



Laboratory Animal
Science Association

Guiding Principles for Preparing for and Undertaking Aseptic Surgery

2nd Edition – April 2017

Note:

This new Guidance supersedes previous guidance prepared by LASA in 2010.

This version has been updated to take into account Amendments to the Animals (Scientific Procedures) Act 1986 (ASPA) to transpose European Directive 2010/63/EU, which came into force on 1 January 2013, and the publication of new Home Office Guidance in March 2014.

Acknowledgements:

The LASA Education, Training and Ethics Section would like to thank the many colleagues from LASA, LAVA, the NC3Rs, RSPCA and the Home Office for their assistance in the production of this document.

Members of the LASA Education, Training and Ethics Section:

Manuel Berdoy (joint convenor), University of Oxford
Elliot Lilley (joint convenor), Research Animals Department, RSPCA
Anne-Marie Farmer, University of Cambridge
Angela Kerton, The Learning Curve (Development) Ltd
Beverley Law, University of Leeds
Lynda Noddings (observer), Home Office
Patrick Sinnott-Smith, Pfizer
Clare Stanford, University College, London
Lucy Whitfield, Royal Veterinary College

How to cite this document:

LASA 2017 Guiding Principles for Preparing for and Undertaking Aseptic Surgery. A report by the LASA Education, Training and Ethics section. (E Lilley and M. Berdoy eds.).

<http://www.lasa.co.uk/publications/>

Updates:

Guidelines may be updated to reflect changes in practice. Please check on the website that you have the latest version.

Original publication: January 2010
2nd Edition April 2017 (this publication)

SUMMARY

This document is designed as a guide to aseptic technique for both new and experienced personal licence holders who intend to undertake surgical procedures under the Animals (Scientific Procedures) Act, 1986: it does not deal with housing, husbandry, anaesthesia and analgesia in detail. Aseptic technique is essential when undertaking recovery surgery on any species and many of the principles laid out in this document apply to both recovery surgery and non-recovery procedures carried out under terminal anaesthesia. See Box 1 for discussion of non-recovery procedures.

The principal aims of any surgical procedure are that it is carried out skilfully with the minimum of risk and disturbance to the animal and without infection, while producing quality scientific output. These guiding principles set high, aspirational standards, above the minimal standards required by the Home Office. LASA encourages institutions to use the principles set out in this document to develop standard operating procedures (SOPs) which are appropriate for the species, the staff undertaking surgical procedures and the facility where the work is carried out. Development and periodic review of surgical SOPs and the application of high standards of aseptic technique will go a long way to eliminating infection as a source of potential research variability.

For more information and training materials in aseptic technique, see the NC3Rs “Procedures with Care” website, available at: <http://www.procedureswithcare.org.uk/aseptic-technique-in-rodent-surgery/>

Preparation prior to Surgery

- Ensure that all legal requirements are met; establishment, personal and project licence authorities.
- Ensure that all staff involved are trained and competent (or appropriately supervised) in the procedure, anaesthesia and post-operative care (**Note:** records of training, supervision and competence must be kept).
- Prepare a detailed study/surgery plan in consultation with the Named Animal Care and Welfare Officer (NACWO), Named Veterinary Surgeon (NVS) and Named Training and Competence Officer (NTCO) as needed. This will include peri- and post-operative care, husbandry and welfare assessment.
- Book the theatre and facilities.
- Ensure that appropriate sterile equipment, instruments and consumables (e.g. gloves, swabs, and drapes) are available in sufficient amounts. Check that there are sufficient medicines available and that they are in date.
- Liaise with support staff (including a trained assistant: see below) to make sure that they will be available and are aware of what you plan to do.
- Consult with the NVS and / or NACWO to check that the animal is in a fit state for the proposed surgery and has had the appropriate acclimatisation period to recover from any transport stress.
- Weigh the animal and record its bodyweight.
- Administer analgesics prior to surgery as well as post-operatively; administer antibiotics and fluids as required.
- As a minimum, one or more suitably equipped areas should be provided for aseptic surgery and facilities provided for postoperative recovery, as set out in the [Home Office Code of Practice for Housing and Care of Animals Bred, Supplied or used for Scientific Purposes, Section 1](#).

Surgery

- Perform the final topical skin preparation in the operating theatre area.
- Prepare for aseptic surgery by scrubbing up and changing into a sterile gown, gloves, hair cover and any other clothing or equipment needed. Once the surgeon has prepared for surgery, non-sterile objects must not be touched and, if they are, at least a new sterile pair of gloves should be used.
- Cover the animal with sterile drapes and place instruments on to a sterile instrument tray before commencing surgery.
- Ensure that the animal is sufficiently anaesthetised before performing surgery, using a method appropriate for the species. Ensure that the animal is continually monitored throughout by a competent person.
- It is good practice to have a 'non-scrubbed' surgical assistant and/or separate anaesthetist present, particularly for longer or more complicated surgeries, or those involving the use of neuromuscular blocking agents. Non-scrubbed assistants must not touch sterile areas.

