Euthanasia Techniques Laboratory
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A. Choosing an Appropriate Method

The method of euthanasia chosen by the veterinarian will depend on many things:

1. Comfort with the technique
2. Supplies
3. The presence of onlookers
4. The type and amount of euthanasia drug available
5. The signalment and physical condition of the animal

1. Comfort with the technique

When a veterinarian has experience with a particular technique, they know what to expect and how to handle the situation if something unexpected happens. All veterinarians should know at least two other methods in case circumstances indicate another technique is needed. Experience is gained with every euthanasia, but if something unexpected occurs, the attending veterinarian and staff should be educated on how to proceed in the animal’s best interest.

2. Supplies

As supplies are prepared, things should be included for a standard euthanasia procedure as well as emergency equipment. For injectable methods, various needle sizes, syringes, catheters, cleaning gauze, etc. needs to be accessible at all times. For physical methods, the equipment must be cleaned and ready for use. Veterinarians are encouraged to keep ample supply of all materials within the euthanasia room, in mobile-supply bags, etc. Depending on the animal being aided, this includes keeping enough inhalants, euthanasia solution, or bullets in stock to avoid the inability to carry out the procedure.

3. The presence of onlookers

Veterinarians know that as long as an animal is sedated or unconscious, most methods of euthanasia are humane. As long as death is as stress and pain-free as possible, and relatively quick, any of the approved methods are acceptable. However, when family members and clients are watching, the least aversive technique available should be chosen for that particular species. This may be an intravenous injection or a small mask with gas anesthesia. As long as it is explained to the client how the procedure will take place and the approximate time frame involved, most clients will be acceptable to the method chosen. Keeping communication open with the client and answering any questions they may have will help decrease their stress. Sometimes the clinician needs to prompt these questions due to the client’s state of mind, they may not think of things to ask. When a slower method is chosen, such as an intraperitoneal injection, onlookers should be prepared that death may take a few minutes. When venous access is impossible, due to poor pressures, overlying masses, too small of animal, etc., intracardiac
injections are commonly done. In the case of large animals, gunshot is often the most practical method, but the reaction of onlookers must be considered. Clients/family members typically handle the technique very well when they understand why it is done and their animal remains comfortable throughout. Once again, education is important to lessen fears of the unknown.

4. The type and amount of euthanasia solution available

Domesticated animal euthanasia is most commonly carried out using barbiturates or barbiturate-combination drugs. It is considered the most acceptable method, except for those intended for food use. All euthanasia solution labels should be fully understood before use. With proper pre-euthanasia anesthesia, barbiturates are approved for all injectable methods: IV, IC, IP, and intraorgan injections. If pre-euthanasia sedation or anesthesia is not available, barbiturate-combination drugs, such as those with phentoyin sodium, are not approved for IP use. The additive may cause cardiac arrest before the pet goes unconscious thus leading to distress. Potassium chloride must be given IV or IC under complete anesthesia. Factors like this should be understood before euthanasia is performed in any situation.

The amount of solution available is also important. Euthanasia should never be attempted without adequate amounts of solution ready for use. Each drug has a standard dosing protocol for each technique that needs to be strictly followed to achieve proper euthanasia parameters. For example, IP injections using pentobarbital require a dosing of 3 mls per 10 pounds of body mass versus the more standard IV amount of 1 ml per 10 pounds (Fakkema 2009). If improper levels of solution are administered, the animal may recover, causing distress to the animal, family, veterinary staff, and aftercare facility operators. Instances like these lead to distrust by the public and negatively impact the general perception of euthanasia by those considering it for their own pet.

If only a small amount of euthanasia solution is available, a technique should be chosen that requires the smallest volume possible, such as an intravenous injection. Injections into the abdomen will be riskier should use miss an organ and the euthanasia solution is taken up slowly causing nothing but prolonged sedation. Intracardiac injections can also be tricky, especially if it is difficult to locate the heart and the solution ends up in the lungs or pleural space. If there is not enough solution, the veterinarian will be unable to complete the euthanasia.

5. The signalment and physical condition of the animal

The signalment and physical condition of the animal being euthanized should always be a factor when choosing the euthanasia technique. Weight, size, disease, species, and even breed all contribute to how well a particular technique can be expected to work. Here are a few examples of differences that veterinarians will encounter:

* Weight – Obesity makes veins harder to see and feel, makes the chest wall thicker, creates large amounts of intraabdominal fat, and may lead to increased dyspnea during sedation/anesthesia. If the patient is an overweight cat, choosing an intravenous injection rather than an intrarenal injection might be advantageous because finding and isolating a kidney can be difficult. The sheer weight of some large animals can make working with them safely almost impossible and methods must be modified to protect staff and the animal itself.

