stimulation during the recovery period. This helps to prevent horses getting to their feet too quickly, which can have the effect of increasing their risk of injury. The risk of post-operative hypothermia is reduced by the use of heat lamps. A small observation window and closed-circuit television should be incorporated into the recovery room, so that personnel can monitor the patient's recovery without putting themselves in danger. It has been found that recovery from general anaesthetic is a major contributor to perioperative fatalities (Farmer, Chase-Topping, Lawson & Clutton, 2014).

The area must be high enough to accommodate an electric overhead hoist, which allows movement of the patient into theatre and then into the recovery box via a track that moves between each area. Hoisting equine patients by their legs can cause ventroflexion of the thoracolumbar spine and thoracic compression, thus a bar must be attached to the hook of the hoist which attaches to the hobbled limbs to reduce this complication (**Figure 1**) (Corley and Stephen, 2008). A separate hoist should also be available from which to hang a sling if the patient requires slinging due to post-operative myopathy. This ischaemic muscle damage, which is more likely to arise in patients over 600 kgs, is exacerbated by inadequate padding and poor positioning, leading to reduced perfusion in affected areas.

Figure 1. A bar incorporated into the hoist prevents ventroflexion and thoracolumbar compression

Changing room

A changing room allows all personnel to change into theatre attire as, although McMillan (2014) noted that there is no evidence that wearing theatre scrubs influences the incidence of surgical site infections, according to Rutland (2011), the biggest source of contamination in the theatre suite is the staff, and the wearing of scrubs acts as a barrier to reduce skin detritus being shed into the theatre environment. Therefore the suite can only be entered via the changing room, thus all members of staff must change into freshly laundered scrubs and theatre shoes before entering the theatre.

According to Al-Benna (2012), squame cells from staff hair and skin generate most of the particles found in the theatre suite and this has been implicated in surgical-site infections.Therefore, surgical hats and masks should be put on before leaving the changing room. Surgical masks are also worn to prevent saliva droplets from contaminating the surgical field (Rutland, 2011).

Scrub room

The scrub room allows the removal of gross contamination from the surgeon's and scrubbed assistant's hands and forearms and will contain knee-operated sinks and elbow-operated dispensers of surgical hand preparation solutions, nowadays these can also be motion-operated. McMillian (2014) found that up to 35% of surgical gloves are punctured after two hours use and only 20% of these are noticed by the surgeons. Hands should be prepared using alcohol gel as the use of hand brushes may damage the skin barrier, encouraging shedding of cells (McMillan, 2014). Grevemeyer (2005) observed that this can lead to an increase in the numbers of Gram-negative bacteria and *Candida*, increasing the likelihood of surgical-site infections if a glove were to be punctured during surgery.

Operating suite

The operating suite should be situated at the end of the building, to prevent

non-theatre-related personnel entering the environment. Rutland (2011) advocated a blind-ended room to minimise the flow of personnel, thus reducing contamination in the suite. Preparation of the patient will take place in a Prep Room which will service one or more theatres.

A drain may be incorporated into the corner of each theatre to facilitate cleaning and disinfection of the room and prevent pooling of fluid on the floor, which could be a slip hazard for staff, although for this reason the floor should slope gently away from the location of the operating table. It should be noted however that Grevemeyer (2005) argued that a drain will act as a haven for bacteria associated with nosocomial infections.

The patient is placed on a table (**Figure 2**), and positioned in dorsal, right lateral or left lateral recumbency without creating unnecessary pressure or tension on any muscle group or nerve. Removable padding and limb supports are used to support limbs in as close to neutral position as possible to reduce the risk of post-operative myopathies and neuropathies (McHugh, 2012). The height of the table can be adjusted to prevent strain injuries to the surgical team during surgery. (**Figure 3**).

A dry-wipe board is used to record the swabs and instruments being used and these are counted in and out of the patient to minimise the risk of items being retained in the abdomen or wound following surgery (Kerrigan, 2013). A used-swabs bucket also enables the circulating nurse to monitor the number of used swabs and to simplify the final swab count prior to closure.

To ensure both surgeon and patient comfort, the theatre suite should have a temperature-control system to ensure that it is kept at 18–25ºC and the humidity levels kept between 40–60%. A positive pressure ventilation fan reduces infection risk by removing 80–95% of airborne particles (Holgate, 2013). Al-Benna (2012) is of the opinion that good ventilation is the most important environmental factor in preventing surgical-site infections. Air is pushed from the cleanest area, to other parts of the suite due to the decrease in positive pressure, allowing the areas of the theatre suite to be differentiated into zones. This practice is advocated in human theatres and Rutland (2011) recommends a minimum of 25 air changes per hour in the operating suite to reduce contamination and the likelihood of surgical-site infections.