An anaesthetised animal should NEVER be left unattended

Recovery and Post-operative care

- Administer analgesics, antibiotics, fluids and supplementary heat (or cooling when there is evidence of hyperthermia) as required.
- Do not leave the recovering animal until it is conscious, able to remain upright and to protect its own airway without assistance.
- Wherever possible, regroup the animal with its conspecifics as soon as appropriate after surgery.
- Reassess the animal's well-being at intervals after surgery, including the need for analgesia, fluids, warmth or modified diet.
- Non-absorbable skin closures must be removed at the appropriate interval post-operatively.

Monitoring Outcomes of Surgery

- Record key events of the procedure, including outcome.
- Compare the success of the procedure and the surgeon with benchmarks (set by the NVS). Any surgeons who perform poorly should be re-trained or refrain from operating on animals.
- Review the literature and discuss the procedure with peers, in order to identify refinements that could be applied.

1 AIMS

This document is designed as a short guide to the principles of aseptic technique for both new and experienced personal licence holders who intend to undertake surgical procedures under the Animals (Scientific Procedures) Act, 1986.

Asepsis is the elimination (insofar as is possible) of all potential sources of contamination of the surgical field, the main sources of which are: the atmosphere, the surgical team, the instruments and equipment, and the animal itself.

Aseptic technique is the method by which asepsis is achieved and is a variable. Therefore, the rigour with which aseptic technique is applied will influence whether or not surgery is undertaken aseptically and will dictate the ultimate outcome. While good practice should always be the goal, the principles applied at the time of surgery may also be influenced by the circumstances under which surgery is undertaken and the species used.

Good practice in surgical technique is clearly essential but it is also very important to ensure that good practice is followed for anaesthesia, analgesia and the development of peri-operative care programmes. The husbandry needs of animals before, during and after such procedures also require careful consideration. However, it is **not** the purpose of this document to address all of these topics in detail; guidance for these should be sought from experts elsewhere (e.g. the NVS and NACWO for the unit).

Box 1: Non-recovery experiments

Full asepsis should be considered good practice for all surgical procedures. However, it may be unwarranted and/or impractical for some non-recovery procedures. For example, in cases where lack of, or poor, asepsis and the consequent risk of clinical or subclinical infection, will not impair the stability of the model or confound the data. Before deciding on the appropriate level of asepsis to be used in any non-recovery surgical procedure, licensees should carry out a risk assessment in consultation with the Named Veterinary Surgeon and/or other experts. Factors to consider include:

- The duration of the surgery
- The nature of the surgery (i.e. how invasive and which organ systems)
- Health status of the animal (e.g. immunodeficiency)
- The likelihood of a local or systemic infection developing over the anticipated timescale of the procedure and the consequent risk of jeopardising the validity of the experimental model and/or the reliability of the data.

Regardless of whether or not full aseptic technique is considered necessary, the same level of training, competence and diligence need to be applied to the surgery. It is also important to monitor relevant physiological biomarkers (e.g. blood pressure, body temperature etc.)

Where there is evidence that a non-recovery surgical model is likely to be compromised by the lack of aseptic technique, the precautionary principle should be applied and aseptic technique used.

2 INTRODUCTION

Aseptic technique is essential when undertaking recovery surgery on any species, including rodents and wild animals, for scientific and animal welfare reasons. Infection may lead to wound breakdown, pain and delayed recovery, which causes avoidable suffering and can compromise scientific data. There is extensive published evidence that subclinical infections can become clinical diseases following stress or immune suppression (1, 2). By way of example, rodents are used routinely to study surgical infection and they clearly develop localised infection, sepsis, and physiologic alterations that may, in extreme cases, progress to death (3, 4, 5). They are also used extensively in immunologic research and are not known to possess any atypical features of their immune systems that would prevent infection from developing. Furthermore, Bradfield and colleagues (6) reported that subclinical infection in rats has significant effects on behaviour, blood cell counts, plasma fibrinogen and serum glucose, even though pathological lesions were not visibly identified in tissues.

Planning and attention to detail should be an integral part of all surgical procedures where invasive surgical techniques are to be undertaken. **Every step in the process should be considered**, from the checking of licenced authorities, to the preparation of instruments, consumables, facilities, the surgeon and the animal, through to post-operative care.