* Size – When one is considering the length of veins, short-legged dog breeds are harder to euthanize than long-legged breeds. Small birds will have smaller, more delicate veins than larger birds, and so on. For obvious reasons, intracardiac injections are rarely, if ever, attempted on large animals. Size will also impact whether an animal can fit into an inhalation chamber, be euthanized with a .22 pistol versus a larger gun, etc.
* Age – Age can affect technique. Young neonates are difficult, if not impossible, to gain intravenous access on. An inhalant agent or IP injection of a barbiturate might be more commonly used in young animals. Young livestock may be easier to euthanize with a physical method due to their softer craniums. An older animal may be naturally weaker and have an underlying disease of some sort, forcing the veterinarian to tailor methods accordingly.

* Disease – The presence of illness, be it heart disease, cancer, renal failure, etc., can affect blood pressure, circulation, perfusion and drug uptake. If the animal has extremely low blood pressure, the veins might be inaccessible. If the heart wall is thickened, or is surrounded by a tumor or a hemopericardium, an intracardiac injection is more difficult. When peripheral edema is present, veins may be virtually impossible to find making it necessary to abandon an intravenous injection altogether. If a small animal has ascites or hemoabdomen, an intraperitoneal injection will be diluted into the abdominal fluid likely leading to a prolonged time of death, and so on.

Another factor to consider is how well the animal will tolerate pre-euthanasia sedation or anesthesia. If the animal in question is having a hard time breathing, a technique should be chosen that allows for rapid euthanasia before the dyspnea worsens. It is hard to watch an animal struggle to breathe while waiting for an intraperitoneal injection to stop the heart. The same is true for seizing animals or any other crisis situation that may present. Drugs and their associated side effects should be well understood before using them.

* Species – In most cases, dogs and cats are euthanized easily by intravenous, intracardiac, or intraabdominal injections. In general, intrarenal injections are easier to perform in cats due to the freely movable left kidney resting outside the retroperitoneal space (Cooney2011). Swine can be difficult to control negating the need for pre-euthanasia sedation or anesthesia. Inhalant gases are not recommended for use with reptiles and amphibians.

* Breeds – Different breeds vary in their physical and physiological attributes; leg length, head shape, hair coat, predisposition to disease, etc., all play a role in determining which euthanasia technique is the most appropriate. For example, brachycephalic dogs and cats have a tendency to become dyspneic under pre-euthanasia sedation/anesthesia and also may overheat when outdoors or lying in front of the fire. It can be nearly impossible for an inexperienced veterinarian to locate the jugular vein on a sheep due to its thick wool, and if clippers are not present, a physical method might be required, and so on.
B. Non-inhalant Pharmaceutical Usage in Dogs and Cats

Intravenous Injection

In order to perform an intravenous euthanasia, the veterinarian or staff member will need to find a vein that can be injected with euthanasia solution. The accessory cephalic and cephalic veins in the front leg and the medial and lateral saphenous veins in the back leg are generally easy to see and feel. Each has its pros and cons. The administrator should pick the one that is most appropriate under the circumstances.

The veins themselves will be covered with the skin and usually lie on top of or in the grooves between neighboring muscles, tendons, and ligaments. Depending on the dog or cat, it may be necessary to first shave the intended area of injection. Shaving close to the skin provides a better view of the vein thus minimizing multiple injection attempts (Rhoades 2002). If an awake pet does not like the sound of clippers, their use should be avoided or a pre-euthanasia sedative given to lessen distress.

The vein will need to be occluded by either a tourniquet or assistant ‘holding off’ the vein to build pressure distally. Occlusion of the vein should be done proximal to the injection site and with enough pressure that the vein can be easily seen and felt. In an awake animal, this should be done gently enough as to avoid added stress. A socialized pet responds well to soft touches and supportive talking. If the vein cannot be easily seen or palpated, occlude again, gently squeezing the leg to increase venous blood return.

The lower on the limb the vein is, the more ‘roly-poly’ it becomes. In general, the more proximal to the body, the more stable they vein becomes. This is due to the surrounding muscle bodies, fascia, etc. When choosing your injection site, consider skin diseases, masses, etc that will make placement difficult.

When preparing to inject, either via direct venipuncture with a needle or with catheter use, hold the vein in place to minimize lateral movement. The cephalic vein can be supported on the side by the administrator’s thumb. For the saphenous vein, which tends to be very movable, the administrator can secure the vein distal to the catheter site using their thumb. Actually placing the thumb over the vein and applying a little tension distally will straighten out any kinks in the vein and tighten the skin. This essentially traps blood between the tourniquet and thumb, hopefully creating a nice target. Medial saphenous veins can be held in place by either technique. In general, keeping the skin tight over the injection site will also help anchor the vein and make injection easier. For direct venipuncture with euthanasia syringe and needle, the administrator should draw back and check for blood. To be safe, the administrator should do this at least once during venous administration to make sure that the needle is still placed correctly.

