

Surgery & Anesthesia - Vertebrate Species "Take-Home" Module

To allow greater flexibility for research staff, the Institutional Animal Care & Use Committee (IACUC) has prepared this "self-instruction" module in Surgery & Anesthesia. Please read the enclosed general information, complete and return the enclosed quiz. In order to become certified you may miss 5 questions. The quiz is "open book." **Return the quiz by campus mail to: IACUC Certification Coordinator, P.O. Box 210101, Attn.: Grace.**

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Introduction

The central mission of the Department of University Animal Care (UAC) is to support research projects using animals; however this support must be accomplished while maintaining full compliance with legal and ethical guidelines. Much of this packet may seem unduly restrictive, please understand that Federal law now defines and determines virtually each step of a research project using animals. The specific "shall's" and "shall not's" contained in these pages are compiled from these various laws and regulations. If you need additional information about training issues, please call the IACUC Certification Coordinator at 621-3931.

Surgical Personnel

Surgical support personnel from University Animal Care are available to assist research staff. The charge for this service is nominal when compared to the cost of hiring research support staff. Current fees may be obtained from the Biotechnology Support Staff. The exact makeup of a particular surgical team is a decision made by the principal investigator in consultation with the attending veterinarian. The IACUC must approve the list of personnel before the research project may begin and investigators must notify the IACUC as new personnel are added to the project.

UAC Surgical Contact:

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Laws and Regulations

Both the Animal Welfare Act and the Department of Health and Human Services have written, minimum "standards" for providing care before, during and after surgical procedures. A project that involves more than momentary or slight pain or distress must involve the veterinarian, in the planning stage!

The Institutional Animal Care and Use Committee (IACUC) is responsible for supervising the use of animals at the institution and has authorized the attending veterinarian to oversee all surgical procedures. The veterinarian must have access to animals and ensure that daily observations of the animals are performed by qualified individuals. There must be routine inspections of sites where surgical procedures are conducted. The IACUC is required to stop any research project wherein non-compliance is suspected.

- **Animal Welfare Act**
 - Passed in 1966
 - Protects against the theft of family dogs and cats, and includes virtually all warm blooded vertebrates.
 - This act ensures that animals intended for use in research be provided humane care and treatment.
- **USDA/APHIS** (United States Department of Agriculture/Animal Plant Health Inspection Services)
 - Once a year USDA performs unannounced inspections of research institutions
 - They inspect housing areas, laboratories and offices where animals or records pertaining to animals are kept
 - They will also inspect surgery and post- operative records for compliance with their rules and regulations
- **Arizona Game and Fish**
 - An Investigator must obtain a valid permit for collection, purchasing, transporting and holding of animals covered under State or Federal regulations
 - The protocol must be approved by IACUC before any surgery can be performed
- **GLP (Good Laboratory Practice)**
 - Food and Drug Administration (FDA) requires the creations of Standard Operating Procedures (SOP) when you are planning a research project where findings will be reported to the FDA
 - The Surgery Section at UAC has developed SOPs that must be followed during a GLP study
- **Controlled Substance Act**
 - Drugs which have the potential for addiction are classified under the law
 - Drug Enforcement Agency (DEA) enforces the law
 - Principle Investigator must obtain a DEA license to order and use controlled drugs
 - The Surgery Section is not allowed to sell you controlled drugs but can administer them for you. If you have a DEA license but are out of a drug, we can sell you one dose but you must provide us with a copy of your DEA license
- **IACUC (Institutional Animal Care and Use Committee)**
 - They ensure that animals purchased for biomedical research are used and cared for in a responsible manner and that all legal guidelines are observed
 - Review protocols/amendments for approval

- Surgery Section & IACUC:
 - Will review your protocol to make sure you are performing your surgeries in accordance to your protocol
 - Will make sure the animals that you are using are listed on your protocol
 - Ensure that you are using only the drugs listed on your protocol for the surgical procedure and post- operative care
 - Ensure that all personnel involved in the surgery are listed on your protocol and have taken the appropriate IACUC training courses
- **AAALAC (Association for Assessment and Accreditation of Laboratory Animal Care)**
 - A voluntary organization that performs site visits once every 3 years. They make recommendations based on results of site visits and determine if the facility has met the accepted standard for accreditation.
 - UAC is an accredited facility. Our standards must be continuously updated to reflect current knowledge in laboratory animal science so our accreditation can be maintained.

Definitions of Commonly Used Terminology

Analgesic - a drug which causes an absence of pain in response to stimulation which would normally be painful; often, what is actually achieved following administration of an analgesic is hypoaesthesia, or diminished pain in response to a stimulus.

Anesthesia Definitions

- **Anesthesia, general** - provides overall insensitivity and unconsciousness. Basic elements of general anesthesia include:
 - unconsciousness
 - amnesia (loss of memory of pain or distress)
 - analgesia
 - muscle relaxation
 - diminished motor response to noxious stimuli
 - reversibility
- **Anesthetic** - a drug which causes a reversible loss of conscious awareness and sensation, including pain.
- **Neuromuscular blocking agent** (paralytic agent) - a drug which blocks transmission at the neuromuscular junction; these drugs lack anesthetic and analgesic properties. It is illegal to use a neuromuscular blocking agent for painful procedures, unless anesthetics or analgesic drugs are used in conjunction. **Mechanical ventilation must be provided.**
- **Sedative** - a drug which produces a state of decreased motor activity, mental calmness, and drowsiness; does not imply analgesia, although most sedatives will increase the pain tolerance threshold by reducing anxiety and fear.

Anesthetic Management Principles - Prevention of perceived pain during surgery is the primary function of anesthesia.

- Anesthesia also enables humane restraint, improves safety, and increases technical efficiency. Although many factors affect choice of a particular anesthetic drug or technique, the greatest concern must be the well-being of the animal.
- A general rule of thumb is "aim only for the degree of restraint and anesthesia required" - more may not be better and often is associated with a greater potential for adverse effects.

Aseptic procedures - All of the techniques and practices employed to prevent microbial contamination of the surgical site. These include: removal of hair from the surgical site, use of surgical scrub and sterile draping of the area. Sterile instruments, proper attire, and adherence to current operating room policy are required.

