IS THERE AN OPTIMAL AGE FOR SPA
Y-NEUTER

Philip A. Bushby, DACVS, MS, DVM
Marcia Lane Endowed Chair of Humane Ethics and Animal Welfare
Mississippi State University, College of Veterinary Medicine
Starkville, Mississippi, USA
bushby@cvm.msstate.edu

Introduction
The optimal time for spay/neuter depends on species, breed, intended use, financial considerations, and life situation. But it is “life situation” that has the biggest impact. For an individually owned animal living in a home, decisions are based primarily on factors that impact that animal’s individual health, and secondarily on population control. But for the shelter animal facing possible euthanasia if not adopted, decisions are based primarily on population control. The Mississippi State University shelter program serves 18 shelters and humane groups across northern Mississippi (making 6 to 8 trips a week, 48 weeks per year) and has performed over 52,000 spay/neuter surgeries since 2007. The shelters this program serves collectively have a 62% euthanasia rate—but an 83% adoption rate of the animals they spay and neuter. For these animals spay-neuter is not considered an elective procedure; it is an emergency life saving procedure.

Demographics
There are some conflicting demographic surveys related to pet overpopulation. One study reveals that:

- 13% of pets living below the poverty level are sterilized
- 80% of pets living above the poverty level are sterilized
- 24 million pets are estimated to fall below the poverty level
- Less than 24% of pets below the poverty level ever receive veterinary care

If it is true that lower income families are more likely to adopt a pet from a shelter, this data supports spay-neuter prior to adoption, regardless of the animals age. Having sterilization surgery prior to adoption from the shelter may be the only opportunity for spay-neuter for those animals.

A 2010 study of pets in Massachusetts that found that: female dogs and cats that are sterilized after having at least one litter accounted for ~85% of all births, whereas cats and dogs that remained fertile their entire life accounted for ~15% of litters. Therefore, from the standpoint of population control, timing is everything, and pets should be sterilized before having any litters.

Recent studies
Recent studies have created questions in peoples minds regarding age of spay-neuter and even if spay neuter is appropriate. We must, however, be careful when considering studies that focus on just one breed of dog or on a limited number of conditions. It is more appropriate to interpret spay neuter research in light of its relationship to the overall
health of the animal and life expectancy. Looking collectively at recent spay-neuter research we can conclude that:

- Sterilized dogs and cats live longer
- Sterilized dogs have a higher incidence of certain cancers
- Sterilized dogs have a lower incidence of mammary tumors
- Intact dogs are more likely to die of infections and trauma
- The conclusions related to sterilized dogs having greater orthopedic problems is very breed specific

Given the fact that veterinarians currently don’t agree on the “best age” to spay or neuter a dog or cat it should not be surprising that the public is confused as well. A 2009 pet owner survey found that 65% of pets were neutered; of the 35% that were intact, 75% of their owners intended to have them neutered at some point. However, a majority thought they had to wait until six months; 17% had no idea when to sterilize; 29% thought it was inappropriate to do so before the first heat; and 8% thought it was inappropriate to do so prior to the first litter. And while the most common reason that people spay/neuter their pets is to prevent unwanted litters, many still wait until after the first litter.

A 2000 survey of spay/neuter veterinarians on pediatric spay/neuter of 85 veterinarians who had performed over 235,000 early spay/neuter surgeries collectively agreed that pediatric spays and castrations were easier and faster (less fat, less bleeding); less stressful on patient; and less stress on the veterinarian (once they were used to it). Additionally, pediatrics patients recover more quickly and require less surgery time, with lower anesthesia risk before 24 weeks of age. He emphasized gentle tissue handling, appropriate suturing, and proper handling of suspensory ligament. The smaller the patient, the greater the risk of hypoglycemia and hypothermia, so taking necessary precautions is important.