More and more veterinary teaching institutions are recommending catheter placement for all intravenous euthanasias. It is considered the gold standard for IV injections, even in sedated dogs and cats. Catheters help ensure that the euthanasia solution given will not accidently be placed outside of the vein, as can happen with direct venipuncture. Direct venipuncture, either with a needle or butterfly catheter, creates a risk of the needle puncturing through the vein at any time. Catheter placement also opens up the option to offer the family some privacy before proceeding with the euthanasia (Cooney 2011). Catheters can be sealed with either a male adapter or extension set. An extension set is commonly used to allow the administrator to sit further back from the pet, giving more room for loved ones to gather close. Luer locking mechanisms on either is recommended to help prevent leaking or dislodging of the syringe from the catheter hub. In the event of an emergency, a syringe with euthanasia solution may be directly connected to the catheter for more rapid administration.

If a good vein should ‘blow’ at anytime during the initial catheter placement, injection, etc., it may still be possible to inject distally to the extravasation site, especially if the vein is
highly visible there and moving to another leg will prove difficult. This location is not standard practice for a pet expected to survive, but when euthanasia is the objective, it is acceptable. Saline should be administered to check the new needle/catheter placement to see how much leakage there is at the original extravasation site. If there is little to none, which is usually the case, the euthanasia solution can be given while applying gentle pressure to the area. Only attempt this if the pet is deeply sedated or completely anesthetized, due to the risk of pain from even slight euthanasia solution extravasation. Veterinarians should also inject more euthanasia solution than necessary due to this mild extravasation.

When families are present, the injection preparation can be a difficult time. They know that with every step completed, they are getting closer to the end. Offering reassuring words that things are proceeding as they should is helpful. If venous access is proving difficult, let those present know that everything is under control and their pet is doing fine. In this author’s experience, families do not want to know technical details more than necessary. To avoid the technical portion, many clinics remove the pet back to the treatment area for catheter placement; however, this may disconnect the family and their pet at a very critical time. When possible, a technically skilled staff member or the veterinarian themselves may want to do everything in the room with family present. If they are interested in talking, ask them to tell a story about their pet. If they prefer quiet time for reflection, veterinarians and staff can continue in silence. In the case of a fractious pet that is reluctant to hold still for the injection, giving a pre-euthanasia sedative will make the process easier on everyone.

The standard barbiturate injection amount is 1 ml per 10 pound body weight for both dogs and cats. If the exact weight of the pet is unknown, make the best educated guess possible and give at least 2 mls more than the required amount (Cooney 2011). Giving more than recommended will hold true for any kind of euthanasia solution given. It also helps to have some extra euthanasia solution in the syringe in case the drug leaks from a catheter set up, such as when a luer lock is not securely fastened. If the euthanasia solution is extremely viscous, it can be diluted with saline to ease its movement through the needle and/or catheter.

Once the needle is inserted directly into the vein or a catheter is placed, inject slowly and steadily to avoid putting too much pressure on the area. When all of the solution has been properly injected, the needle or catheter may be removed. Apply pressure to the injection site to stop any bleeding. A catheter may be flushed with saline to clear any residual solution. The injection site should be checked to make sure there is no bleeding before allowing anyone to hold the body.

When performing an intravenous injection, death occurs very quickly. The onset of death with a barbiturate should be seen within 30 seconds or so (Fakkema 2009). Potassium chloride is also quick. As of 2011, overdoses of propofol or xylazine for euthanasia purposes have not been adequately studied and consistent time to death is unknown. Anyone present for the euthanasia should be told what to expect and how fast the death will occur. If the pet is sitting, it should be gently guided down toward the table or floor to avoid a rapid drop. In this author’s experience, it is the sudden collapse that is most surprising to loved ones watching.

Technical Challenges

During the injection, there are a few scenarios that can occur leading to a less than perfect IV euthanasia. One such technically challenging scenario is the vein that cannot be found. Veins can be difficult to find for a variety of reasons: poor venous pressures, thickened or loose skin, improper tourniquet placement or handler holding technique, poor lighting, etc. Those present to help with the euthanasia procedure should work together to prepare the site for injection. The administrator should be comfortable with the vein and only attempt injection when success is likely. If IV euthanasia of a dog or cat is being attempted by one person without assistance, pre-euthanasia sedation is strongly recommended, especially for fractious animals.
If a leg vein cannot be found, and intravenous euthanasia is the only acceptable method given the circumstances, a tongue vein or the jugular vein can be used. The tongue has multiple veins along the ventral surface, but one vein will likely be more prominent than the others. Tongue veins do not have valves sometimes making insertion of a needle or catheter easier (Evans 1993). They can be occluded and stabilized similar to leg veins. Tongue veins should only be used in extreme situations, especially when family is present and the personal nature of working in the pet’s mouth. Due to the difficult location, all animals should be heavily sedated or anesthetized before attempting to inject a tongue vein. Jugular veins may also be used. Shaving the neck is encouraged to improve visibility. Depending on the dog or cat’s neck structure, veins can be deep and difficult to palpate. Assistance is recommended when attempting to inject the jugular vein. A staff member or client can apply hand pressure near the thoracic inlet to improve vein size.