Major Surgery - Any surgical intervention that penetrates and exposes a body cavity Or any procedure that is likely to produce a permanent impairment of physical movement or basic physiological function, And/Or any procedure associated with orthopedics or extensive tissue dissection or transaction.

- **Major survival surgery** for warm-blooded "higher" vertebrate animals such as rabbits, dogs, cats, pigs, sheep, or monkeys must be performed in dedicated facilities specifically designed, operated, and maintained for that purpose. Cold-blooded vertebrate or rodent surgeries may be performed aseptically in a clean, non-dedicated room or laboratory. Farm-type procedures may be performed at the agricultural center. Surgical procedures on wild animals, both major and minor may be performed in the field but aseptic principles must be followed. The IACUC approves the appropriate site for specific operative procedures.
- Use of one animal in **multiple major survival surgeries** is allowed only when such procedures are related components of a protocol; they must be scientifically justified in the protocol and approved by the IACUC. Cost savings is not an acceptable justification for multiple major survival surgeries on any animal. Determination that a procedure constitutes major surgery is usually made during the IACUC review process. However, development of "permanent physical or physiologic impairment" may not be recognized until after the procedure is performed. If such impairment develops after a surgery, that animal cannot be used for another recovery procedure.
- If the second major procedure is non-survival, this is not considered to be **multiple** major survival surgery.

Minor Surgery – Any surgical intervention that does not penetrate a body cavity nor expose a body cavity, or causes little or no physical or physiologic impairment (e.g. wound suturing, peripheral vessel cannulation, laparoscopy, percutaneous biopsy).

- A dedicated surgical facility is not required for such procedures, however, the surgical area should be clean and aseptic techniques must be observed. For minor survival surgery procedures, there is no prohibition against multiple procedures. Good professional judgment should be used to limit the number of minor surgical procedures performed on a single animal.

Non-Survival Surgery - Surgery from which the subject does not regain consciousness from anesthesia prior to being euthanized.

Preoperative Management Principles - The well-being of the animal and validity of the study are enhanced by proper management before the operative procedure.

- **Animal health status** - The health status of animals should be assessed before undergoing a surgical procedure. Evaluation of blood, urine, and feces can be helpful, depending on the animal species and health history of the animal or colony. Health assessments are usually conducted during a quarantine period when the animals are kept separate from conditioned animals. The quarantine period of random source animals is generally a few weeks duration, in part since these animals may need to be immunized against common infectious diseases. Purpose bred animals also require quarantine, but the period is much shorter.
- **Conditioning** - It is important that animals be provided a period of adaptation prior to undergoing surgical procedures. This allows the animal's physiologic and metabolic systems to stabilize to a new environment thereby minimizing risk of complications; this

period also minimizes the effects of uncontrolled environmental influences on the results obtained from the experimental protocol.

- **Animal stress** - Investigators and research staff should be familiar with the normal behavior of the species and recognize abnormal behaviors. Since distress can alter experimental results, efforts should be targeted to reduce stresses associated with survival surgery, prolonged studies, confinement, and chronic pain.
- **Proper handling and restraint** - Proper handling and restraint will help prevent injury and minimize stress, to both the animal and personnel! Consultation with the veterinarian is advised.
- **Antimicrobial prophylaxis** - Antimicrobial agents might be indicated prophylactically for certain surgical procedures or when known breaks in sterility occur, but should not be used as a substitute for proper aseptic techniques. Please consult the veterinarian about using antimicrobials for each individual animal.

Survival Surgery - Surgery from which the subject regains consciousness from anesthesia for any period of time prior to a complete recovery, use, or euthanasia.

Common Drugs Used

*Detailed list may be found in the IACUC Handout for [Approved Anesthetics, Analgesics, & Sedatives Currently Approved by the IACUC](http://www.iacuc.arizona.edu/training/surgery/Approved_Anesthetics_Analgesics_Sedatives.pdf) at (http://www.iacuc.arizona.edu/training/surgery/Approved_Anesthetics_Analgesics_Sedatives.pdf)

Management of Drugs - Drugs which are considered by the U.S. Department of Justice, Drug Enforcement Agency (DEA) to be controlled substances must be stored in a locked cabinet in a secured area (e.g. behind two locked doors). Controlled substances must never be left unattended since the potential for theft and misuse of these drugs is high. In the past, the DEA allowed some latitude in research facilities and did not closely observe who exactly administered these drugs to the research animal. This is no longer true. Therefore, **each investigator with a DEA license must personally supervise the administration of these drugs.** In addition, UAC may no longer transfer controlled drugs to research staff.

All drugs, whether or not they are DEA regulated, must be properly labeled and included on the label must be the expiration date. Expiration dates should be checked periodically, at least once every three months, and expired drugs immediately discarded. **It is a violation to use expired drugs on animals involved in research procedures** (there are a few limited occasions wherein expired drugs may be used for terminal, non-survival procedures). University Animal Care staff will discard any drug they observe to be improperly labeled, or in use after the expiration date has passed. Please refer to the "[Free Controlled Substance Disposal Service offered by UA Risk Management and Safety](http://www.iacuc.arizona.edu/training/surgery/Approved_Anesthetics_Analgesics_Sedatives.pdf)" handout for specific information regarding pick up and discard of controlled drugs which can be found on-line at (http://www.iacuc.arizona.edu/training/surgery/Approved_Anesthetics_Analgesics_Sedatives.pdf)

At a minimum, the label on a drug shall include:

- name of drug and concentration
- expiration date (also the mixing date if a combination)
- name of Investigator (if the drug is not owned by UAC)
- specific storage requirements (e.g. refrigerate)

Criteria for Choosing Anesthetic Agents for Project

- knowledge of the procedure and duration

- compatibility of the anesthetic with experimental design
- actions and properties of the anesthetic agent(s)
- biological characteristics of the selected species
- prior experience with the anesthetic in the species
- available equipment, personnel and facilities.

Two Main Delivery Systems used in Veterinary Medicine include: Inhalation & Injection

Inhalation anesthetics are gaseous or volatile agents administered via the respiratory tract. Inhalation anesthetics, when properly administered allow one to control and regulate anesthetic depth. Disadvantages include need for specialized delivery equipment and potential toxicosis to personnel chronically exposed to anesthetic vapors. Endotracheal intubation facilitates effective and safe delivery of inhalation anesthetics. A waste gas scavenging system should be used to minimize exposure to personnel. Examples include: Ether, Halothane, Sevoflurane, and Isoflurane.

