



# Guide to Veterinary Surgery

If you are like most people, you want to know what you are paying for and why things cost what they do. You will find that veterinary providers are all different, and you may find that the prices for things like spay and neuter surgeries are quite variable. What costs \$45 at one clinic might be \$200 at another. Unless you know what to ask, it's hard for you to know what the differences are between the two options. After all, a neuter is a neuter, right? Well, not exactly. We have put together this guide for you so that you can ask informed questions and make informed decisions about your pet's health care. Below you will find a lot of fact, some opinion, and a lot of advice - but advice is what vets are good at!

## 1. Pre-surgical examination

In order for your pet to have a safe surgical experience the veterinarian performing the procedure should be familiar with your pet's history and physical condition. At the very least, this means that the veterinarian should have a copy of the records from any previous veterinary visits, be informed about any significant medical problems, drug allergies, and should perform a complete physical examination of your pet before beginning any part of the anesthetic regimen. This is very important; pets with certain health conditions can be high-risk patients for anesthesia.

For example, a heart murmur in a young dog might mean a serious heart defect, and anesthesia could prove fatal. On the other hand, some heart murmurs in puppies can be "innocent" and pose no threat at all to the dog's health. An examination well before the day of surgery will reveal most potential problems and allow the veterinarian to investigate any potential problems before "zero hour".

Probably the most important factor is the veterinarian's familiarity with your pet. If he or she has examined your pet several times over the course of puppy- or kittenhood, chances are they will already know about any potential pitfalls. There will also be a sense of trust between you and your veterinarian.

## 2. Pre-surgical blood testing

On the whole, routine full pre-surgical blood testing in apparently healthy, young animals (such as those presented as young animals for spaying and neutering) may be of little practical value. Approximately one in one thousand pets in this category that undergo screening will have an abnormality that results in a change in the anesthetic or surgical protocol.

Having said that, there are a few minor tests that can be performed quickly in the clinic the day of surgery that will be indicators of major problems such as infection, blood sugar abnormalities, anemia, kidney insufficiency, all of which could significantly effect the process of anesthesia and surgery, and inhibit recovery or even be fatal. A hematocrit test (or packed cell volume, PCV) will tell the veterinarian whether a pet is anemic. A urine specific gravity (USG) will tell us whether the kidneys are working properly and concentrating the urine, and a blood urea test (BUN) will also indicate good kidney function. A blood glucose will tell us if the patient is a diabetic or is able to regulate his own blood glucose. Looking at a blood film can tell the veterinarian whether the platelet numbers are adequate for clotting, and whether the white blood cells and red blood cells are normal. These tests can be performed in just a few minutes.

There are certainly reasons for doing tests if the surgery is not routine or if the patient is not a young healthy animal. Whether to do pre-anesthetic blood testing of any kind is a decision between you and your veterinarian.

## 3. Pre-operative analgesics

We now know that by giving pain medications before the pain signals are sent, we can significantly reduce the amount of pain experienced after surgery. Analgesics sit on the pain receptors and prevent the so-called "windup" of the pain response. Other things prevent windup as well, which we will discuss later. The pre-op analgesic is usually given in the same injection as the sedative, and in some

cases is the same drug (e.g. morphine can act as both a mild sedative and an analgesic).

For some surgeries we can pre-place transdermal patches. These all work the same way, whether they are nicotine patches for soon-to-be-ex-smokers, or pain patches. In all cases a small, measured dose of the drug is released in a controlled manner from the patch and is absorbed across the skin into the bloodstream. For pain relief we place patches with a drug called fentanyl approximately 12 hours before surgery. By the time surgery is performed, there are therapeutic levels of fentanyl in the body and the drug is able to prevent pain windup.

#### **4. Pre-operative sedatives**

Most animals in the hospital, just like people, experience some anxiety. If there is a lot of adrenaline rushing around the body it can affect the way the anesthetic drugs work, as well as making the heart more sensitive to some of the drugs. To counter this and make the pet more comfortable a sedative should be given before anesthesia. With a good sedative on board the animal will need less anesthetic agent and will have a smoother induction and recovery from anesthesia.