Another poor scenario is extravasation of the solution. If a bleb is seen forming in the surrounding tissue, the needle or catheter has slipped out of the vein. If the pet is fully sedated, there should not be any reaction. An awake animal will feel pain upon extravasation of the euthanasia solution. This is due to increased pressure within the subcutaneous space and/or the chemical properties of the drug. The pet will likely vocalize or try to pull away from the injection site. A second injection attempt should be tried higher up the leg. What makes this scenario challenging is that the bleb makes placing a new injection proximally very difficult. The SQ bleb obscures the administrator’s view of the original vein and may force the use of another one. Proceeding quickly helps keep the family comfortable and limits the time available for the misplaced injected solution to absorb and lower blood pressures. In the worst-case scenario of not being able to access a vein in another leg, the veterinarian will need to switch to another euthanasia method like the intracardiac or intraabdominal injection.

Another difficult situation is when a catheter is placed within the vein, but the solution will not flow. Causes for this are a kinked catheter, a plug within the tip (either tissue or blood clot), or the tip pressed up against a venous valve or wall. When this happens, the catheter should be pulled out ever so slightly to see if flow resumes. If not, a new catheter will need to be placed proximally and the procedure started over.

If there is leakage around a properly placed catheter, the adaptor or extension has not been securely fastened together and solution is able to leak out. If this occurs, the setup should be examined and the problem corrected before proceeding. More solution may need to be drawn up if too much as leaked out and euthanasia cannot be achieved with the remaining amount.

Actively seizing pets also pose a challenge. To place a catheter under these conditions, the administrator should use the leg that has the biggest vein or they feel most comfortable with. If someone is willing to help, they may steady the leg. With a back leg, they may push the stifles straight, and for the front leg, they can brace the elbow. Front legs tend to extend during seizures, which can be helpful when no one is available to assist. If the legs are paddling too much, the euthanasia injection may be administered into the heart or abdomen. Intracardiac injections are preferred because of their rapid action. Intraabdominal absorption can take a long time and the pet will continue to seizure in the meantime.

Not having enough euthanasia solution may be the biggest technical challenge of all. This happens when the pet weighs more than anticipated, the pet is not passing normally and all remaining solution has been given, or stocked supply fell below normal amounts. Whatever the situation, it is important to find the next logical course of action to prevent suffering. If the inadequate amount is found before euthanasia is attempted, more solution should be acquired before proceeding. If the euthanasia procedure is in progress, an overdose of sedatives/anesthetics on hand, such as propofol, xylazine, or an inhalant gas like isoflurane, can be administered. However, at this time, there are no scientific reports on the appropriate dosing of propofol, xylazine, or any other injectable anesthetic for euthanasia in dogs. One manufacturer of propofol gave an LD50 of 30mg/kg and suggested that 100mg/10lbs may be adequate for euthanasia.
Something like this is only recommended in the direst of circumstances due to superior, more reliable and inexpensive methods.

When no other drugs can be utilized, and euthanasia must be accomplished, a physical method will need to be attempted under anesthesia. If the euthanasia drug used was a barbiturate like the common pentobarbital, a dose of 25-30 mg/kg IV may have already been given and is sufficient for anesthesia of dogs and cats (Plumb 2005). An example of this dose would be 1.5-2 mls of pentobarbital solution given IV to a 50 lb dog. Physical methods can then be attempted including gunshot, exsanguination, etc. Anyone present should be advised on the manner of death and reassured that their pet is free of pain and stressors.

**Intracardiac Injection**

Veterinarians have performed intracardiac injections for a very long time. Veterinarians choose cardiac sticks for a variety of reasons, most often when veins are not accessible or when an immediate death with little to no preparation is desirable, such as with a seizing dog. However, no studies have ever been conducted comparing this method to other euthanasia techniques or to determine what depth of sedation is necessary for a dog or cat to be completely pain free. The challenge is to perform the procedure accurately, and when the family is present, perform it perfectly on the first attempt.

The simplest way to give an intracardiac injection is to have the pet lying in lateral recumbency on either their right or left side. A pet lying on its right side is the standard position. The heart is easy to auscult from the left and the left ventricle is usually the easiest chamber to locate due to its size. The left side of the chest also has fewer lung lobes, but the right side does have the cardiac notch where no lung tissue resides. Heart and lung disease can complicate things; thickened myocardium, tumors, displacement, pulmonary edema/effusion, etc., even a large lipoma over the chest wall can make an intracardiac injection difficult. In terms of death, there is little difference between using the right or left side of the heart. When injecting the right side, the right ventricular chamber is usually smaller than the left making injection more difficult. Once located however, time to cardiac arrest is essentially the same, even though solution from the right ventricle must pass through the lungs before making its way up to the brain.