Injectable anesthetics can serve as the sole anesthetic agent, be used to induce anesthesia before inhalation anesthesia, or supplement regional anesthesia.

To minimize the chance of drug overdose and to reduce drug-related tissue damage, drugs used for smaller (<4 kg) laboratory animals may need to be diluted.

- **Hypnotic/sedative drugs** are widely used for inducing or managing general anesthesia. They induce a dose-dependent spectrum of CNS depression, from sleep to deep general anesthesia. Higher doses may cause medullary paralysis, respiratory arrest and death. Examples include: Pentobarbital, Sodium Thiamylal, Sodium Thiopental and Chloral Hydrate.
- **alpha 2-Adrenergic receptor agonists** have tranquilizing, sedative, and potent analgesic properties. Examples include: Xylazine (trade name Rompun).
- **Dissociative drugs** induce anesthesia, have short duration of action, a wide safety margin, and cause minimal cardiopulmonary depression. To decrease undesirable actions such as muscle hypertonus and emergence delirium, they may be used in combination with hypnotics, tranquilizers, or alpha 2-adrenergic agonists. Examples include: Ketamine which is often in combination with the tranquilizer Tiletamine/Zolazepam (Telazol).
- **Muscle relaxants** are predominantly central or peripheral acting. The peripheral acting muscle relaxants are devoid of sedative and analgesic properties. These drugs, when used during surgery, must be administered only in conjunction with general anesthetics. The investigator must remain aware that the animal is unable to respond with purposeful movement to noxious stimulation and the animal must be closely monitored (e.g. heart rate, arterial blood pressure) to ensure adequate general anesthesia. Examples include: Succinylcholine and Dimethyl Tubocurarine.
- **Local and Regional Anesthesia** - is used most often in large animals, such as horses, cattle or sheep. Localized insensitivity in awake or mildly sedated animals can result from topical application or injection of appropriate anesthetics in the region of the surgical incision (local anesthesia); injection in proximity to nerve trunks (nerve block); or injection into the subarachnoid or epidural spaces (regional anesthesia).
 - **Advantages Include:**
 - the cost of drugs and equipment is low
 - the need for special post-anesthetic care is minimal

- avoids undesirable complications that accompany unconsciousness and recumbency, such as regurgitation and aspiration of gastric contents, inefficient respiratory gas exchange, traumatic complications associated with recovery, myopathy (particularly in large, heavy animals)
- **Disadvantages Include:**
 - some degree of animal cooperation is necessary
 - the anesthetic period is relatively short
 - tissue damage has been associated with inj. of large volumes of anesthetic agents
 - rapid absorption or inadvertent intravascular injections of large quantities of anesthetic agents can cause life-threatening reactions.

Analgesic drugs - used to reduce pain initiated during the surgical period and continued well into the postoperative recovery period. Consultation with the attending veterinarian is recommended since there is tremendous variation between species as to their response to analgesic drugs. Limited animal studies have been conducted and for many species there will be widely different published dosage schedules. Never extrapolate from human data, please consult with the veterinarian.

- It is often erroneously presumed that an animal is not in pain, when there is no obvious change in behavior.
- Pain can be difficult to detect because of individual and species variation. "Typical" signs of pain include guarding the painful area, vocalization, licking, biting, self mutilation, signs of depression, grinding of teeth, restlessness, lack of mobility, failure to groom, abnormal posture, changes in sleep patterns, and failure to eat or drink.
- **Pain can be assumed to have been present if administration of analgesics causes these signs to disappear.**

Guidelines for the Administration of Analgesic Drugs

- Medical and veterinary reports suggest analgesics are most effective when administered prior to the painful stimulus, before the surgical incision and tissue manipulation.
- Analgesic drugs must be given at the proper initial dose and subsequent doses must be given according to schedule.
- Federal law requires pain relief according to the same guidelines for a human patient undergoing a similar procedure.

Selection of Analgesic drugs - In addition to the care which must be taken when choosing the proper dosage and schedule for a particular species, different analgesics are indicated for different types of pain:

- **Nonsteroidal anti-inflammatory agents (NSAID)** are effective against pain associated with inflammation, acute pain associated with soft tissue injury, burns, and pain associated with bone injuries or disease. However, severe pain in any of these categories may be best treated with NSAID's in combination with potent opioid agonists. Examples include: Banamine, Ibuprofen.
- **Opioid agonists** are effective against most visceral and somatic pain; although generally not as effective as NSAID's against bone pain, they may be used in conjunction with NSAIDs to treat severe bone pain. Examples include: Morphine, Meperidine.
- **Opioid agonist-antagonists** are effective against mild to moderate visceral and somatic pain. Examples include: Buprenorphine, Butorphanol.

Neurogenic pain is pain which arises from damaged nerves or from amputation. This pain is difficult to treat and rarely responds well to any of the drugs listed above. Most likely to be effective: tricyclic

antidepressants such as Amitriptyline, anticonvulsants such as Carbamazepine, or antiarrhythmics such as Lidocaine.

Rodents & Rabbits:

- **Routes of administration** for rodents are injectable or inhalant.
 - Inhalant anesthesia can be administered via an anesthesia machine through a nose cone, anesthesia chamber, or by intubation
 - Injectable routes of drug administration are intramuscular (IM), intraperitoneal (IP) and subcutaneous (SC)

- **Inhalant Anesthetics:**
 - Isoflurane
 - Sevoflurane

- **Injectable Anesthetics:**
 - “**Rabbit Mix**” is a commonly used anesthetic in all rodents and rabbits.
 - This mix is made up of a combination of:
5cc Ketamine + 8cc 20mg/ml Xylazine + 2cc Acepromazine.
 - Drug Dosage:
 - 1 cc/kg for Rats, Guinea pigs and Rabbits as an anesthetic
 - ½ cc/kg as an induction agent

Non-Rodents:

- **Inhalant Anesthetic:**
 - Isoflurane
 - Sevoflurane

- **Injectable/Preanesthetic/Anesthetic :**
 - Tiletamine/Zolazepam (Telazol) (for short procedures of not more than 30 minutes)
 - Ketamine/Xylazine
 - Pentothal
 - Sodium Pentobarbital

Antibiotics:

Antibiotics are given pre-operatively or post-operatively according to the project protocol and recorded in the animals post-op charts by date, time, injection site and amount given.