#### **5. Intravenous fluids**

In my opinion, without exception, patients undergoing general anesthesia must have an intravenous (IV) catheter in place before anesthesia is induced. There are two main reasons for this and both are critical. The first is that the intravenous catheter provides a route to give drugs quickly into the circulation in case of an emergency. If something happens and the blood pressure falls, it is extremely difficult to raise a vein and place a catheter after the fact, and placing an IV catheter takes several minutes. By the time the catheter is in place it may be too late. With a catheter in place, emergency drugs can be given rapidly and easily with no loss of precious time, potentially saving the animal's life.

The second reason to have an IV catheter in is that for most elective surgeries an animal should be receiving intravenous fluids for the duration of the anesthetic period. We are giving a number of drugs that will affect the blood pressure. Most will cause the blood vessels to relax, the heart to slow, and consequently the blood pressure to fall. Intravenous fluids help to keep the blood pressure above critical levels. This ensures that oxygen and nutrients con-

tinue to reach the organs that need them, including the brain and kidneys. It is, in my opinion, dangerous to anesthetize an animal without providing blood pressure support in the form of fluids.

#### **6. Injectable induction**

Induction of anesthesia is the process of actually making the pet unconscious by administering anesthetic agents. This is the step in human medicine where the anesthesiologist asks you to count backward from 100 as he gives you an injection. Generally, moderately deep anesthesia is accomplished very quickly when injectable drugs are used. This is the same procedure that should be used for all animals.

There is the option in to use inhalants to induce anesthesia. This is usually called "masking", as the gas is delivered to the patient via a face mask. This is not the safest method for many reasons. It takes approximately 4 to 5 minutes before the pet is anesthetized enough to be intubated (which we will talk about next). During that period there is no control over the airway; that is, if the pet regurgitates, fluid can be inhaled into the lungs. This is also a very stressful and frightening thing for most pets. They have a large mask placed over the muzzle and they are forced to inhale a strong-smelling gas while being physically restrained. As the gas begins to make them feel dizzy, they try to escape it. There is a large release of adrenaline, which can cause heart arrhythmias. There is also a lot of waste anesthetic gas that escapes around the mask, exposing the veterinary personnel.

Instead, check that the veterinarian is using injectable agents to induce anesthesia. These act very rapidly, in 30 seconds to 2 minutes generally. They allow excellent control of anesthetic depth and allow the airway to be intubated quickly, avoiding most of the risks of aspiration. With an IV catheter in place the pet does not even realize the drug is being administered, and just falls asleep with little or no excitement. Overall the effect is a much more peaceful, safer induction.

#### **7. Intubation**

It is important to have control over the pet's airway as quickly as possible and to protect it at all times. Oxygen must get to the lungs in order for animals to live! Some breeds are predisposed to airway trouble. Dogs and cats with short faces, like Bulldogs, Persians, Boston Terriers,

Pugs, Himalayans, and Pekingese all have long soft palates and small nostrils that will interfere with air flow. Even in animals with “normal” anatomy the airway can become obstructed inadvertently.

We “intubate” a pet in order to have control over the airway. We pass a special kind of tube called an endotracheal tube through the mouth and into the trachea, or windpipe. This tube has fairly rigid walls and cannot be collapsed. This bypasses all of the soft structures that could potentially flop into the airway when the pet is unconscious and allows us to deliver fresh gas and anesthetic right to the lungs where it is absorbed. The endotracheal tube has a cuff on the end, which effectively seals the airway. In addition to preventing anesthetic leaks, this also protects the patient from inhaling any gastric fluid that might be passively regurgitated during anesthesia.

## 8. Gas anesthetics

Gas anesthesia is reliable and safe when delivered by an experienced anesthetist. We prefer them to injectable anesthetics (for maintenance) because the depth of anesthesia is much easier to control. This is particularly important when an animal become too “deep” under anesthesia and we need to lighten the anesthetic plane. With inhalant or gas anesthetics we are able to do this relatively quickly, since the anesthetic is expelled by breathing. With injectable anesthetics, if the pet is too deep after the anesthetic we have to wait for the body to metabolize the drug and eliminate it. With some drugs this can take up to an hour. In my opinion gas anesthetics should be used when an anesthetic period will be longer than 5-15 minutes.