Recent research publications have caused some in the profession to question not only pediatric spay neuter, but spay neuter in general. A study out of UC Davis found an increased incidence of hip dysplasia, cranial cruciate rupture, lymphoma and osteosarcoma in purebred Golden Retrievers if they were sterilized.¹ Similar results were found in Labrador Retrievers.² The authors of the golden study cautioned that “The results of this study, being breed-specific, with regard to the effect of early and late neutering cannot be extrapolated to other breeds or dogs in general” and close examination of these papers, however, reveals that the number of cases were relatively low.

A study in Rottweilers looked at the impact of the duration of ovary exposure in two groups of dogs: those that lived to a normal age and those that lived an exceptionally long life. In that study intact female dogs lived longer than spayed females.³ But another study specifically looking at incidence of osteosarcoma in Rottweilers demonstrated that spayed females lived longer than intact.⁴
So should we be debating to sterilize or not sterilize rather than when to sterilize? First, we must be careful not to base such decisions on studies with small number of animals. Secondly, in making any decisions about the medical or surgical care of pets we should look at all factors that influence health and longevity.

A study at the University of George analyzed the records of over 80,000 patients and demonstrated that sterilization is strongly associated with an increase life expectancy in dogs. In this study life expectancy was increased by sterilization in both male and female dogs.

- Mean age of death of intact dogs - 7.9 years
- Mean age of death of sterilized dogs - 9.4 years
- Sterilization increased life expectancy of males by 13.8%
- Sterilization increased life expectancy in females by 26.3%

While sterilization decreased risk of death from some causes, such as infectious disease, it actually increased risk of death from others, such as cancer. In this study sterilized dogs were “dramatically” less likely to die from:

- Infectious disease
- Trauma
- Vascular disease
- Degenerative disease

and sterilized dogs were more likely to die from:

- Neoplasia
- Immune mediated disease

Within the neoplasia category, occurrence of:

- Transitional cell carcinoma
- Osteosarcoma
- Lymphoma
- Mast cell tumors

Were increased in sterilized dogs

Within the neoplasia category occurrence of:

- Mammary cancer was significantly decreased in sterilized dogs

One need only to look at the overall incidence of various cancers to recognize that significantly increasing incidence of a tumor that is relatively rare still leaves that tumor relatively rare while significantly decreasing the incidence of a tumor that is common may make that tumor uncommon.

Banfield operates over 900 veterinary hospitals that share a common computerized medical record system. Each year Banfield releases a “State of Pet Health Report.” In 2013 that report was based on analysis of data from 2.2 million dogs and 460,000 cats. Looking at longevity compared to spay neuter status they discovered that:

- spayed dogs lived 23% longer than intact dogs
- neutered dogs lived 18% longer than intact dogs
- spayed cats lived 39% longer than intact cats
- neutered cats lived 62% longer than intact cats
Perhaps the most comprehensive reference is a 2007 article by Margaret Root-Kustritz. In this article she summarizes the literature up to that date detailing the impact of sterilization at various ages and disease incidences between sterilized and intact pets.

**Recommendations**

Decisions on whether or not to spay/neuter a pet must be based on an assessment of all known relationships between reproductive status and health and longevity, not just one or two. And not just on whether or not spay or castration increases the incidence of a condition, but what is the incidence and what is the change in incidence of that condition. For example a 5-fold increase in something that is extremely rare might still be extremely rare and could be outweighed by protection against something with a significantly higher incidence.

So how do we sort through the conflicting data that is in the literature? For shelter animals the most logical time to spay neuter is prior to adoption. For people’s pets the owner must make an informed decision based on species, breed, intended usage and current medical knowledge at hand. For most breeds the protective of spay before the first heat cycle on mammary neoplasia far outweighs the potential risks associated with other cancers and orthopedic conditions.

**References**

EFFICIENT DOG AND CAT SPAY/NEUTER TECHNIQUES

Philip A. Bushby, DACVS, MS, DVM
Marcia Lane Endowed Chair of Humane Ethics and Animal Welfare
Mississippi State University, College of Veterinary Medicine
Starkville, Mississippi, USA
bushby@cvm.msstate.edu

Introduction

Most veterinary schools teach students how to perform spays and neuters at a point in their education when they are very inexperienced surgeons. Therefore, students are taught many techniques that are simply designed to compensate for poor surgical skills. Students are taught to double ligate everything because instructors, for good reason, don’t trust the students’ ligatures. Students are taught interrupted patterns because instructors don’t trust their knots. They are taught long incisions and extensive exposure because instructors believe students don’t fully understand abdominal anatomy. As veterinarians gain experience in surgery they become much more efficient, much more skilled, but often fail to abandon those techniques that were simply designed to compensate for lack of experience? Many of those techniques can be replaced by ones that are perfectly safe and much more efficient.