A normal dog or cat will contain the following anatomical features that must be penetrated for a successful intracardiac injection (Evans 1993):

From outside inward
1. Skin
2. Body wall with costal musculature
3. Costal pleura
4. Pleural cavity
5. Pericardial pleura – part of the medistinal pleura
6. Fibrous pericardium
7. Serous pericardium
8. Pericardial cavity
9. Epicardium
10. Myocardium
11. Endocardium
12. Ventricular chamber

If the lung is penetrated, the needle must pass through the pulmonary pleura and lung tissue itself.
The heart in most dogs and cats will reside from the 2nd or 3rd intercostal space (ICS) to the 5th or 6th ICS and from the sternum about two-thirds of the way up the thorax (Pasquini 1992). In this author’s experience, the heart is usually more cranial and ventral than one might think. When auscultating the heart, the administrator must pinpoint the PMI or Point of Maximum Intensity. On the left side of the chest, this will likely be the point of the aortic valve located in the 4th intercostal space at the level of the shoulder. On the right side, the right AV valve will generally be the loudest and is also in the 4th intercostal space at the level of the olecranon/elbow. The olecranon is located near the 5th intercostal space so there will be little heart caudal to this point in a normal chest. A stethoscope or hand can be used to find the Point of Maximum intensity (PMI) on the chest wall. If necessary, the administrator can grasp the lower antebrauchium and press the elbow up the chest wall to simulate where it would normally be if the dog or cat were standing. A good place to insert the needle is usually just a bit cranial to the point of the elbow. Combining the location of the PMI with this landmark should help locate the heart.

Before attempting an intracardiac injection, all supplies should be ready to go before even locating the injection site. The animal must be completely unconscious and should not react in any way to the injection. It could be considered malpractice if the veterinarian’s hand or a drape of some sort can be placed to limit visibility. When the veterinarian thinks the heart has been located, the syringe plunger can be withdrawn to check for blood. Proper placement leads to a rapid uptake of blood. If only a small amount is found in the needle hub, the needle is within myocardium or small capillary. If negative pressure occurs within the syringe, the needle tip is within or against something solid (e.g., the myocardium, a tumor, a pleural lining, etc.). The needle should be advanced further and aspiration attempted again. If blood is still not found, the veterinarian can gently redirect without removing the needle completely from the chest. The only time to completely remove the needle is to draw up more solution.

A large syringe, with extra room for aspiration, should be used to hold the solution. When injecting into the heart, the veterinarian will draw back blood to make sure they are within a chamber and therefore a little extra room in the syringe is necessary. If giving 6 mls of solution, this author recommends using a 12 ml syringe rather than a 6 ml syringe. Blood, pulmonary fluid, and air can be aspirated into the syringe. Once obvious blood is in the syringe, the veterinarian is free to inject the euthanasia solution. It is always good practice to draw back again halfway through the injection to check for proper placement. This will not be necessary for those proficient with this technique. When all of the solution has entered the heart, death should occur quickly.

Administering more solution than required is good practice with intracardiac injections (Cooney 2011). If the pet weighs 40 pounds, and the solution dose is 1ml per 10 pounds, administering at least 6 mls will help ensure death takes place. There is no limit to how much solution can be given with any technique. A higher volume allows for minor accidental injection outside of the heart, which is never ideal, but does commonly occur.

When the veterinarian is holding the syringe in the heart, it may move along with the contractions. This is disturbing for any loved ones present to see, so the syringe should never be let go. A free hand can be used to shield the syringe from view if necessary. When properly performed, the intracardiac injection is no more invasive than any other technique; however, those present should be prepared for what they will witness. If anyone expresses concern, the veterinarian’s hand or a drape of some sort can be placed to limit visibility.
Before performing an intracardiac injection, the administrator may need to share with the family why this method is best for their pet. In this author’s experience, some families have found it difficult to watch and accept, especially when proven to be technically challenging. When the pet is unconscious, this technique remains one of the most efficient methods used today.

**Technical Challenges**

Due to the higher level of skill required to perform intracardiac injections, more technical challenges present. The administrator cannot see the heart itself so the injection site location is based solely on anatomical landmarks and auscultation. What exactly lies beneath the chest wall can only be learned once the technique is started. Ultrasound or radiography might be used to increase visibility.

If pulmonary effusion/edema is present, pulmonary fluid may be aspirated before blood. Having extra room in the syringe will allow the administrator to redirect and try again without having to draw up a new syringe full of euthanasia solution. The same holds true for air aspirated from lung tissue, airways, etc.

When the heart is difficult to locate, and the syringe is full of fluid (both solution and pulmonary fluid) or air, the syringe can be gently expressed in the chest. If this does not seem like a viable option, the administrator can express the contaminated syringe contents into a towel or trash container and redrew fresh solution to start again. Injecting a small to moderate amount of euthanasia solution into the chest of an unconscious animal should not have any adverse effects (Cooney 2011). All wasted drug will need to be recorded.

