The equine nurse's approach to arthroscopic surgery: part 2 – care and maintenance of arthroscopy equipment

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ABSTRACT: The equine veterinary nurse plays a crucial role in the care and set-up of equipment for arthroscopic procedures. In this Part 2 of a 3-part series, we will provide a practical resource for equine nurses, covering aspects such as cleaning and disinfection of instrumentation, equipment care, and set-up for arthroscopic surgery in the horse.

Keywords: Equine; horse; arthroscopy; surgery; veterinary nursing

Introduction

The incidence of septic arthritis has been shown to be relatively low (<1%) following elective arthroscopy, regardless of whether prophylactic antimicrobials are used or not (Borg & Carmalt, 2013). This low rate of surgical site infection can be attributed in part to thorough processing of instruments and careful aseptic handling techniques. Nurses play a critical role in the maintenance and implementation of asepsis protocols in theatre, and the quality control of instrument processing. In human hospitals, lack of compliance by staff with respect to instrument processing procedures can lead to increased incidence of surgical site infections (Obasi et al., 2009). For this reason, it is advisable to implement automated cleaning processes, which allows for maintenance of consistency in decontamination.

Care of arthroscopy equipment

In human hospitals, it has been shown that clinically significant micro-organisms can persist on non-critical medical equipment for several months (Weinstein & Hota, 2004). In one study, 80% of non-critical hospital equipment e.g IV poles, cables, keyboards etc. were contaminated, and 25% of this equipment carried clinically significant pathogens (Obasi et al., 2009). Another report found that 25% of IV poles were contaminated with Methicillin Resistant *Staphylococcus Aureus* (Boyce, 2007). Therefore, it is important to pay careful attention to the hygiene maintenance of our portable non-critical medical devices. After physical cleaning with a damp soaped cloth, the arthroscopy tower and equipment, such

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as the camera unit, keyboard, monitor, light source unit etc. should be wiped with non-corrosive, hospital grade disinfectant wipes, not neglecting commonly-overlooked areas, such as electrical cables and keyboards. A wide and evolving range of disinfectant brands are available on the market. Ensure that the chosen disinfectant has proven efficacy as a broad spectrum virucidal, fungicidal, sporicidal and bacteriacidal, with proven efficacy against common pathogens such as *S. aureus, S. enterica*, *Enterococcus* spp., *E.coli, Klebsiella* spp., and *P.aeruginosa* (Rutala & Weber, 2014). Arthroscopy tower covers can be custom-made or purchased to cover the trolley when it is not in use. This protects the trolley, as well as the equipment, and prevents them from gathering dust.

Service maintenance of all the electronic devices should be performed annually by a qualified engineer, to ensure they are in appropriate working order. It is most efficient if the servicing of all devices can be performed on the same day to minimise disruption to work-flow. Light source units, in particular, will require replacement light bulbs, depending on the type of bulb i.e. Xenon (350- 500 working hours) or LED (up to 17,000 working hours) (McIlwraith et al., 2015).

Cleaning and sterilisation of arthroscopy instrumentation

The mode of cleaning and sterilisation of equipment often depends on the hospital case-load, surgeon preference, the number of surgeries to be performed, the sterilisation facilities available and at what speed the instrumentation turnover is required. Ling et al. (2018). stated that "sterilisation is a process not an event". It is important to keep this in mind as we approach the processing of our arthroscopy equipment, whichever method of sterilisation is chosen, in order to ensure consistent quality control. As with any surgical instrument processing, a number of steps must be followed. First, a prewashing step is required to remove visible soiling, and can be accomplished manually, or through enzymatic or mechanical means (Verwilghen, 2019) (Figure 1c). Following prewashing, instruments must be cleaned in a pH neutral detergent (Figure 1b). Finally, sterilisation is performed. Although instrument cleaning can be performed equally well either manually or by automated cleaning machines, effective cleaning and disinfection has been shown to be more consistent and reproducible when using the automated machines (Alfa, 2013). It has been shown that reprocessing compliance rates of only 1.4% are achieved with manual cleaning, compared to 74.5% with automated machines (Ofstead et al., 2010).