## 9. Intra-operative analgesics

Progressive veterinarians recognize the benefits of delivering pain medications continuously during surgery. Often this takes the form of a constant rate infusion, or CRI. A CRI is a simple concept; a drug is diluted in regular intravenous solution and delivered continuously during the surgical procedure, and often after it as well. Drugs used may include morphine, lidocaine, medetomidine, hydromorphone, and ketamine. Ketamine is an interesting drug, in that we use it as an anesthetic induction agent, but at very low doses it acts to enhance the pain-killing properties of opioids like morphine. By giving ketamine in a CRI during surgery we get very good pain relief.

The intraoperative analgesics also prevent the windup of

pain that we talked about in section 3.

## 10. Anesthetic monitoring

The most important piece of equipment any veterinarian can have is a properly trained and educated Registered Veterinary Technician. These people are the RNs of the veterinary world, as well as being radiology technicians, dental hygienists, pharmacy technicians, and educators. Unregistered assistants are sometimes “on the job trained” and only know what the veterinarian has chosen to teach them.

Having a educated, experienced person with eyes and ears monitoring your pet is the best protection you can get. A stethoscope on the chest and a hand on the pulse can tell us a lot more than a device clipped to the toe or tongue. An experienced technician will notice trends in pulse rate and quality, respiration, and blood pressure and take steps before a problem occurs. They will be present during surgery in case of emergency. And they are with your pet during the entire anesthetic period.

The most important piece of physical equipment to have when monitoring anesthesia is the ability to measure blood pressure. Low blood pressure can result from many of the drugs we use as sedatives and for pain control. It is also an extremely common consequence of the 8-12-hour fast we require before surgery. Pets come into the hospital without food, but most also don’t drink very much the night before surgery. They are in a state of marginal hydration, and this lowers the blood pressure. We add drugs on top of that, and many patients (especially cats) become quite hypotensive.

If low blood pressure continues for too long, organ damage can result. This is especially a concern for the kidneys, which need a minimum blood pressure for proper perfusion. If there is no blood pressure monitoring, the veterinarian will never know whether vital organs are being supplied with nutrients and oxygen. He or she will never know whether the intravenous fluids need to be increased, or whether the pet needs a large amount called a “bolus” to correct the blood pressure and hydration level.

Falling blood pressure can tell us that an animal is getting too deep under anesthetic, and we can correct it quickly. If we are not monitoring the blood pressure trend, how do we know if it is falling? Again, this is where an experienced

technician monitoring the situation comes into play. They can take into account the blood pressure, respiration, heart rate, reflexes, medications given, and the overall picture that the pet presents to make a determination as to the animal's state. In concert with the veterinarian, the technician makes changes to fluid rates, anesthetic rates, oxygen flow, and medications delivered in order to keep your pet at a safe, quiet, pain-free plane of anesthesia.

Other equipment like ECGs and pulse oximeters are also useful as ancillary monitoring equipment, but can never replace a technician. They do give some warning of impending problems, but usually lag behind the observations of the human monitors.

## 11. Surgical sterility

On days of yore human and animal doctors alike used to do surgery in a less than sterile manner. Post-operative infections were relatively common, and post-surgical mortality rates were high by today's standards. Fortunately, things have changed over the last 50 years, or certainly should have! The standards for veterinary surgery today are very close to those of human surgery.

All clinics should have an operating room that is physically separate from the rest of the clinic, and used only for surgery. This room should be kept as clean as possible, without foot traffic. All surfaces in the room should be disinfected weekly, and the majority of the surfaces daily, before surgery.

The patient should be prepped for surgery in another room so that hair and dirt contamination of the operating room is minimized. No animals should enter the room unless they are anesthetized and about to undergo a surgical procedure.

The surgeon should be capped and masked, and gowned in a new, sterile gown. Sterile surgical gloves (not exam gloves) must be worn. An unopened, autoclave-sterilized instrument set should be used for each surgery. New, sterile suture should be used for every surgery.

Some of these things seem very basic, but as amazing as it seems, some veterinarians do not do these things. You need to check into the procedures at the hospital you select to do your pet's surgery. Of course, it goes without saying that a veterinarian should perform the surgery itself.

## 12. Maintenance of body temperature

This is a simple concept. We try to maintain body temperature as close to normal as we can. There are many places in the anesthetic and surgery process where heat is lost. These include heat energy expended warming the air that is breathed in, and lost when the air is breathed out, body heat lost from the skin, heat lost when the abdominal cavity is exposed to room air (during a spay, for example), heat energy spent warming room temperature IV fluids, etc.