There will be times when the heart is impossible to find; the chest is too deep, the needle length is inadequate, the heart is not in the standard position due to disease, etc. When the heart cannot be located, it will become necessary to attempt another technique altogether. When loved ones are present, multiple intracardiac needle insertions are not advised. Another technique should be attempted as soon as it becomes evident that the heart cannot be found. This will help lessen stress for those watching.

In the rare instance when ample blood is in the syringe and the solution is injected successfully, but the pet is not passing, the solution has been third spaced somewhere. The solution is possibly trapped in the pericardial cavity or some other blood-filled space and cannot make its way to the brainstem. At this point, the administrator should attempt another cardiac injection or move to another location like the liver.

Sometimes pushing down on the needle during injection will move it out of the ventricular chamber. A steady hand is needed throughout the injection. If the needle moves out of the chamber during injection, the needle should first be redirected to locate it again. If blood cannot be found, the contents of the syringe can be expressed within the chest and the procedure immediately started again.

**Intraperitoneal Injection**

An intraperitoneal injection is generally considered easier to perform than most other methods. It is a nice alternative to IV injections when poor venous pressures are observed. The euthanasia solution is given into the peritoneal space, i.e. the abdomen. The solution must therefore miss neighboring organs or the administration would be considered intraorgan, and without anesthesia, is considered painful. Intraperitoneal injections are very common and work on all domesticated cats and dogs, including young kittens and puppies. Fetal euthanasia is also commonly achieved via this method following the removal of the uterus from the bitch or queen.

Shelters in particular use this technique on a daily basis due to the low level of skill required to perform them and that no sedation is required for pure sodium pentobarbital administration. According to the 2011 AMVA euthanasia guidelines, only pure barbiturates are
approved for IP injection in awake animals. Barbiturate combination drugs, such as Beuthanasia-D® from Schering-Plough, are only approved through IV or IC injection because of the added component phenytoin sodium. Should phenytoin sodium be absorbed first, leading to premature cardiac arrest before pentobarbital-induced unconsciousness, the animal may experience distress. Please refer to the drug reference sheet for all approved solution administration sites.

There are two approved sites of intraperitoneal injection: ventral midline caudal to the umbilicus and low on the right lateral abdomen (Rhoades 2002). These locations prove most reliable for avoiding abdominal organs. Smaller needle length such as ¼” up to 1” is recommended to avoid deeper organs. If the body wall is abnormally thickened, a longer needle should be used. To minimize pain, the needle bore size should be appropriate to the size of the animal and the solution given at a rate of 1ml per second. Newborns handle 25-gauge, 5/8-inch needles well up to 20-gauge, 1-inch needles in obese cats (Fakkema 2008).

The needle should be inserted at an angle slightly toward the head and the syringe plunger pulled to check for fluid. If no blood or fluid is seen in the syringe, the administrator may inject the solution. Because the euthanasia solution is moving into the blood stream through absorption across abdominal organ membranes and serosal linings, it may take longer to achieve cardiac death. An awake pet may take up to 10-15 minutes to reach unconsciousness with another 5-10 minutes before cardiac arrest (Rhoades 2002). It may take this long or longer for a sedated pet to die due to lowered blood pressures. When necessary, the abdomen can be gently massaged to help the solution absorb.

Dogs and cats that are not pre-sedated should be placed in quiet rooms, cages, etc. free of distraction. This will allow a smoother transition into unconsciousness. The animal may paddle, appear disoriented, lick their lips, and vocalize a bit as the drug starts to take effect. These movements correlate to Stages 1 and 2 of anesthesia (Fakkema 2009). If the owner is present, they can hold the pet offering comfort, but due to the unpredictable nature of Stage 1 and 2 anesthesia, risk of personal injury should be considered. Pre-euthanasia sedation/anesthesia might be warranted when owners are present. In this author’s experience, sedation does not appear to greatly increase time to cardiac arrest.

Intraperitoneal injections require the administration of more barbiturate solution than the standard 1 ml per 10 lbs. The recommended dose is 3ml per 10 lbs. If more than one injection is needed when family is present, the family can be updated on why more is being given. Because waiting for a pet to die can be difficult for some, injecting an area of high perfusion such as the liver or kidney under anesthesia is recommended over the standard IP injection. Death must be verified closely to make sure deep unconsciousness is not confused with death and the pet subsequently recovers.

Technical Challenges

There has been discussion on the validity of this technique without pre-euthanasia sedation/anesthesia due to the possibility of abdominal irritation from barbiturate injection. Specifically, a study looking at abdominal irritation in rats following barbiturate injection demonstrated tissue irritation (Wadham 1997). If subsequent studies demonstrate consistent findings, pre-euthanasia sedation/anesthesia may be required for all IP injections using pure barbiturates. As of 2011, Vortech Pharmaceuticals is working on FDA approval of a new barbiturate-combination drug (FP-3®) containing lidocaine. This solution works by eliminating pain at the injection and absorption site. If effective, FP-3® may be an ideal IP injection solution for awake or sedated pets. Until a combination product like this is marketed, local anesthetics may also be given to lessen pain at the injection site.