Modes of sterilisation for arthroscopy equipment include autoclaving at 134 °C, and ethylene oxide gas sterilisation or high-level disinfectant/cold sterilisation for heat sensitive equipment. The use of Sterrad® machines for heat sensitive items are slowly making their way to large veterinary hospitals due to their versatility and as ethlylene oxide is being phased out due to growing health risks and increased licensing requirements (McIlwraith et al., 2015). The Sterrad® system involves the use of hydrogen peroxide gas plasma for the purpose of sterilisation, and provides several advantages, including negligible health hazards, as well as short turnaround times (Verwilghen, 2019). High-level instrument disinfectant, such as Cidex®, can be used to cold sterilise the instruments, requiring only 10 minutes' contact time, in a plastic basin (Figure 1a and d) (McIlwraith et al., 2015). The use of a plastic basin reduces electrolytic corrosion, which occurs when using a metal basin (Figure 1d). Cold sterilisation in this manner is often the preferred choice of sterilisation for surgeons with several arthroscopies scheduled on the same day (McIlwraith et al., 2015). Equipment should be rinsed thoroughly before use, with copious amounts of

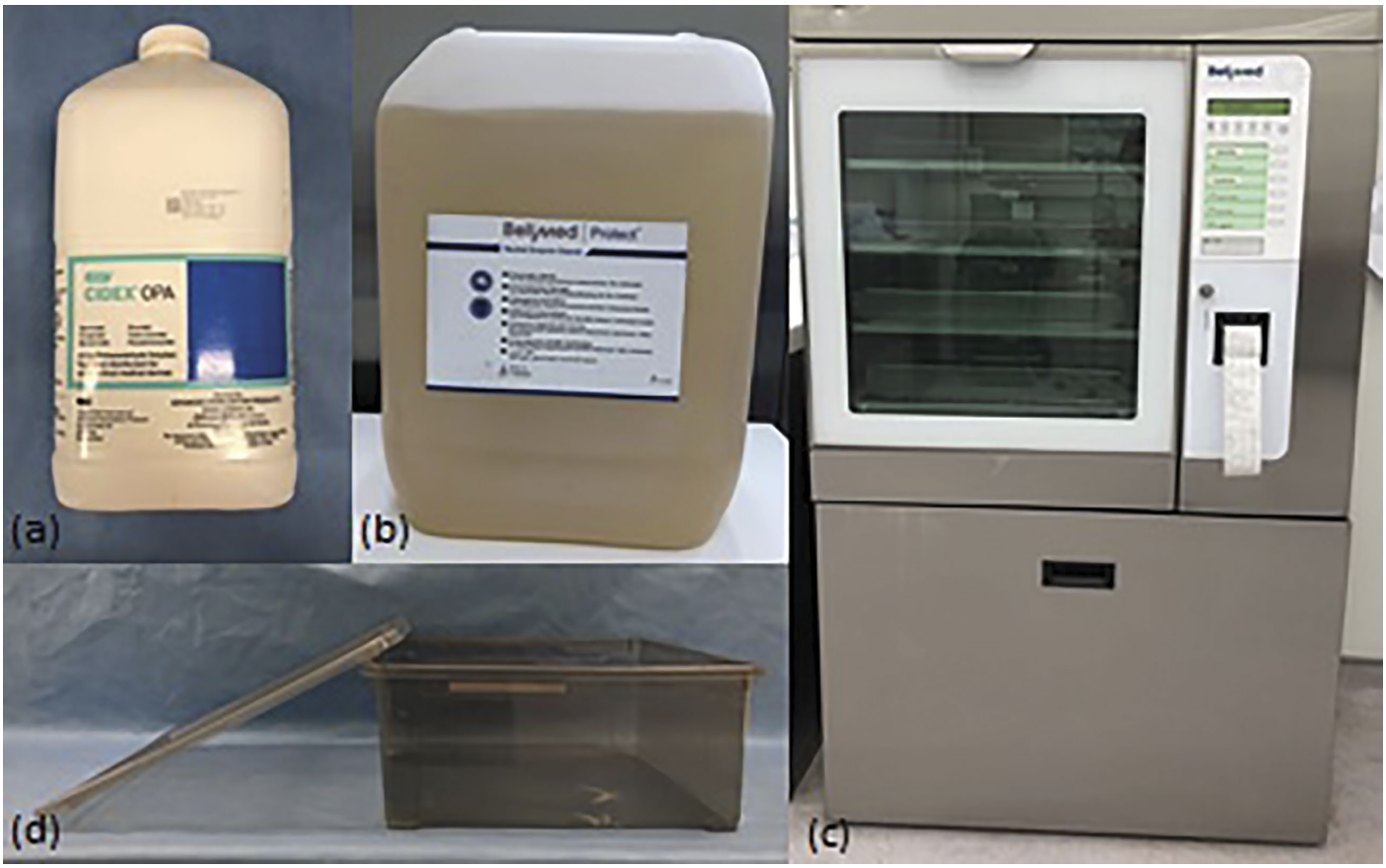

Figure 1. The figure showing Cidex OPA for high-level disinfection (a) in plastic basin (d); and enzymatic cleaner (b) for automatic washer-disinfector machine (c).

Figure 2. The figure showing instrument oil (left) and oil spray (right).

sterile water after submersion, in an aseptic manner. In contrast to cold sterilisation, the complete 134°C autoclave cycle will take a minimum of 40 minutes, a Sterrad® cycle is approximately 30 minutes, and the ethylene oxide cycle will take 12-24 hours (Verwilghen, 2019). Autoclaves should be periodically checked for efficacy, such as performing routine leak and Bowie-Dick tests to ensure proper functioning (Verwilghen, 2019). Whichever method of sterilisation is chosen, water quality must not be overlooked (Seavey, 2013). Water purifying or deionising systems should be in place to purify the water before use. Water quality can also greatly impact the lifespan of automated reprocessing machines (Seavey, 2013). Generally, all other arthroscopy equipment can be autoclaved at 134°C, but nurses should always consult the manufacturer's guidelines, as recommendations will vary between different brands.