Methods of Administration of Inhalants & Injectable Drugs

Induction chamber



Masks



Anesthesia chamber



Injection



Surgical Instruments

Sterilization kills or renders inactive all microbial organisms. The common methods used are steam heat, ethylene oxide gas or chemicals. Any item used for survival surgery must be sterilized: instruments; materials and devices such as catheters, flow probes, or electrodes; and all fluids used for flushing or injection. Special care is needed to ensure that multi-dose vials of drugs are not contaminated.

Packs of sterile instruments or materials that are to be stored for more than a week, should be double wrapped in packaging which is impermeable to water. **The date of sterilization should be clearly marked on the outer wrapper.** Expiration dates vary with packaging materials, but a general guideline is two months from the date of sterilization. Commercially available plastic dust covers will extend the shelf life to 6-12 months.

Preparation and Sterilization of Surgical Instruments

- **Gas Sterilization** – is used to sterilize materials that can not withstand high temperatures. Items are placed in an autoclavable bag then sealed in the special plastic bag provided, along with a dosimeter and a gas sterilant ampule.

The bag is placed in the gas sterilizer, and the exhaust hose is placed inside the bag. The bag is sealed with a twist tie, then the ampule is broken through the bag. The door is sealed. After 14 hours the bag is removed and ready to use for surgical procedures.

- **Cold Sterilization** – is used when gas or steam sterilization is not possible, but sterilization is required.

Cidex is a liquid chemical sterilant and a high level disinfectant for such objects as anesthesia equipment, rubber, most stainless steel instruments, plastic, most dental equipment and many types of metals. **Materials must be kept in the solution for 10 hours to eliminate all microorganisms.**

- Wear gloves, a mask and goggles to protect your hands, eyes and respiratory system from splash or inhaling of Cidex because it can be toxic. Use forceps to remove materials from container and rinse thoroughly.
- Other commonly used chemicals include: glutaraldehyde, phenols, and chlorine dioxide. But all have serious drawbacks: glutaraldehyde is mutagenic, phenols are corrosive and both require special disposal procedures; chlorine dioxide has a short sterilizing useful life (1 day) and is corrosive to metals.
- All chemical agents require rinsing with sterile solutions prior to tissue contact.
- Review the manufacturers' recommendations regarding effectiveness of chemical sterilizing agents.
- **Glass Bead Sterilization** – only the portion of the instrument placed into the heated beads is sterilized. This is convenient when doing multiple animals, but care must be taken to follow recommended time in the beads to assure sterilization.
- **Steam Sterilization** - is used to autoclave metals and materials that can withstand high temperatures of at least 250°F for at least 15 minutes. Temperature and time will vary with each individual autoclave.

Instruments for Rodent Surgery - Either Single or Repetitive

1. All instruments used in survival rodent surgeries must be steam or gas sterilized (this can be done by Biotechnology Support Service for a fee) prior to each group of surgeries (biological indicator monitoring of sterilizer effectiveness is advisable).
2. Instruments must be kept on sterile non-porous drapes during use.
3. Instruments must be cleaned of blood and debris by brushing or wiping with sterile water or saline and sterile gauze sponges between surgeries.
4. If contamination has occurred, instruments must be placed in a chemical agent or a glass bead sterilizer for the appropriate period of time for the method used to be effective (or the instrument pack replaced by a new sterile instrument pack).
5. If a chemical agent is used, instruments must be rinsed with sterile water or saline before being used on the next animal.
6. Surgical gloves and blades should be changed between each animal or after contamination.

Following surgery all instruments must be thoroughly cleaned and preferably placed in an ultrasonic cleaner and rinsed.

Non-Rodent Surgery

- Must be performed in University Animal Care, in the designated surgery area.
- Routes of administration for non-rodents are injectable or inhalant.
 - Injectable routes of drug administration are intramuscular (IM) and intravenous (IV).
 - Inhalant anesthesia can be administered via an anesthesia machine through a nose cone, an anesthesia chamber, or by using an endotracheal tube.

Rodent Surgery

- Surgery can be performed in a lab or in the UAC surgery section for both non-survival and sterile procedures.
- Sterile survival procedures require that the animal be prepped for surgery in a different area than where the surgery will be performed, whether the procedure is done in the lab or at UAC.
- If it is not possible to have a fresh pack of sterile instruments available for repetitive rodent surgeries, then a resterilization or decontamination procedure must be in place for use between each animal. *See section on Sterilization methods.


Non-Survival Surgery

All non-survival surgeries, other than rodent, must be performed in University Animal Care, in our designated surgery area. While instruments do not need to be sterilized for these acute procedures they should be clean and disinfected. Gloves must be worn.

- Non-survival rodent surgery can be performed in a lab or in UAC. While instruments do not need to be sterilized for acute studies they should be clean and disinfected. Gloves need to be worn.

Survival Surgery

A. Pre-operative Prep

- Preparations are physically in a separate location from where the surgery will be performed.
- **Fasting Prior to Anesthesia/Rodents**  (NPO = Nothing Per Os)
 - The Veterinarian should be consulted before fasting. Some animals require it while some do not, and the time period varies based upon species, i.e. regurgitation rarely occurs in rats and fasting may cause life threatening hypoglycemia, where as prolonged fasting in ruminants will reduce bloat and the risk of regurgitation and pulmonary aspiration.
 - NPO forms are available in room 1126 in UAC. These forms are used to NPO non-rodent species. They are filled out by the investigators, returned to the Surgery area at UAC to room 1204 or 1201B. NPO stickers are issued and placed on the appropriate animal's cage on the date requested. All NPO forms must be turned-in 48 hours before an animal is to be NPO'd. Animals that will need to be NPO'd on Monday will need to be turned in on the prior Friday.
 - Bathing may be necessary in some species to remove excess dirt and hair. This should be done the day before the scheduled surgery.
 - Surgeon and assistants should wash hands and wear gloves and a clean (sterile is not necessary) gown over the scrub suit while preparing the animal.