3 PREPARATION FOR SURGERY

a Planning for Surgery

- Before beginning any procedure or series of procedures on a live animal,
 - ensure that the procedure(s) is/are fully authorised in the project licence under which you are working; and
 - that the purpose for which you are doing the work is authorised in the project licence; and
 - that you have the correct personal licence authority (both licence category and species); and
 - check that the room in which you propose to work appears on the establishment licence schedule of premises, is registered for surgical use (SEP) and the project licence authorises work at the establishment¹;
 - check that the procedure/approach is the most refined and up to date (e.g. by liaising with the NVS and NIO);
 - When required, arrange for training and supervision for the procedure(s) that you intend to perform (7) and ensure that up-to-date records of this training, supervision and competence are kept². 'Refresher' training may also be necessary where a procedure has not been performed for some time. For additional practical advice see the "[LASA Guiding Principles for Supervision and Assessment of Competence as required under EU and UK legislation](#)" (8).

¹ See personal licence standard condition 19.

² See personal licence standard conditions 17 and 20.

- A tailored study/surgery plan, detailing peri- and post-operative care, husbandry and welfare assessment, should be agreed with the NVS and NACWO before surgery commences. This may include:
 - **Housing and husbandry:**
 - acclimatisation periods for animals moved between facilities, or for testing, to allow recovery from any stress caused by transport;
 - whether any dietary restriction is required prior to surgery;
 - any requirements for special diets pre or post-surgery;
 - accustomise animals to any post-op diet that will be used;
 - housing requirements e.g. if and when animals can be regrouped after surgery;
 - whether any special monitoring is required and how this will be resourced;
 - requirement for husbandry refinements post-operatively, e.g. heat pads, mash, specific nesting/bedding materials, whether or not a refuge can be provided;
 - routine weighing, monitoring food and water intake³. Whenever measurements are taken, accurate records should be kept.
 - **Assessment of animal well-being and recognition of pain and distress** should be carefully planned and tailored to the species, strain and procedure. This could include the use of specific post-operative welfare score sheets and should be discussed with Named Persons and animal technologists or care staff.
 - **Analgesic requirements of the animal.** The use of anaesthesia and analgesia in painful procedures benefits the animal and is a legal requirement unless specifically excluded by the project licence⁴. Information and training videos are available at [AHWLA](#). If in doubt, ask the NVS for advice when planning your particular experiment and do not leave this until the day of surgery or during surgery. Wherever possible, analgesics should be administered in order to provide adequate pain relief for the whole of the operative period (pre-, peri- and post-operative). Pre-emptive analgesia has been shown to alleviate pain more effectively (9). Personal licensees should be aware of their legal responsibility to use anaesthesia and analgesia⁵.
 - **Antibiotics.** In most cases antibiotics should not be necessary if surgery is done aseptically and competently. The NVS is the best person to advise on the use of antibiotics. Any potential interference with scientific data should also be considered.

³ It is important to monitor food and water intake and the physical appearance of the animal because this provides essential baseline data for use in the health and welfare assessment. Deviations from normal values can be used to identify an animal that is unwell and requires attention/treatment. These observations may indicate that the procedure and/or aftercare require refinement and should be used when reviewing surgical outcomes and anaesthetic and/or analgesic regimes.

⁴ See project licence standard condition 17(a) & (b)

⁵ See personal licence standard conditions 9(a) & (b), 10, 11, 12

Guiding Principles for Preparing for and Undertaking Aseptic Surgery

- **Fluid replacement.** Any requirement for fluid replacement to prevent dehydration and aid recovery should be considered as part of surgery planning. Consult your NVS for advice.
- **Temperature control.** Consider the need for supplementary heat (or cooling when there is risk of hyperthermia). Methods to prevent adverse core body temperature changes during surgery should be adopted.
- Before starting surgery, ensure you know which records you need to keep. (For additional practical advice see the LASA “[Guiding Principles on Record Keeping for Personal Licence Holders](#)”;¹⁰) For example, check that appropriate animal record sheets are available for recording the procedure(s) undertaken. Ensure you know how to use any recording sheets (sometimes referred to as ‘score’ or ‘clinical observation’ sheets), which have been designed to record animal welfare during surgery and during the post-operative period. The NACWO is the best person to advise you on local procedures/requirements.
- Ensure that sufficient support staff will be available for both surgery and post-operative care. These may include animal care, veterinary staff, anaesthetist and scientists. **Note:** the primary legal responsibility for the health and welfare of the animal remains with the last personal licensee who undertook a regulated procedure on that animal. This licensee must make arrangements to ensure the welfare of the animal is safeguarded if they cannot, themselves, be available.
- If necessary, book the surgical facilities. **Note:** surgical procedures should be carried out early in the day and as early in the working week as possible, to facilitate and help ensure good post-operative monitoring and care. If surgery cannot be performed at these times, licensees are responsible for ensuring the health and welfare of the animals during the post-operative period, which might include provision for animal care overnight and at weekends.
- Before commencing the surgical procedure, check that the operating theatre area is clean and ready for use; make sure that all unnecessary equipment and clutter has been removed. After completing surgery make sure that the room/area in which you have been working is left clean and tidy.