Figure 2. An anaesthetised patient on the operating table

Figure 3. The operating table is adjustable to reduce strain on the surgical team

A piped oxygen system has many advantages, including removal of the need to handle heavy pressurised oxygen cylinders, thus improving staff safety. However Barrand (2011), cited some disadvantages in using piped oxygen, including the risks associated with power cuts leading to non-function of the supply. Therefore a backup generator should be in place to run the anaesthetic system as well as the operating lights, hoist and monitoring equipment, in the event of a power cut.

To improve personnel safety and cleaning, the flooring throughout the whole theatre suite should be slip resistant, under both dry and wet conditions. It should be easy to clean and able to withstand the effects of powerful cleaning and disinfectant solutions. Paint with antimicrobial additives can also be used where appropriate, although Al-Benna (2012) argued that there has been no evidence that this type of paint has any role in infection control. The walls incorporated into the design can also be crack resistant and water-impermeable to prevent the harbouring of microorganisms.

Decontamination room

Waste receptacles are provided in this room including sharps bins, and receptacles for clinical and domestic waste. To protect the safety of personnel, waste contaminated with bodily fluids, such as blood is disposed of into clinical waste for incineration, and all sharps should be disposed of in the sharps bin to comply with BS EN ISO 23907:2012 regulations.

Instruments and equipment are cleaned in this room. Gross visible debris, protein and fat are removed and all ratchets should be opened prior to submerging into an enzymatic cleaner. The instruments should then be rinsed with demineralised water, as tap water contains various electrolytes, which could lead to corrosion of the instruments during sterilisation, (Grevemeyer, 2005). Following rinsing, the instruments should be dried using a clean towel and are then moved into the sterilisation room for packaging and sterilisation.

Sterilisation room

The sterilisation room should contain a worktop and storage for sterilisation equipment and consumables. As well as a large autoclave there should ideally be facilities for cold chemical sterilisation such as ethylene oxide which is mainly used to sterilise heat- and moisture-sensitive instruments and equipment that cannot support conventional high temperature methods of sterilisation. There are various health and safety issues associated with the use of ethylene oxide. Symptoms of inhalation include nausea, vomiting and neurological disorders (McGrotty & Dickson, 2014) and it must therefore be used within a lockable, sealed unit to prevent these risks to personnel.

Storage room

This must be a clean environment as storage of sterile supplies in a contaminated area reduces storage time, requiring supplies to be resterilised more frequently (Grevemeyer, 2005). Sterile supplies are stored in closed cupboards and monthly checks should be carried out to check sterility expiry date, and to check that there is no damage to the packaging, which would indicate a break in sterility potentially affecting intraoperative patient safety. The record of date checks should be kept in the nurse's office.

The addition of a dedicated storage room to the surgical suite area limits the movement of airborne contaminates as the equipment does not come into contact with the environment outside the theatre suite. It also reduces potential injuries to personnel as it minimises the risk of cluttered areas in other parts of the operating suite.

The room should be organised into sections according to the type of instrument, which are stored in alphabetical order to ensure that they can be easily found thus reducing time spent searching for them whilst the patient is on the operating table, which in turn improves perioperative care (Dungworth, 2013).

Nurse's office

Positioning a nurse's office next to the recovery boxes enables rapid entry in the event that complications arise. This is also the ideal situation for placement of a crash kit.

The nurse's office is so called because one of its functions is the storage of a wide range of paper work that supports the efficient running of the theatre suite, including:

- sterilisation records
- surgery lists
- clinical audit records
- standard operating procedures
- safety check lists

Clinical audits

Clinical audits are important to encourage improvement in standards as they help to reduce the risk of problems, which helps to ensure the autonomy of the veterinary profession (Dunn, 2012). Clinical audits will include surgical-site infections, post-anaesthetic complications and theatre hygiene, and should be cyclical as follows:

- A problem is identified
- Staff then implement a change based on evidenced-based research to prevent the risk of further problems arising
- Following the modification, the audit should be repeated 6–12 months later to assess the effectiveness of the change

Standard operating procedures (SOPs)

The staff can refer to the SOPs that are stored in the nurse's office regarding the hygiene standards required in theatre. These procedures should have been drawn up using evidence-based research, which is then agreed and applied in the clinical environment. These SOPs would include surgical-site preparation, hand hygiene, cleaning and disinfection of the theatre environment.

Conclusion

The surgical suite should be designed to ensure patient safety and effective peri and intra operative patient care, by minimising exogenous microorganism contamination in the surgical environment and reducing the likelihood of nosocomial infections. The use of standard operating procedures and clinical audits will ensure that patient care should not be compromised, and continual improvements and structured monitoring of standards should ensure gold standard care. Personnel safety should be considered when designing the surgical suite to ensure that the staff are at minimal risk and are able to work in a comfortable environment.

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