Based on the speed of abdominal absorption, it is possible for this technique to take up to an hour or more before death is achieved. Abdominal fluid, weak blood pressures, and simply
third spacing can all contribute to the rate of absorption. When these factors are taken into consideration, IP injections may not be the best technique to use.

This technique requires specific solution be given in an awake animal. Pre-euthanasia anesthesia must be given when administering a barbiturate-combination drug. Anesthetic overdoses with propofol, xylazine, etc. are not appropriate for IP injections. Pure barbiturates are the only drug allowed for this technique. More solution must be administered to avoid deep unconsciousness without cardiac arrest.

If an organ is injected in an awake pet, the pet will likely squirm and try to move away from the handler. The injection should be stopped and redirected. If all the available solution has been given, and the pet has not died within a reasonable amount of time, more solution should be quickly acquired before the pet regains consciousness or a physical method of euthanasia should be performed.

**Intrahepatic Injection**

The liver is large, highly vascular, and is usually easy to palpate. Veterinarians choose intrahepatic injections over intraabdominal injections because of the improved uptake of the euthanasia solution, especially when owners are present. This organ resides right up against the diaphragm and for the most part, takes up to half of the caudal rib cage space. Seated within its curvature will be the stomach, gall bladder, and proximal small intestine. When an intravenous injection is not viable, an intrahepatic injection can be a great alternative (Cooney 2011).

Like intracardiac injections, intrahepatic injections need to be done in unconscious pets. They may cause pain in an awake pet due to parenchymal swelling and possible irritation from the euthanasia solution. Before injecting the liver, absence of deep pain and reflexes should be checked; pinch the toes, touch around the eye, etc. When no response is seen, the administrator is safe to inject. Because the pet is unconscious, it will likely be laterally recumbent making hepatic injection easier.

A needle long enough to reach the liver should be used. With small pets, a 1 inch needle should be adequate, but in larger pets, a 1.5” or 2” needle may be necessary. To inject the liver, the needle will have to be placed in the notch on either side of the xyphoid process or wherever a liver lobe can be easily palpated. The liver is best reached by aiming cranially, up under the last rib of the laterally recumbent pet. Inward pressure with the syringe or with the administrator’s free hand will allow the needle to move deeper. Aspirating and detecting blood usually indicates the needle is correctly placed, however, absence of blood does not mean the placement is wrong. Intrahepatic injections are effective from either the left or right side of the body.

Intrahepatic injections require the administration of more barbiturate solution than the standard 1 ml per 10 lbs. The recommended dose is 2ml per 10 lbs (Cooney 2011). If more than one injection is needed when family is present, the client can be updated on why more is being given. Death should occur within about two minutes or so with a well-performed intrahepatic injection (Grier 1990, Cooney 2011). Cessation of breathing should be almost immediate. In case the injection does not entirely penetrate the liver, anyone present should be prepared that death may take up to 10 minutes or more.

**Technical Challenges**

If the administrator feels the liver was not injected properly, death may not occur in a reasonable amount of time and more solution should be given, especially when loved ones are present. A second full dose of solution may be injected towards the liver again or placed in another area of high perfusion like a kidney. If the second injection is given and the pet continues to breathe, the administrator may gently massage the region to increase blood flow and absorption.
time. When cardiac death takes longer than 10 minutes, an intraperitoneal injection was performed or the area of liver injected was not well-perfused. If all the available solution has been given, and the pet has not died within a reasonable amount of time, more solution should be quickly acquired before the pet regains consciousness or a physical method of euthanasia performed. Good planning will help to prevent this.

**Intrarenal Injections**

Intrarenal injections are a viable option for cats and small mammals. This method is a great choice if venous access is difficult or when preparing a catheter site is too obtrusive. This technique is non-invasive and works well when loved ones are present. They can easily hold the pet on their lap keeping the human-animal bond strong. As with intrahepatic injections, renal tissue will improve the rate of absorption over standard intraperitoneal injections. Complete unconsciousness is required to attempt this technique. For instructional purposes here, this technique will be demonstrated in cats.

Feline kidneys and kidneys of small mammals are usually easy to palpate, especially if the animal has a normal to poor body condition score. The kidneys are a paired structure lying adjacent to the sublumbar muscles along side the vertebral column. Increased abdominal fat decreases the administrator’s ability to isolate either kidney. Assuming both kidneys are present, the administrator will be able to choose the most appropriate one to inject.

In general, the right kidney will reside more cranially than the left. It is usually located just under the last 2 ribs along the dorsum. The left kidney in contrast is more caudal and free of the overlying ribs. In cats, the left kidney rests outside the retroperitoneal space making it easier to isolate than the right.

When choosing which kidney to inject, the administrator can use the one they feel and isolate the best. This author, being right-handed, prefers to use the left kidney. If a cat is in renal failure, the kidneys may be smaller, have a nodular feeling, or even be impossible to locate. Abdominal masses or fecal balls in the colon are sometimes confused with kidneys. Should one kidney be assessed as unusable, the other may be tried.