b Preparation of Instruments and Consumables

- All surgical and/or consumable equipment should be ordered and checked to ensure availability, suitability and functionality well in advance of surgery. It may be necessary to acquire spares of some instruments in case of breakage or malfunction.
- Check that there are sufficient medicines and gas supplies for the whole procedure. Extra gas cylinders may be required for prolonged surgeries. Remember to check expiry dates: out of date medicines should not be used; fresh dilutions of medicines should be made each day.
- All instruments must be sterilised (packed and autoclaved) before use.
- Similarly, all consumables (e.g. swabs, needles, suture materials) to be used during the procedure must be sterile and should be of an appropriate size and packaged in suitable quantities.

- Aluminium foil can be packed into autoclave pouches and sterilised. This can be used to cover any items that can't be sterilised, such as hand-held drills, microscope knobs, etc.
- Check that the sterilisation process (e.g. autoclaving, irradiation or other suitable method) has been effective: for example, by checking the indicator/mark on packaged instruments and checking that the outer packaging has not been breached.
- It is good practice to use a new set of sterile instruments⁶ for each animal to avoid spreading infection between animals. Therefore, if multiple animals are undergoing surgery during any one session, ensure that you have a sufficient number of sterile instrument and consumable kits for use before you start. Disposable sterile instruments are readily available and may present an economical option where a number of instruments are required. Alternatively, instruments can be sterilised between animals; if this is the preferred procedure then do not start to prepare the next animal until the instruments required have been adequately sterilised.
- A 'bead steriliser' may be used during surgery to sterilise the tips of instruments. However, since they sterilise only the tips of instruments, their use is not considered good practice because the possibility remains that the surgeon's glove may be contaminated by the non-sterile parts of the instrument during handling.
- The use of alcohol/disinfectant dipping should be discouraged, because this is ineffective in delivering asepsis and are therefore not considered good practice.

c Dressing for Surgery

- All hair should be covered; a suitable cap should be used to cover the hair on the head (this should be applied first).
- The mask is applied before scrubbing, gowning and gloving. Bearded licensees should use masks which are large enough to cover their facial hair. A face mask is worn primarily to protect the licensee from allergy and, for some species, the animal from potential infection from the licensee. Immunocompromised animals may be particularly susceptible to infection via this route.
- The surgeon must remove all jewellery from hands and wrists and perform a thorough scrub of hands and nails. Fingernails should be cut short and cleaned before starting to 'scrub up' for surgery.
- Typically, a commercial chlorhexidine-containing skin disinfectant, such as Hibiscrub[®], is used. Users should wet their hands and forearms, apply 5ml of the disinfectant and wash for one minute, cleaning their fingernails with a brush or scraper. Rinse, apply a further 5ml and continue washing for a further 2 minutes.

⁶ Disposable sterile instruments are widely available, relatively inexpensive and may be a viable alternative

Rinse thoroughly and dry. For other products, follow the manufacturers' instructions for volumes and contact time. During the 'scrub up', hands should be held with the fingertips uppermost and the hands held higher than the elbows so that water runs away from the fingers down the arms thereby reducing the risk of re-contaminating the fingertips. Hands should be dried using a sterile paper towel starting with the hands and finishing with the elbows.