Surgeon Positioning

Where does the surgeon stand while performing a spay? What factors influence where you stand during a spay? Do you stand with the patient’s head to your right or to your left? Most right-handed veterinarians stand with the patient’s head to their left and most left-handed veterinarians stand with the patient’s head to their right. But why is this? Try standing with the patient’s head to the side of your dominant hand. There is a very valid reason for this. If you strum the suspensory ligament of the ovary this allows you to strum it with your stronger hand. If you cut the suspensory ligament it allows you to cut the ligament easily with your dominant hand. While I am not necessarily recommending that you change sides of the table if you have been doing surgery for years. I am recommending that you always ask why you are doing a particular technique a particular way and consider if there is a better, more efficient approach.

Patient Positioning

In a spay, position the patient with the front legs along it’s side rather than pulled forward past it’s head. Pulling the legs forward, which is commonly done, tightens the muscles of the back and tightens the suspensory ligaments of the ovaries. Pulling the limbs along side the patient’s thorax will relax the suspensory ligaments and make delivery of the ovaries through an abdominal incision easier. A simple restraint devise allows this positioning of the patient and helps prevent tilting of the patient to one side or the other.

Surgical Techniques

Placement of incisions

One key to efficient ovariohysterectomies is making appropriately placed small incisions. While most surgery instructors promote long incisions and maximum exposure; lengthy incisions are considerably more time consuming to close. Small incisions, obviously, can be closed much more rapidly than long incisions. The proper location of the incision varies with species and with age of the patient. In a cat spay the tissue that is more difficult to exteriorize is the uterine body. In the adult dog it is more difficult to exteriorize the ovaries. Vary the location of your incisions accordingly. Puppies are intermediate. In the cat spay the skin incision should be located on the ventral abdominal midline at the midpoint between the umbilicus and the anterior brim of the pubis. In the adult dog, the skin incision is on the ventral abdominal midline just caudal to the umbilicus. In the puppy spay (6 months or younger) the skin incision is on the ventral abdominal midline a little cranial to the location of the cat spay incision and a little caudal to the location of the incision in an adult dog.

Remember abdominal anatomy; the right kidney and the right ovary are located further cranial in the abdomen than the left kidney and left ovary. It is, therefore, more difficult to exteriorize the right ovary than the left ovary. To equalize the difficulty of exteriorizing the two ovaries make the entry into the abdomen of the adult dog through a right paramedian
incision. Incise the skin on the ventral abdominal midline, undermine only on the right side of the linea alba and, depending on the size of the dog, incise the rectus sheath 1/2 to 2 cm to the right of the linea alba. To prevent hemorrhage incise only the fascia. Enter the abdomen by bluntly separating the fibers of the rectus abdominis muscle and cutting the peritoneum.

Castration incisions in the cat, the puppy and in the adult dog can be made through the scrotum.

**Ligation techniques**

Most of you were probably taught to double ligate ovarian pedicles and uterine stumps and to ligate before transecting the tissue, but why. As stated above, you were, most likely, taught how to perform spays when you were very inexperienced at surgery. Accordingly, at that stage of development it was not wise to trust your tissue handling and your ligations. Both of these techniques, however, can slow you down considerably. It is much more efficient to transect the ovarian pedicles prior to ligation and to single ligate each pedicle. The most efficient technique is to place 3 hemostats, the first most proximal, the second several millimeters distal to the first, but still proximal to the ovary, and the third between the ovary and the uterine horn. Close the first hemostat one click of the box, the second two clicks and the third three clicks. The purpose of the 1, 2, 3 clicks is to avoid completely crushing the tissue at the most proximal clamp. Complete crushing predisposes the pedicle to tearing. Before ligating, transect the ovarian pedicle just distal to the second hemostat. Ligate with a square, surgeon’s or Miller’s knot.