- **Shaving Animal for Surgery**
 - All hair and fur must be clipped around the area where the surgical incision will be made. The area clipped must be larger than the incision in case the incision site must be extended, and to prevent contamination from non-prepped areas.

- **Prepping Animal Using Aseptic Technique**
 - The shaved area is then prepped aseptically alternating between 70% alcohol and a scrub solution (e.g. Betadine), starting from the incision site and moving away from it in a circular pattern. This process is repeated 3 or more times. A final antiseptic solution (devoid of soap) is sprayed or swabbed along the proposed incision and is not rinsed. The site is then covered with clean gauze sponges or cotton, saturated with the antiseptic solution (devoid of soap) so the animal is prepared prior to transport to the surgical area.

- **Fluid Therapy**
 - An IV catheter should be placed in a vein for fluid maintenance and replacement if blood is lost during the surgical procedure.

- **Surgery Record**
 - A written surgery record must be maintained while the animal is being prepped for surgery. The date, investigator, department, protocol number, project title, surgical procedure, species, breed, sex, weight, color of animal, animal ID number must be recorded.
 - Pre-op status must also be checked and noted. This includes membrane color, temperature, pulse, and respiration rate. Pre-anesthetics given, induction agent used, and anesthetics given must be recorded by agent used, dose, and time of administration.
 - A brief description of the procedure performed and the names of the anesthetist, surgeon and assistant surgeon must also be noted on the record. Any medications given to the animal during preparation such as antibiotics, analgesics or fluids must be recorded on the Surgical Record as supportive treatment.

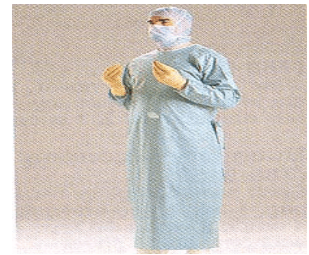
- **Anesthesia Record**
 - During the pre-surgical & surgical procedure vital signs should be monitored:
 - Temperature, respiration, heart rate, anesthesia flow percentage, fluids administered (all should be noted periodically)
 - Any drugs given, doses and routes, and time of administration
 - Any noted response to the drugs or medications
 - Name of surgeon, assistant surgeon and individual administering anesthesia must be recorded on an anesthesia record.

- Just prior to taking the animal to the surgical area, the protective gowns (now dirty and covered in hair) should be removed in the animal preparation area.
- When animals are placed directly on metal surgery tables, body heat is lost, therefore insulating materials or warming devices should be placed between the table and the animal. Circulating warm water or air heating pads should be used since electric heating pads are likely to burn. When heat lamps are used, avoid placing the animal in the direct beam. If possible, reflect the heat lamp off of a metal surface and place the animal in the reflected beam.

- **Surgeon Prep**

- **Proper Attire**

- Cap
- Mask
- Sterile Gloves
- Sterile Gown (Rodent and cold-blooded vertebrate animal surgeons may use a clean scrub top as a substitute for a sterile gown).



- **Surgical Scrub for Hands**

- The key components are to use an antiseptic soap and scrub all surfaces of the fingers, hands, wrists and arms up towards the elbows.
- The surgeon first performs a surgical scrub and rinse on his or her hands for a minimum of 5 minutes, starting with the fingers and working towards the elbows.

- **Proper Hand Drying Technique**

- With hands held upwards, the hands are then dried with a sterile hand towel again starting with the fingers and working up towards the elbows.

- **Proper Method for Putting on a Sterile Gown**

- The first time, UAC Surgical staff should be consulted to assure you are gowning correctly. The proper method assures the gown is not touched by anything, including the surgeons' hands.



- **Proper Method for Putting on Sterile Gloves**

- The first time, UAC Surgical staff should be consulted to assure you are gowning correctly. There are two acceptable methods:

- 1) Open Method:



2) Closed Method:



B. Surgery

- Once anesthetized, it is recommended that all warm-blooded vertebrates be intubated, since the endotracheal tube minimizes the potential for aspiration of stomach contents. The endotracheal tube also allows for positive pressure ventilation should emergency resuscitation be required.
- **Principles of Operative Technique** - Proper surgical technique is important to prevent wound infection, promote wound healing, and ensure likelihood of a satisfactory outcome to the surgical procedure.
- **“Good Surgical Technique” Includes:**
 - **Asepsis, Asepsis, Asepsis - Aseptic technique** is required at all times and all team members are responsible for monitoring for breaks in aseptic technique. "Asepsis is a chain which is only as strong as its weakest link." Potential sources of contamination include the team members, the patient, all articles used in the procedure, the surgical room or area, and other personnel entering the surgical area.
 - **Gentle tissue handling** - Gentle handling of tissues will help minimize postsurgical pain. Tissues should not be cut or separated without reason and tissue dissection is usually done along fascial planes. Exposed tissue must be protected from drying or contamination.
 - **Effective hemostasis & maintenance of sufficient blood supply to tissues** - allows visualization of the surgical field while preserving the total blood volume. Hemostasis is achieved by ligation, pressure, electrocoagulation and avoiding damage to major vessels. Only the vessel to be occluded should be incorporated in a ligature or clip. In using electrocoagulation, a high frequency current is applied to a small area of tissue (the bleeding vessel) and electric energy is converted to heat, resulting in coagulation of tissue and sealing of the vessel. To avoid excessive tissue damage, only the vessel to be occluded is in contact with the electrode. Electrocoagulation can be used for minor hemorrhage; large vessels should be ligated.
 - **Proper use of surgical instruments** minimizes trauma. For example, vascular forceps are used to occlude blood vessels when flow is to be reestablished; hemostatic forceps, which crush, are applied to vessels through which blood will no longer flow.
 - **Accurate tissue apposition** enhances healing and promotes rapid return to normal function. Retraction and dissection of tissue can produce pockets known as dead space. Dead space can delay healing and serve as a site for bacterial growth and fluid accumulation. As tissues are returned to their normal positions, dead space needs to be

obliterated by careful suture placement to appose tissue and/or placement of drains to prevent fluid accumulation.