- Alternatively, instead of an aqueous scrub, an alcohol rub containing additional active ingredients (e.g. chlorhexidine) could be used, as a recent report (11) has demonstrated that this produces an equivalent level of antiseptics.
- A sterile, clean, long-sleeved operating gown should be worn during surgery. The gown should be put on by the 'scrubbed' surgeon and the gown ties passed carefully to an assistant to tie at the back.
- Sterile gloves should be worn. The outer packet of gloves must be opened either by the surgeon before scrubbing up or by an assistant. To prevent contamination, the internal sterile packing containing the gloves should be touched only by the 'scrubbed' surgeon and the gloves unpacked without touching their outer surface, preferably using a 'closed' gloving technique⁷.
- Once the surgeon is wearing sterile clothing and gloves, care must be taken, throughout the procedure, to avoid touching non-sterile items such as the table, animal, anaesthetic equipment or operating lights. Ideally an assistant should be available, throughout surgery, to move the animal, adjust the table and any non-sterile equipment and to assist with monitoring the depth of anaesthesia and making adjustments, as required. For these reasons the presence of an assistant is strongly recommended but if an assistant is not available, or if the surgeon needs to make fine adjustments to equipment, such as the vaporiser or operating microscope, the adjustable knobs should be covered with suitable sterile material, such as foil or plastic covering, before surgery starts. If working alone cannot be avoided, the surgeon must take particular care not to touch non-sterile materials. If this cannot be avoided or happens accidentally, the surgeon must at least change their contaminated gloves for a new sterile pair.
- Where it is suspected that instruments may have been accidentally contaminated, these must be replaced with sterile ones before continuing or, if the surgeon believes only the tips of the instrument have been contaminated, a 'bead sterilizer' may be used.
- 'Non-scrubbed' surgical assistants must not touch sterile instruments, drapes or consumables.

d Preparing the Animal for Surgery

- The general health and clinical condition of the animal(s) should be checked at least 24 hours before surgery to ensure that each animal is in a fit state for the proposed surgery (e.g. food and water intake, urine and faecal output and appearance of the animal. In the case of larger animals, this may include body temperature and auscultation of the heart and lungs).

⁷ <https://www.youtube.com/watch?v=exJylcD4SjA>

- Weigh animal(s) immediately prior to surgery. In growing animals, you should establish rate of growth. This can be achieved by taking at least 2 or 3 weighings in the days prior to surgery, so as to provide a baseline for more accurate assessment of the animal's welfare status post-surgically.
- Where possible and when appropriate, the animal should be anaesthetised in a room which is separate from holding rooms which house conscious animals. However, there may be some species, such as pigs and sheep, which benefit from the administration of the pre-operative sedative in their home pen because they become anxious when moved to unfamiliar surroundings. Minimising stress will have a positive impact on anaesthesia e.g. by making the induction safer for both the animal and staff involved (12). Advice should be sought from the NVS if you are unsure what is best for the welfare of the animal which you are anaesthetising.
- Following the induction of anaesthesia, sufficient hair must be removed (using depilatory cream⁸ or clippers) from the incision area to expose the surgical site. Allow adequate skin preparation to prevent hair ingress into the incision during surgery and afterwards during wound healing. The size of the hair removal margin around the incision site will depend on the size of the animal and hair length but, to reduce the risk of hypothermia, this should be the minimum compatible with achieving the objectives outlined above.
 - Hair removal should be done with care because inappropriate preparation of the incision area can make the skin more susceptible to infection through disturbance to the delicate skin microfloral ecosystem, grazes and other skin surface damage. For this reason shaving the surgical area is not considered good practice because of the potential for damage to the skin (13, 14).
 - As recommended in the Home Office Code of Practice for the Housing and Care of Animals bred, Supplied or Used for Scientific Purposes Section 3, hair removal should be done outside the operating theatre, or in an area from which airborne particulates cannot escape. This will help to prevent contamination of the surgical area/facility with hair, dander and associated microbes. If a separate area is not available, an alternative is the use of a small portable vacuum cleaner to capture the dander as the animal is clipped, although this is not considered good practice.
- Preliminary skin preparation should also be done in an ante-room or an area such as a containment cabinet and not in the surgical theatre/area.
- The skin must be cleaned and then prepared with a suitable topical solution (e.g. dilute chlorhexidine or povidone-iodine). These solutions should be used sparingly and not allowed to soak the animal. Where possible, solutions should be warmed to body temperature; this increases their effectiveness and reduces the risk of causing hypothermia. The use of warm solutions is especially important in small animals, such as rodents, or sparsely haired animals, such as pigs. Where surgery is to be performed on non-mammalian species, it is essential to discuss peri-operative preparation of the animal with the NVS or other suitably qualified person.

⁸ Use of depilatory cream must be planned carefully to ensure that contact time is minimal and that excess cream is removed.

- If neuromuscular blocking agents (NMBs) are required, check the project and personal licence authorities and additional standard conditions applied to licences authorising the use of NMBs. Seek advice and assistance from the NVS until competent in the use of NMBs and how to monitor and maintain animals where NMBs are used. When NMBs are used, an assistant, preferably a trained anaesthetist, should be present at all times.