When body temperature drops it affects the animal's metabolism, which also affects the way the body processes drugs. Anesthetics are cleared at a slower rate than in an animal with a normal temperature. Hypothermia (sub-normal temperature) causes decreased immune function, slower wound healing (and this includes surgical "wounds"), and increased risk of bleeding. Older dogs and cats have poor thermoregulatory systems, and they do not start to compensate for heat loss until a much lower temperature than a young dog or cat would. So it is important that we do everything we can during the surgical period to keep the body temperature normal.

This is achieved in a number of ways. Anything placed between the pet and the operating table (which is stainless steel) will reduce heat loss. This can be as simple as an insulated blanket, insulated foam rubber padding, bubble wrap that is used for packing parcels, circulating warm water pads, warm water bottles, and oat or rice bags that are heated in the microwave. The veterinarian and staff have to be very aware of these warming devices becoming too hot, as they can burn the patient, who is unable to move away from the source of heat.

A Bair Hugger is used in pediatric wards in hospitals to warm small babies and has been adapted for veterinary use. A Bair Hugger has a forced air heating devices that use a thin paper "blanket" with small holes on one side in defined areas to direct the heated air onto the patient. They are very effective at providing warmth without the risk of burning.

## 13. Monitored recovery

This is a very simple thing that is easy to overlook, but is more important than most of the things we have already talked about. A healthy percentage of animals that do not survive surgery and the anesthetic period succumb to

problems that arise after the animal is out of the operating room and into recovery. It is vital that someone is constantly watching your animal after surgery, when the anesthetic machines are off, to make sure that recovery is going well.

In the normal course of events the gas anesthetic is turned off, the system is flushed with oxygen, and the pet is allowed to breathe 100% oxygen. As the anesthetic wears off, the pet regains protective reflexes (like the gagging, coughing and swallowing reflexes) that prevent things from entering the airways. Once these reflexes are re-established, the endotracheal tube is removed. The patient is generally awake enough to roll himself into sternal recumbency, or up on his chest with his head up. The time from anesthetic off to head up is variable, but is usually somewhere between 5 and 20 minutes, depending on the premedications and pain medications given, and the depth and duration of anesthesia.

Once the pet is sitting up, constant, direct observation is generally not necessary after most elective surgeries. Most pets are returned to a recovery kennel and checked every few minutes once they are able to stand. Technicians check the patients condition periodically, making sure there are no signs of distress or surgical complications and that the body temperature is maintained.

#### **14. Post-operative analgesia**

So far we've done a good job controlling the patient's pain now we have to continue! There is pain after abdominal surgery in animals for at least a 3 day period. Patients should be sent home with a supply of oral pain medication. DO NOT give your pet anything for pain on your own without checking with your veterinarian! Many of the drugs people use for pain are toxic to dogs, or require a very different dose to be effective.

#### **15. Immediate post-surgical home care**

Most veterinarians will send your pet home the evening of the elective surgery. This is done for a few reasons, chiefly because most clinics are not staffed overnight. Many veterinarians feel that the pet's interests are best served by being at home with someone watching them the night after surgery. Some veterinarians keep your pet overnight and release them the next morning. There is some benefit to this, even with no one at the clinic all night, because the patient is kept confined and can be kept on injectable pain relief. The decision to send your pet home or keep him depends on you and your veterinarian, and neither is wrong.

If, however, your pet is sent home the night of surgery, be sure that there is some provision for problems. What if your pet starts to lick the incision? What if they are in pain? Make sure that your veterinarian is either on call or has provided the phone number for the emergency veterinary clinic. Most patients do very well post-surgery, but be sure that you know what to do in the event of a complication.

#### **Conclusion**

As you can see, making an elective surgery like a spay or neuter safe for your pet is quite a complicated process. It involves several people, and a variety of specialized equipment. It is possible to "cut corners" and omit some of the things that we have talked about. It is possible to spay a cat like we did in the old days with an injectable anesthetic, without surgical gowns or even gloves, just bare-handed on a counter in the back of a clinic. This certainly would make the surgery cheaper! But for some things, cost should not be the driving force behind the decision. We have to consider safety and the animal's pain first, and costs a distant third.

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**Any Further Question Please  
Contact East Hill Veterinary Clinic:**

**P. 707.459.5236**

**F. 707.459-9048**

**E. drchana@easthillvet.com**