As a procedure is concluded, tissues are replaced to their normal anatomic positions. Most tissues should be apposed with minimal amount of tension and sutures must not devitalize the tissue in which they are placed. Type of suture material and pattern to be used will be dictated by the tissue involved and forces applied to those tissues.

Behavior of animals also might influence the choices; some animals are more prone to chew or remove certain types of suture materials or devices such as surgical staples. Because physicians normally work with cooperative human patients, they must re-evaluate surgical materials and methods to be used with animals.

- **Intraoperative patient support and monitoring** - Appropriate use of monitoring equipment – Accepted medical and veterinary surgical practice requires assessment of the physiologic status of the animal on a regular basis. Vital time for resuscitation can be lost by failure to notice life-threatening physiologic or metabolic problems.

The degree of monitoring sophistication depends on the species, the extent and duration of the surgical procedure, and whether it is a survival or terminal procedure. Monitoring can be qualitative, using the anesthetist's sense of touch, sight and hearing to evaluate the patient; or quantitative, using instruments for periodic measurement of specific vital organ performance.

The anesthetic record provides a detailed account of the course of anesthesia and intraoperative events. Blank record forms are available from University Animal Care. Whether you use one of these forms, or one of your own design, it is important to record data from the pre-operative period, the induction period, the anesthetic/surgical period and the immediate post-operative period. Later measurements may be written on the individual animal's chart.

- **Support of vital organ functions** is an integral part of any surgical protocol. Many devices are available but they may not be practical or applicable for all species.

Body temperature can be measured via rectal or esophageal thermometers. Every effort should be made to combat hypothermia by use of circulating warm water blankets, warm water bottles, heat lamps, or application of insulating materials such as drapes.

Support for the respiratory system can be as simple as appropriate positioning of the animal to ensure an unobstructed airway, endotracheal intubation, or providing supplemental oxygen. A variety of techniques exist to assess cardiovascular function: capillary refill time, heart rate monitoring, Doppler Flow probes, EKG, palpation of pulse, and use of esophageal or conventional stethoscopes. Cardiovascular support includes fluid therapy and use of defibrillators and cardioactive drugs.

Monitoring rate and amount of urine production, as well as subjective assessment of blood loss, and capillary refill time of the oral mucus membranes can indicate adequacy of fluid volume. There are many possible choices for fluid replacement, but normal (0.9%) saline or balanced electrolyte solutions such as lactated Ringer's are common. Intravenous (IV) administered fluid therapy is best for larger animal species, but can be difficult in smaller animals; subcutaneous (SQ) or

intraperitoneal (IP) fluids may be appropriate for these species. Warming fluids may be helpful.

- **Expeditious performance of the surgical procedure** implies that the surgical team will have sufficient training and competence to perform the surgical procedure in the least required amount of time. A rapid response to unplanned or emergency situations is the result of good organization and coordination of team members.

- **Maintaining a Sterile Field**



- **Sterile Personnel** - are only allowed to handle sterile objects. If they accidentally touch an item that is not sterile they will need to stop immediately and change their gloves.
- **Non-sterile Personnel** - are not able to handle any sterile objects. If they do the items are no longer considered sterile and must be removed from the sterile field. The outer layer of packs are not considered sterile. A non-sterile person is able to open the package and present it to the surgeon without compromising the sterile object inside.
- **Proper Draping of the Animal**
 - A drape is placed on the animal to maintain sterility. The area over the incision site is removed by the surgeon to expose the skin surface where the incision will be made.
- **Wound Closures**
 - There are several types of wound closure. The type of animal and problems that will occur with certain stitches must be considered. Multiple layers of sutures placed in a simple interrupted pattern are preferred to a continuous pattern to minimize the risk of dehiscence. A subcuticular suture pattern is advantageous for skin closure in animals that are inclined to chew or otherwise remove stitches.

C. Post-operative Care

Involves observations and administration of therapeutic measures that tend to promote recovery from anesthesia and/or surgical manipulations. These measures should minimize pain and distress. The postoperative period consists of 3 overlapping phases: anesthetic recovery, acute and long-term postoperative care. Adequate postoperative care enhances the animal's recovery by improving it's physiologic status and minimizing pain and distress.

The Recovery Period - is the critical time because it is a period of physiologic disturbance during which crises can arise. **Frequent observation and monitoring** is required.

- Recovery/rodents/large animals
 - The endotracheal tube should not be removed until the animal is exhibiting an active swallowing reflex. Maintain a clear and unobstructed airway!
 - Dogs: the neck is extended and the tongue gently pulled out of one side of the mouth.
 - In most instances, animals should be frequently turned from side to side to avoid dependent pulmonary edema.
- Antibiotics
- Analgesics – as per protocol, and veterinary recommendations
- Observations

- Record Keeping

- **Vitals Signs Monitoring**

- **Monitor heart rate** - Cardiovascular function can be assessed by EKG, blood pressure monitors, auscultation, and evaluation of mucous membrane color.
- **Monitor respiration** - Respiratory function can be evaluated by mucous membrane and tongue color and respiratory volume and rate. Some situations may require a pulse oximeter.
- **Check body temperature/touch/thermometer** - Body temperature needs to be maintained. If circulating warm water heating devices or heat lamps are used, care should be taken to ensure that animals do not chew these devices and electrocute themselves.
- **Check mucus membranes** for healthy pink color
- **Check for signs of normal body movement** - To prevent drowning or aspiration, water and food is withheld.

- **Rodent Recovery:**

- **Never recover an animal on bedding.** The animal can suffocate by inhalation of bedding through the nose or mouth. Bedding can also get in the eyes and cause irritation or damage.
- A towel should be placed on the bottom of the cage along with a heat source such as heating lamp or heating pad to prevent hypothermia.



- Place your hand over or under the animal, depending on your heat source, to verify that the animal is not receiving too much heat therefore preventing hyperthermia.
- Monitoring: Turn the animal from one side to the other every half an hour to help maintain proper circulation, respiration, prevent nerve damage, and to help stimulate normal body movements .
- Recovered: When the rodent is ambulatory, place animal back in a pan on its normal type of bedding.