4 SURGERY

- a Final skin cleansing and preparation should be completed in the surgical theatre, just prior to draping. Avoid the excessive application of alcohol, especially to small rodents, because chilling will occur as the alcohol evaporates.
- b Sterile drapes of a sufficient size must be used to cover unprepared parts of the animal and adjacent surfaces. Proper draping will provide sufficient space for the surgeon to use instruments and suture materials without accidentally contacting non-sterile items or surfaces. The use of transparent disposable drapes over the animal can aid anaesthetic monitoring.
- c Instruments should be placed either on a sterile surface (e.g. plastic sterile drape) or on a sterile tray.
- d During surgery it is preferable and highly beneficial for the surgeon to have an assistant on hand to pass him/her extra materials, to adjust equipment (e.g. operating microscope) and to help with the surgery (e.g. retraction of skin edges and organs). A 'scrubbed' surgical assistant must be surgically attired (e.g. sterile gown and gloves) if assisting with the surgery itself. If it is not possible to have a 'non-scrubbed' assistant present, sufficient consumables must be laid out on a sterile drape/tray prior to the surgeon commencing the procedure. A means of handling non-sterile items (eg vaporiser, drill, stereotaxic frame) must be provided, such as sterilised aluminium foil.
- e Ensure that the animal is adequately anaesthetised before making any incision. A withdrawal response to toe web pinch (suitable to assess in most species), or brisk eyelid reflex (not appropriate for rodents), means that the animal is able to perceive pain and is not sufficiently anaesthetised for surgery. Alternatively, for small rodents, the tail-pinch reflex can be used (an increase in respiration rate following a sharp pinch of the tail-base indicates that the animal can still feel pain). If the surgeon is making this assessment, they must avoid contaminating gloves or instruments (e.g. carry out pinch through a sterile drape). Alternatively, the 'non-scrubbed' assistant may perform this test.
- f Maintenance of body temperature during surgery is essential for all species. A warmed gel pad or thermostatically controlled electric pad) should be used during surgery to prevent heat loss, particularly for small and/or sparsely haired animals. In other species, cooling may be required. Body temperature should therefore be monitored throughout the surgical procedure and normal core body temperature maintained by the external application of an appropriate heat or cooling source and application of insulating materials (e.g. bubble wrap), as appropriate. In aquatic species it may be necessary to keep the skin moist.
- g Physiological parameters should be monitored, recorded and acted upon, as necessary, throughout the surgical procedure; including breathing, circulation (e.g.

heart rate and blood pressure), body temperature and response to surgical stimulation. Physical checks may be supplemented by monitoring instruments such as electrocardiographs, pulse oximeters, capnographs or blood pressure monitors, especially in animals over 10 kgs.

- h** Always apply a corneal lubricant to the eyes to prevent drying (especially for prolonged surgical interventions) unless the procedure lasts only a few minutes, or if the surgery involves the eye.
- i** For warm-blooded animals, sterile, physiologically-buffered fluids, warmed to 37°C, may be given (preferably by the subcutaneous, intraperitoneal and on occasion, intravenous routes) during and/or after surgery to prevent dehydration and aid recovery. This is particularly important for procedures lasting longer than 30 minutes, or where a body cavity is opened. The use of all intravenous fluid treatment should be carefully monitored to minimise the risk of over-hydration which could result in pulmonary congestion and pneumonia. Consult your NVS for advice.

5 RECOVERY AND POST-OPERATIVE CARE

- a** The animal should be allowed to recover in a separate area or room, which is clean and quiet. It is essential to maintain the body temperature of the animal during the recovery period, as the anaesthetic agent impairs the animal's ability to thermoregulate. The ideal temperature is at the upper end of the animal's thermoneutral zone. This can be achieved by using a temperature-regulated environment; direct heat from lamps is not suitable as this may result in inadvertent thermal injury.
- b** No animal should be left unattended before it has recovered consciousness, is able to remain upright and protect its own airway without assistance.
- c** Unconscious animals should not be placed in a cage with conscious animals, although it is acceptable and recommended to re-group once the animals are fully conscious. Some establishments re-group certain species, such as rabbits, before they are fully recovered from anaesthesia because they believe that the animals benefit from minimal time away from their established groups (15, 16). Where this is the practice, senior care staff and the NVS should be responsible for ensuring that sufficient well-trained staff members are available to monitor the animals until they have fully recovered and are exhibiting normal behaviour. **Note:** this takes time and will require forward planning.
- d** During recovery, and sometimes in the first few days after surgery, soft bedding materials such as paper or lint-free fabrics should be used instead of normal bedding material, to prevent particles entering the eyes or the wound.
- e** Wet mash diet, transgel, liquid nutrition, baby foods or small pieces of fruit and vegetables may be provided to promote feeding and assist adequate fluid intake. Such interventions (if new to the animal) should be planned and introduced for a short period before the surgical interventions commence so the animal has become accustomed to the post-operative diet before the surgery takes place.
- f** Check the animal at appropriate intervals post-operatively, to assess the state of the wound and administer continued analgesia as required. If a licensee has any doubt

about the health or welfare of the animal, they should immediately seek advice from the NVS and/ or the NACWO⁹.