Hinged items and cannulae with stopcocks should be thoroughly manually cleaned before automated washing/disinfection. Ultrasonic cleaning is important for instruments with difficult-to-access lumens. A variety of bottle brushes and/or high pressure air guns can help to clear out and dry small lumens. Once dry post-cleaning, the stopcocks and hinges should be oiled with surgical instrument oil before sterilisation, to ensure that the moveable parts do not get stiff or seize up (Figure 2). All instruments should be checked thoroughly before sterilisation for any signs of damage, staining or stiffness. To ensure steam penetration, cannula valves should be left open for sterilisation (Verwilghen, 2019). The arthroscope, in particular, should be examined by looking through the lens for signs of damage, such as scratches or cracks on the lens.

Video camera

The camera, depending on the brand, is generally heat sensitive. It is common practice to sterilise the camera using ethylene oxide overnight, then between procedures the equipment can be cold-sterilised (McIlwraith et al., 2015). Alternatively, the camera can also be kept unsterile, and a sterile disposable plastic camera drape can be used for the procedure (refer to Part 1). It is important that the camera sleeve is of good quality and a strong dry seal is achieved between the sleeve and camera, to avoid fogging or breaks in sterility. It has been suggested that anti-fog solutions are rarely of benefit in equine arthroscopy surgery to reduce fogging (Martens et al., 2019). Instead, it can be useful if the surgeon passes a sterile swab into the sterile sleeve prior to connecting the arthroscope to the camera, to allow the surgeon to wipe the lens within the sleeve, without breaking sterility, should fogging occur.

Synovial resector

Motorised equipment, such as the synovial resector, requires particular attention during processing given their multiple components which can prove challenging to clean (refer to Part 1). Outbreaks of *Pseudomonas aeruginosa* in human settings have been linked to improper processing of an arthroscopic synovial resector (Tosh et al., 2011). It was found that, despite repeated sterilisation of the instrument, residual tissue within the lumen of the device protected the *P. aeruginosa*, found in the tap water, from sterilisation (Alfa, 2013; Tosh et al., 2011). Manual cleaning, automated cleaning, as well as the use of an ultrasonic cleaner, are all useful to ensure effective processing of these instruments. Re-usable resector tips can be autoclaved. Despite manufacture guidelines, single-use resector tips are routinely re-used in equine practice, in order to make their use economically viable. Therefore, they should also be thoroughly cleaned in a similar

manner, but should be gas sterilised for re-use rather than autoclaved (McIlwraith et al., 2015).