- **Large Animal Recovery**

- Large animals can be recovered in heated cages or on the floor of a cage on a mat with a sheet or blanket.
- When the large animal is ambulatory, place it back in its room or cage
- Regurgitation associated with the movement of the rumen may be avoided by not moving the animal more than necessary.



- **Long term postoperative care** requires careful observation of body temperature, food intake, locomotion, behavior, and signs indicating pain. For warm-blooded species "higher" than rodents, **notes must be maintained in an individual animal record** and each entry should be dated and initialed.

Research staff must daily examine the surgical site, monitor for signs of infection, and remove sutures or other devices at the correct time (generally 7-10 days). The surgical site should be observed for signs of infection, incision breakdown (dehiscence), or self-inflicted trauma. At least once a day, catheters should be examined and may need to be cleaned and flushed. Drains, collars, and dressings should be examined daily and changed as needed. Bandages, Elizabethan

collars and restraint devices may help prevent self-mutilation; but staff must watch that the animal can obtain food and water and move about to perform bodily functions.

Monitoring food and water intake is important to successful recovery. Oral or parenteral supplementation may be necessary to maintain normal hydration and anabolic state. Special diets may be indicated during the recovery period. The quantity and character of urine and feces should be monitored, because changes could indicate complications such as paralytic ileus, acute renal failure, or intestinal hypermotility caused by irritation.

Pain control (Analgesics)

Analgesics are given to patients according to the dosage stated in the protocol and also as need during daily assessment.

Please visit the website on Controlling Pain and Distress in Laboratory Animals at http://www.iacuc.arizona.edu/training/surgery/module/Controlling_Pain_and_Distress.html

Record keeping

Daily Observations and Record Keeping - All post-surgical care provided must be documented. Daily notes recording the animal's progress, administration of medications and management of surgical incisions up to the time of suture removal should be written in the clinical records. These permanent records must be complete, current, and readily accessible.

Euthanasia (Must follow the current AVMA Panel on Euthanasia)

- **Rodents**
 - Injections: Intraperitoneal injection of barbiturates is acceptable for small rodents.
 - Inhalant: Rodents and other small animals are placed in a closed, often transparent vessel which usually contains a gas such as CO₂. Exposure must be maintained for at least 10 minutes to ensure that the animals do not revive when again exposed to room air.
 - Cervical dislocation: for mice and rats, a rod the diameter of a pencil is pressed horizontally across the spinal cord at the base of the skull. With the other hand, the base of the tail or hind limbs are quickly pulled, causing separation of the cervical vertebrae from the skull. Special training is required.
 - You must verify that the animal is dead before disposal
- **Non-Rodents**
 - Injectable Chemicals: intravenous injection of a barbituric acid derivative, such as pentobarbital, is the preferred method for euthanating dogs, cats, and other animals that have readily accessible veins of a reasonable size.
 - You must verify that the animal is dead before disposal.
- **Disposition:** All animal remains should be returned to the designated cooler(s) in University Animal Care facilities. Never place more than one large animal in a barrel and the total weight per barrel must be less than fifty (50) pounds. Animals exposed to biohazardous materials involve special care (radioisotopes in yellow bags and carcinogens in red bags). Never put animal remains in laboratory trashcans or outside dumpsters.

Training and consultation contact information

The Surgical and Clinical staff at UAC are available by appointment, to consult on protocols, surgical procedures and a wide variety of technical training.

Mandatory pre-surgical meetings are required for all surgical procedures involving **non-human primates**. The meeting must take place a minimum of 48 hours prior to the surgical procedure. Contact the Surgical Supervisor to arrange the meeting.

Contact numbers: Surgery Area: 626-7304
Clinical Area : 626-5015

Room scheduling

The surgical rooms (both sterile and non-sterile rooms), and the x-ray room need to be scheduled in advance.

Contact number: K Stollberg: 626-7304 or Email: stollbek@u.arizona.edu

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By Kathy Stollberg-Zagar & supplemented by Paula Johnson, DVM, MS, & adapted from the original course by D.W. DeYoung, DVM, PhD, DACVS

Surgery, Anesthesia - Vertebrate Species "Take-Home" Module

Your Name(print): _____ Department: _____

Employee ID# _____ Investigator: _____ Lab phone: _____

E-mail: _____ Confirm I passed (Must provide email address) _____

CERTIFICATION NOT GIVEN IF INFORMATION IS NOT READABLE OR INCOMPLETE

In order to become certified, you may miss FIVE or less questions. The notes may be consulted when answering this quiz. Please circle the "T" if "true", or the "F" if "false".

1. T F The Animal Welfare Act ensures that animals intended for use in research will be provided humane care and treatment..
2. T F Amongst other places they inspect, the USDA will inspect surgical and postoperative records for compliance with their rules and regulations.
3. T F Wild animals may be used for research and undergo IACUC approved surgery, but a valid permit must be obtained from Arizona Game and Fish in order to collect, purchase, transport or hold animals covered under State or Federal Regulations.
4. T F GLP studies involving surgery must strictly follow SOP's created by UAC, when the findings will be reported to the IRS.
5. T F The Controlled Substance Act allows UAC to sell you controlled drugs if you do not have a DEA license.
6. T F The UAC Surgery Section reviews all protocols to assure you are performing procedures in accordance with your approved protocol, but the responsibility is that of the researcher.
7. T F AAALAC is the voluntary organization that performs site visits on a 5 year cycle. They make recommendations and determine if the facility has met the accepted standard for accreditation.
8. T F The definition of "Aseptic Procedures" are those techniques and practices that are used to prevent microbial contamination of a surgical site.
9. T F Major surgery is defined as surgery that results in no impairment of physical movement or basic physiological function, and usually only involves external tissues.
10. T F Minor surgery does not penetrate a body cavity, and causes little or not physical impairment.
11. T F Survival surgery, regardless of species, is when the animal regains consciousness from anesthesia for a period of time.
12. T F An animal undergoing Non-Survival surgery will not regain consciousness from anesthesia prior to being euthanized.
13. T F A detailed list of drugs used in surgery (Anesthetics, Analgesics, Sedatives), may be found in the UAC/IACUC Handout "Anesthetics, Analgesics and Sedatives Currently Approved by the IACUC".
14. T F Routes of administration of drugs for rodents and non-rodent species can be by either Inhalation or Injectable (IM, IP, SC, IV).
15. T F Currently available and approved inhalation anesthetics include Isoflurane and Sevoflurane.
16. T F Antibiotics are rarely needed with aseptic surgery, but when used they only need to be administered 24 hours post operatively, and no records need to be kept.
17. T F The only method of administering Inhalation anesthetics is the induction chamber (such as a modified bell jar).
18. T F Gas sterilization is used to sterilize materials, such as rubber tubing, which can not withstand high temperatures.
19. T F A chemical with high level disinfection properties can be used as a cold sterilizer for objects such as rubber, plastic, and most stainless steel instruments.