- g** Remove non-absorbable skin sutures or clips, usually 7 to 10 days after surgery, or as advised by the NVS because the interval can depend on the species of animal and position of the wound (e.g. if the wound is in an area of the body where the skin is especially mobile). Alternatively, consider the use of absorbable suture materials or tissue glue. **Tip:** at the time of opening a new bottle of tissue glue, the opening and discarding dates should be written on the bottle because the shelf-life is limited.

6 MONITORING OUTCOMES OF SURGERY

- a** Even when surgeons are trained and competent, surgical abilities can vary widely. Therefore, it is important to monitor standards for each surgeon by keeping accurate records to facilitate review; e.g. mortality figures, infection and wound breakdown rates, requirements for antibiotics, analgesic usage and the clinical signs observed following completion of each procedure. Acceptable success rates should be benchmarked for each type of procedure and surgeons who perform poorly should either re-train or refrain from operating on animals. The NTCO is responsible for ensuring that anyone working with animals under A(SP)A is trained and supervised until they are competent and that they continue to undertake appropriate further training to maintain their expertise.
- b** Licensees should keep abreast of progress in surgical techniques and models, through literature review and discussion with colleagues and the Named Persons, in order to apply refinements to their procedures.

⁹ See personal licence standard condition 15.

7 REFERENCES

- 1 A. Abbas *et al* (1991) **Cellular and molecular immunology**. Philadelphia, WB Saunders Company. 229, 302-3
- 2 G. Bancroft *et al* (1989) **T cell independent macrophage activation in SCID mice. The ScidMouse – Characterisation and Potential Uses**. New York, Springer Verlag. 253-242
- 3 E. Gaar *et al* (1994) **Improved survival in simulated surgical infection with combined cytokine, antibiotic and immunostimulant therapy**. *Br. J. Surg.* 81:1309–1311S.
- 4 F. Grappel *et al* (1983) **Prophylactic activity of cephalosporins in a mouse model of surgical wound infection**. *J. Antibiotics* 36:161–166.
- 5 B. Onderdonk (1998) **Pharmacodynamics and microbiology of trovafloxacin in animal models of surgical infection**. *Am. J. Surg.* 176(suppl 6A):39S–45S
- 6 J.F. Bradfield *et al* (1992) **Behavioural and physiologic effects of inapparent wound infection in rats**. *Laboratory Animal Science* 42 (6) 572-8.
- 7 Home Office Guidance and Code of Practice for the Housing and Care of Animals Bred, Supplied or Used for Scientific Purposes:
<https://www.gov.uk/guidance/research-and-testing-using-animals>
- 8 LASA 2016. **Guiding Principles for Supervision and Assessment of Competence as required under EU and UK legislation**. A report by the LASA Education, Training and Ethics Section. (M. Jennings and M. Berdoy eds.).
<http://www.lasa.co.uk/publications/>
- 9 M.I. Gonzalez *et al*; (2000) **Ovariohysterectomy in the rat: a model of surgical pain for evaluation of pre-emptive analgesia?** *PAIN II*: 79-88 Home Office 2000.
- 10 LASA 2016. **Guiding Principles on Record Keeping for Personal Licence Holders**. A report by the LASA Education, Training and Ethics Section. (M. Jennings and M. Berdoy eds.). <http://www.lasa.co.uk/publications/>
- 11 J. Tanner *et al* (2008) **Surgical hand antisepsis to reduce surgical site infection**. *Cochrane Database of Systematic Reviews* Issue 1. Art. No.: CD004288. DOI: 10.1002/14651858.CD004288.pub2
<http://www.cochrane.org/reviews/en/ab004288.html>
- 12 P. Flecknell (2015) **Laboratory Animal Anaesthesia (Fourth Edition)**. Academic Press. ISBN: 9780128000366
- 13 J. Tanner *et al* (2006) **Preoperative hair removal to reduce surgical site infection**. *Cochrane Database of Systematic Reviews* 2006, Issue 3. Art. No.: CD004122. DOI: 10.1002/14651858.CD004122.pub3.