Arthroscope

The arthroscope is a very delicate piece of equipment and should be handled gently, and with great care. Ensure that the arthroscope is stored in a protective cage or box, with a protective sheath on the shaft. Ensure that the sheath is in place at all times when the arthroscope is not in use. Nurses should be aware that prolonged exposure, for 30 minutes or more, in the disinfectant can cause damage to the arthroscope lens (McIlwraith et al., 2015). Repeated autoclaving of arthroscopes can reduce the longevity of the instrument, and so gas sterilisation or high level instrument disinfection, such as Cidex OPA®, may be preferred (McIlwraith et al., 2015).

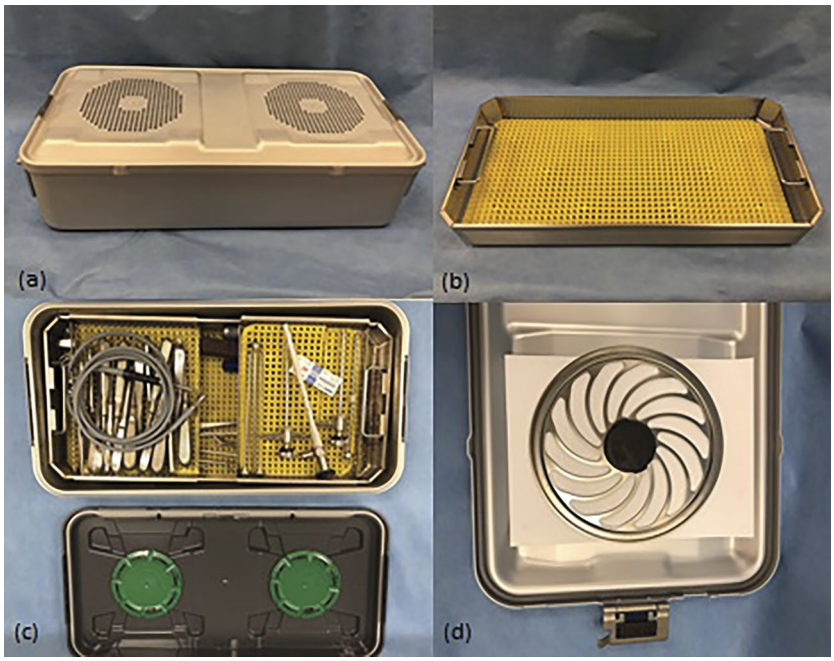

Figure 3. The figure showing complete arthroscopy instrument aluminium box (a), instrument tray insert with silicone liner (b), box containing instruments with lid removed (c), lid with filter inserted (d).

Figure 4. The figure showing indicator strips (a), changing from blue to pink; and autoclave tape (b), changing from yellow to brown to indicate that adequate temperature, time and pressure have been achieved.

Packing instruments for sterilisation

Various materials are available for packaging the arthroscopy pack, such as muslin, crepe paper, and heat-sealed paper/plastic pouches (Verwilghen, 2019). As mentioned previously, it is advisable to sterilise the arthroscope in its own protective cage, to avoid damage. Fabric drapes are considered the least desirable material to use for wrapping instruments, due to the risk of strike through and the poor shelf life of 30 days (Verwilghen, 2019). Commercially available stackable aluminium composite material containers are convenient and easy to store (Verwilghen, 2019) (Figure 3). These containers allow for good air and steam circulation and allow for adequate drying of the instruments (Verwilghen, 2019). Individual items can be double-packed in sterilisation pouches. Effective packaging should allow for air removal, steam penetration, provide a barrier to microorganisms, should be non linting, cost effective and tear/puncture resistant (Ling et al., 2018).

Both cleaning and sterilisation indicator strips are commercially available (Figure 4). It is important to monitor cleaning and sterilisation procedures routinely, through use of mechanical, biological and chemical indicators, to ensure efficacy of procedures (Verwilghen, 2019). Mechanical indicators are shown at the end of a cycle to confirm the correct temperature, pressure and time was achieved, whereas chemical indicators undergo a colour change once parameters are achieved e.g autoclave tape and indicator strips (Verwilghen, 2019) (Figure 4). Biological indicators are less frequently used in veterinary practice, however these kits are commercially available. It is advised that chemical indicator strips are placed in the centre of the pack or on each level of a tiered box, to ensure the steam reaches all levels of the pack (Ling et al., 2018). It is not advisable to pack instruments in pouches that are contained within a larger pack, as the steam may not penetrate these packets fully (Verwilghen, 2019).