20. T F Steam, at a temperature of 250degF for at least 15 minutes, is used to sterilize items which cannot withstand high temps.
21. T F Non-rodent surgery may only be performed in the designated surgical facilities of Animal Care.
22. T F Rodent Surgeries may be performed in the designated surgical facilities of Animal Care or a researchers laboratory if appropriate pre-surgical and surgical areas are present.
23. T F Non-rodent, non-survival surgeries can be performed somewhere other than the designated surgical facilities of Animal Care.
24. T F NPO forms, which are completed for non-rodent species, must be completed and turned into UAC no later than 12 hours before the animal is to be NPO'd.
25. T F All hair and fur must be clipped around the area larger than where the surgical incision will be made in case the incision site must be extended, and to prevent contamination from non-prepped areas.
26. T F Aseptically alternating between 70% alcohol and betadine (repeated 3 times), starting from the incision site and moving away from it in a circular pattern, is the appropriate method of surgical preparing an animal for surgery.
27. T F Fluid therapy is necessary to maintain and replace blood lost during surgery.
28. T F The only information required in a surgery record is the date and type of surgery. This can be completed after the procedure is finished.
29. T F Pre-op status of the animal, which includes membrane color, temperature, pulse, and respiration rate must be checked and noted. The agent used, dose, and time of administration of the pre-anesthetics, induction agent, and anesthetics given do not need to be recorded.
30. T F The surgical record should also include: a brief description of the procedure performed, the names of the anesthetist, surgeon and assistant surgeon, and any medications given to the animal during preparation or procedure such as antibiotics, analgesics or fluids as supportive treatment.
31. T F During the surgical procedure vital signs should be monitored and recorded in the Anesthesia Record, as well as any drugs given, doses and routes of administration, name of surgeon, assistant surgeon and any individual administering anesthesia.
32. T F Cap, mask, sterile gown and sterile gloves are all needed attire for a properly prepared surgeon.
33. T F An appropriate surgical scrub for the surgeon will last a minimum of 5 minutes, starting with the fingers and working toward the elbows.
34. T F After a 5 minute minimum surgical scrub, the hands can be dried on a paper towel, removing all water and residual soap.
35. T F There is a proper method for putting on a surgical gown – it assures the gown is not touched by anything, including the surgeons' hands. The UAC Surgical staff should be consulted on the first procedure to assure you are doing it correctly.
36. T F Although the first time one is gowning and gloving for surgery UAC Surgical staff should be consulted to assure it is done correctly, there is only one acceptable method of putting on gloves ... a Closed method.
37. T F If a surgeon is prepped, gowned and gloved in a sterile fashion, and a non-sterilized item is touched, he must immediately stop and change gloves.
38. T F During a surgical procedure, if a person has washed his hands he may touch any item on a surgical table or field.
39. T F While a surgical drape is placed over an animal to maintain sterility, rodent surgeries do not need to do this since they aren't sterile anyway.
40. T F There are several types of wound closure. The type of animal and problems that will occur with certain stitches must be considered. For example a subcuticular suture pattern is advantageous for skin closure in rodents, as they are inclined to chew or otherwise remove stitches.
41. T F Post Operative Care involves placing the animals back in their original cage immediately after a surgical procedure.

42. T F In the recovery period, for post operative care, the animals should be observed, antibiotics given if appropriate, analgesics administered, and observations recorded.
43. T F During the post operative phase, and while recovering the Vital signs should be monitored. This means 2 out of the following 5 should be observed: Monitor heart rate, Monitor respiration, Check body temperature/ touch/ thermometer, Check mucus membranes for healthy pink color, Check for signs of normal body movement.
44. T F Never recovery an animal on bedding, it should be placed in a clean dry, padded cage with a monitored heat source provided.
45. T F During the Recovery phase following surgery, the animals should be monitored and turned from side to side every half hour to maintain proper circulation, respiration and prevent nerve damage. Once the animal is ambulatory, it can be placed back in it's cage/pan.
46. T F Large animals, such as pigs, sheep, dogs, should be recovered from surgery by being placed in a heated cage or on the floor of a cage/pen with an appropriate mat, sheet, or blanket. They should be monitored until ambulatory where they can be placed back in their normal cage/pen/room.
47. T F As stated in the approved IACUC protocol, analgesics are given to the patient according to the dosage stated. This will be assessed daily and if adjustments need to be made the IACUC will be notified by submission of an amendment.
48. T F Once the surgery is performed, the animal recovered and placed in it's normal cage/pen, no further observation or record keeping is required (including drugs that may be given, as this is for the researcher's benefit anyway).
49. T F Euthanasia is the same for both rodents and non-rodents.
50. T F Euthanasia must follow the current methods recommended by the AVMA Panel on Euthanasia and must adhere to the methods approved in the IACUC protocol. Any changes to the approved method must be submitted in an amendment to the IACUC prior to being implemented.

DON'T LEAVE ANY QUESTIONS UNANSWERED, THEY WILL BE MARKED INCORRECT!

2007 Evaluation of "Take Home" Surgery & Anesthesia Module - Version A

Thank you for completing this "self-instruction" module. Please take time to complete the short evaluation form. Your comments are valuable in designing the style and substance of future certification courses to make this process effective for research staff. (circle one)

Was this packet useful? YES NO

Did you learn anything new? YES NO

Was the training adequate? YES NO

Was the packet too long? YES NO If so, suggested items to cut:

Were the questions too difficult or was it hard to find answers to the questions? YES NO

Did you like the self-instruction packet? YES NO, I would you prefer to attend a lecture.

Do you have any other comments or suggestions to improve this module? Topics not covered?