- 14 I. Kjønniksen *et al* (2002) **Preoperative hair removal – A systemic literature review.** *AORN*, 75, (5): 928-940
<http://www.cochrane.org/reviews/en/ab004122.html>
- 15 K. Boers *et al* (2002) **Comfortable Quarters for Rabbits in Research Institutions**, in *Comfortable Quarters for Laboratory Animals* Washington (USA) Animal Welfare Institute p43 – 49
<http://www.awionline.org/www.awionline.org/pubs/cq02/cqindex.html>
- 16 D. B. Morton *et al* (1993) **Refinements in rabbit husbandry. Second report of the BVAWF/FRAME/RSPCA/UFAW Joint Working Group on Refinement.** *Oct*;27(4):301-29
<http://journals.sagepub.com/doi/pdf/10.1258/002367793780745633>

8 FURTHER READING AND RESOURCES

- (i) T.L. Cunliffe-Beamer (1993) **Applying principles of aseptic surgery to rodents**. AWIC Newsletter. April-June; Vol. 4, No. 2.
- (ii) BVA Animal Welfare Foundation Tutorials: **Assessing the Health and Welfare of Animals**. <http://www.ahwla.org.uk/>
- (iii) **Code of Practice for the Housing and Care of Animals Bred, Supplied or Used for Scientific Procedures**. (2014) London: Her Majesty's Stationary Office
<https://www.gov.uk/government/publications/code-of-practice-for-the-housing-and-care-of-animals-bred-supplied-or-used-for-scientific-purposes>
- (iv) H.B. Waynforth & P.A. Flecknell (1992) **Experimental and surgical techniques in the rat**. Academic Press; 2nd edition.
- (v) **Gloving technique videos**: <http://cal.vet.upenn.edu/projects/surgery/4900.htm>
- (vi) **Guidance on the Operation of the Animals (Scientific Procedures) Act 1986**. London: Her Majesty's Stationary Office.
- (vii) <https://www.gov.uk/government/publications/operation-of-aspa> Committee on Infections Diseases of Laboratory Rats and Mice, I.L.A.R. (1992). **Infectious Diseases of Laboratory Rats and Mice**. Washington, D.C. Government Printing Office.
- (viii) M.B. Popp & M.F. Brennan (1981) **Long-term vascular access in the rat: importance of asepsis**. Am J Physiol Heart Circ Physiol 241: H606-H612,
<http://ajpheart.physiology.org/cgi/content/abstract/241/4/H606>
- (ix) T.L. Cunliffe-Beamer (1972-73) **Pathological changes associated with ovarian transplantation**. 44th Annual Report of the Jackson Laboratory. Bar Harbor, Maine. 104.
- (x) G. Martinic. ANZCCART fact sheet: **Practical guidelines for aseptic surgery in rodents and the management of surgical facilities in a laboratory**.
<http://www.adelaide.edu.au/ANZCCART/publications/surgical.pdf>
- (xi) D.M. McCurnin & R.L. Jones (1985) **Principles of surgical asepsis**. Textbook of small animal surgery, Slatter, D.H. (ed.). Philadelphia (USA): W.B. Saunders, 1985.- ISBN 07-216-83487. p. 250-260
- (xii) P.A. Flecknell (1999) **Surgical Skills; 1&2; Disc 7**
<http://www.digires.co.uk/product/disc-7-surgical-skills>
- (xiii) S.L. Hoogstraten-Miller & P.A. Brown (2008) **Techniques in Aseptic Rodent Surgery** Curr. Protoc. Immunol. 82:1.12.1-1.12.14
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2587003/pdf/nihms78703.pdf>
- (xiv) J. Bruce et al (2001) **The measurement and monitoring of surgical adverse events**. Health Technol Assess. 5 (22):1-19
- (xv) Michalopoulos & L. Sparos (2003) **Post-operative wound infections**. Nurs Stand. Jul 16-2;17(44):53-6, 58, 60.
- (xvi) Ueno et al (2006) **Using physiology to improve surgical wound outcomes**. Plast Reconstr Surg. Jun;117(7 Suppl):59S-71S.
- (xvii) E. N. Adam & L.L. Southwood (2006) **Surgical and traumatic wound infections, cellulitis, and myositis in horses**. Vet Clin North Am Equine Pract. Aug;22(2):335-61, viii. Review
- (xviii) L. M. Howe (2006) **Surgical methods of contraception and sterilization**. Theriogenology. Aug;66(3):500-9.
- (xix) J.S. Weese (2008) **A review of post-operative infections in veterinary orthopaedic surgery**. Vet Comp Orthop Traumatol. 21(2):99-1



LASA
PO Box 524
Hull HU9 9HE
Telephone: 08456 711956
Fax: 08456 711957
E-mail: info@lasa.co.uk
Web: www.lasa.co.uk