Setting up the equipment prior to arthroscopy

Prior to surgery, the nurse should prepare the necessary equipment and instrumentation

that will be required for the intended arthroscopic procedure (Table 1).

Arthroscopy tower positioning is an important consideration to ensure ergonomic working conditions for both the surgeon and nurse, therefore it is advised to consult with the surgeon regarding their intended surgical approach in order to position the equipment appropriately (Gasiorowski & Richardson, 2014). This saves time and allows for ease of surgeon performance. It is advisable to save time by entering the patient's details on the image storage device, prior to induction. Switching on all devices, and preparing them for attachment of cables, prior to induction, allows for any trouble-shooting to be performed in advance of the patient being anaesthetised, where necessary.

Care should be taken to maintain strict asepsis during the tower set up, as the sterile surgeon will hand the cable ends to the nurse in order to plug into the machine, and to set up the fluid delivery system. The spikes of the fluid delivery set are a potential source of contamination, so care must be taken not to break asepsis when changing fluid bags. It is crucial that the circulating nurse is diligent in replacing fluids before the bags empty, as this can cause a loss in joint pressure and air bubble creation that can interrupt and delay the surgery, if fluids run out.

Particular diligence is required when using a suction device attached to a synovial resector, to ensure that the suction canister does not overfill, as this can result in a non-sterile backflow of material into the suction tube, and result in surgical site contamination (Bacarese-Hamilton et al., 1991; McIlwraith et al., 2015). It is also important to pay particular attention to the ingress fluid supply during this process, as loss of ingress fluids can cause a loss of pressure in the joint, resulting in back-flow into the joint (Bacarese-Hamilton et al., 1991). Ingress fluid rate must be adjusted upward according to the degree of suction applied to the synovial resector.

Monopolar electrosurgery can be used for cartilage and synovial soft tissue dissection, and vessel coagulation (McIlwraith et al., 2015). Glycine 1.5% is commonly used as a fluid medium during arthroscopic electrosurgery, to reduce electrical dispersion within the joint (Martens et al., 2019). Glycine 1.5% can be interchanged with Lactated Ringers as required, during the use of the electrode.

Table 1. Example of checklist of items required for most arthroscopy surgeries (specific requirements will vary based on the surgery site and surgeon preference).

✓ Surgeon's impervious gown
✓ Surgeon's gloves in variety of sizes
✓ Table drape
✓ Reusable drapes
✓ Impervious drape
✓ Non-sterile and sterile vetwrap
✓ Sterile impervious stockinette
✓ Sterile antimicrobial adhesive drape (Ioban® or similar)
✓ Arthroscopy kit.
✓ Arthroscopic synovial resector handpiece & blades.
✓ Arthroscope
✓ Arthroscopy tower (including arthroscopy camera)
✓ Electrical extension cord
✓ Fluid irrigation tubing
✓ 5 L Lactated Ringers (& Glycine, if required)
✓ Suction machine and tubing
✓ Sterile camera cover
✓ Syringes 10 ml, 20 ml, 60 ml
✓ Needles 20 g 1.5" × 6
✓ Spinal needles 20 g or 18 g × 3" ✓ Intra-articular medication (e.g. morphine, bupivacaine).
✓ Suture material (USP 0/2-0 monofilament, round-body needle) ✓ Bandage material

Other points to remember

It is important to protect electrical equipment from contact with fluids during arthroscopic procedures. Arthroscopic procedures can result in flow of fluids from the joint portals and cannulae, therefore equipment and electrical plugs must be protected from wetting. Depending on surgeon's preference, theatre lights may be requested to be turned off, or dimmed, once the camera is placed in the joint, in order to minimise light reflection of the monitor screen.

Conclusion

As surgical procedures and equipment evolve in equine arthroscopy, the challenge to provide consistently clean and sterile instruments in a time-pressured environment is ever increasing. Nurses play a key role in the quality control of the sterilisation processes and asepsis protocols before, during and after arthroscopy surgery in the horse.

Disclosure statement

No conflict of interests to declare.

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