Once the feline patient is completely anesthetized, it should be laid in a lateral recumbent position either on a table, owner’s lap, etc. The administrator will move their hands along the abdomen to find the kidney and feel for any abdominal muscle tensing. If the cat tenses, it is not yet in a surgical plane of anesthesia and ready for injection. If necessary, more pre-euthanasia anesthesia will need to be given until no response. For left kidney injections, the cat should be positioned on its right side with legs facing away from the administrator. For right kidneys injections, the cat should be down on the left side and a finger used to draw the kidney caudally from under the ribs. The right kidney will shift by only a centimeter or two.

When ready for euthanasia, the administrator may likely need to use both hands to gently isolate the kidney before switching to one hand to hold it in place. From the cat’s downside, a hand can help to push the kidney upward for easier grasping. Once within reach, the administrator’s less-dominant hand can cup the kidney within their fingertips raising an it up as far dorsal as possible.

If this cupping motion proves too challenging due to abdominal fat, scar tissue, etc, the kidney can be trapped firmly in a position by pressing the index finger and middle finger at each renal pole. The kidney will need to be held in place throughout the entire injection. When loved ones are present, any manipulation of the abdomen should be subtle.

To inject, the administrator will hold the syringe alongside the body travelling directed towards the dorsum (see illustration 5.6). A 1” needle length of 18-22 gauge should be sufficient to easily penetrate the kidney. Diseased kidneys can feel granular, cystic, etc making needle insertion more difficult. The syringe can be shielded from view by tucking it below the hand
holding the kidney. This is a very effective way to hide the injection from onlookers. If the kidney is located deep in the abdomen, the syringe will have to be held more perpendicular to the body.

The needle should be inserted deep within the renal parenchyma, avoiding the renal pelvis. Injecting the pelvis may move the euthanasia solution into the ureter limiting absorption. The kidney is a highly perfused organ, as one might expect based on its function, making it an ideal organ for rapid uptake of solution.

As this technique is considered relatively new, there remains no standardization of euthanasia solution dosing, however barbiturates are the only type of drug used. Private practitioner reports indicate that anywhere from 2 mls per 10 lbs up to 6 mls total per cat is effective with a properly executed injection. This author administers 6 mls per cat with excellent results. Whatever the volume, the kidney may swell due to increased pressure within the renal capsule. This is a good indication that the needle is positioned properly within the renal cortex. Kidney swelling does not guarantee immediate death, but it does increase the odds that death will occur faster (Cooney 2011). A proper injection within a viable kidney should produce respiratory and cardiac arrest within 30 seconds or so. Depending on the volume of solution given, the cat may pass before completing the injection. As with intrahepatic injections, loved ones present should be informed their pet may pass immediately or within just a few minutes.

Technical Challenges

A common technical challenge with intrarenal injections is losing hold of the kidney. If the administrator accidently inadvertently lets go of the kidney mid-injection, and it cannot be quickly isolated again, the needle can be gently advanced toward the liver or spleen and the injection finished. This may not be necessary if the majority of the solution was administered before the kidney was lost. However, giving the remaining solution into an area of high perfusion helps to guarantee a more rapid death.

Another challenge is the absence of the administrator’s preferred kidney. Many older pets, cats in particular, have small to non-existent kidneys on one side making injection more difficult, especially when moving the pet is not an option with loved ones present. It can be awkward to roll a pet over onto its other side when an owner is holding it close. An example of this is the left kidney missing from a cat lying on its right side. The right kidney must now be used. If the right kidney cannot be fully grasped while the cat is lying on its right side, it can be isolated using the index and middle finger from the administrator’s non-dominant hand. These two fingers will essentially ‘trap’ the kidney in place for injection.

Some well-placed intrarenal injections will result in prolonged time to cardiac death. Reasons for this prolonged time may include poor venous pressures, injection of a diseased kidney, or injection into an area of minimal vasculature such as the renal pelvis. These reasons are purely speculation as no scientific studies have been conducted to date. Whatever the reason behind the prolonged time, there are ways to compensate. If the administrator has injected the full dose, and the pet is still breathing, a repeat injection may be given immediately following. When the family is present, the second injection can be explained as ‘giving the rest’. In general, when administering any type of euthanasia solution with any method other than intravenous injection, loved ones present can be prepared for up to two injections. When one injection is not achieving death in a timely manner, a second can always be given. In the case of intrarenal injections, this author immediately administers a second full dose whenever breathing continues following the first injection. The second injection may be directed toward the same kidney, assuming it is viable, or injected deeper internally. However, the spleen may be best to avoid since splenic injection may lead to slower uptake (Grier 1990). Based on preliminary findings from a retrospective study on intrarenal injections in cats 2011, a second injection within an area of high perfusion should lead to cardiac death within 2 minutes.