**Hand ties**

Becoming skilled at hand ties; square knot, surgeon’s knot and Millers’ knots will improve efficiency in both dog and cat spays. To be efficient this skill must be practiced. But once you are skilled at hand ties it increases your speed significantly.

**Pedicle ties**

The pedicle tie is a method of ligation in which the structure is tied to itself around a hemostat. This self-tie can be used in cat castrations and puppy castrations (called cord tie) and in ligating the ovarian pedicles in cat spays (called pedicle tie). There are several variations of the pedicle tie in the cat spay. In the technique I use, deliver the ovary through the abdominal incision, cut the suspensory ligament and tear a window in the broad ligament just caudal to the ovarian vessels. Hold the ovary in your non-dominant hand and gently pull the ovary towards you. Using the dominant hand a curved hemostat is crossed over the ovarian vessels into the hole in the broad ligament and underneath and behind the vessels. The hemostat should be held closed with the tip of the hemostat facing away from you. The tip of the hemostat is then directed above the vessels as the hemostat is rotated counter-clockwise to end up facing you. The hemostat is opened and used to clamp the ovarian vessels. The vessels are cut or torn between the hemostat and the ovary and the knot is gently pushed off the tip of the hemostat. The knot should be pulled tight before releasing the hemostat.

**Miller’s knot**

The Miller’s knot is a very secure, self-locking knot that can be placed either with an instrument or with a hand tie. The Miller’s knot can be used on spermatic cords, on ovarian pedicles in dogs and uterine bodies of dogs and cats. To place a Miller’s knot pass the suture under the tissue to be ligated, bring the suture back over the tissue and under the tissue one more time. This creates a small loop of suture above the tissue to be ligated. Position the needle holder through that small loop, wrap the long strand once around the needle holder, grasp the short strand of suture with the needle holder and pull the needle holder towards you while pulling the long strand of suture away from you. Gentle upward tension while pulling this knot tight facilitates placement of the ligature. Complete the knot by place three or four square knot throws.

**Scrotal Castrations in Adult Dogs**

Scrotal castration are rarely ever taught in veterinary school, in fact, for decades we have been taught to avoid making incisions in the scrotum of dogs. Scrotal castrations appear, however, to offer several advantages over the prescrotal approach including, smaller incisions, less surgical time, less tendency for scrotal hematomas and less tendency for self-trauma. The justification for avoiding scrotal castrations in dogs had been to prevent self-mutilation. As long as no external skin sutures are placed in the scrotum there appears, however, to be no greater risk of self-trauma in a scrotal castration than in a prescrotal castration.
Position the patient in dorsal recumbency. Grasp one testicle and position it in a manner that elevates and exposes the median raphe. Make an incision through the skin and subcutaneous tissue along or near the median raphe over the displaced testicle. Continue the incision through the spermatic fascia to exteriorize the testicle. In the closed castration technique care is taken not to incise the parietal vaginal tunic and tunica albuginea. Use gentle traction to exteriorize the testicle and reflect fat and fascia from the parietal tunic of the spermatic cord using a gauze sponge. Place three hemostats on the spermatic cord and transect the cord distal to the third hemostat. In smaller dogs a single ligature tied with a Miller’s knot and placed in the crushed area of the most proximal hemostat is sufficient for hemostasis. The second testicle is exteriorized through the same scrotal incision. A second incision in spermatic fascia is made over the second testicle to allow exteriorization, transection and ligation of the second spermatic cord is accomplished in a manner identical to the first testicle.

The technique for closure is the surgeon’s preference. Incisions can be left open to heal by second intention, can be partially closed with one buried subcutaneous suture of absorbable suture material, or can be closed fully with skin glue. All three of these techniques are considered acceptable.

**Age at which surgery is performed**

As a general rule the larger the animals is (dog or cat), the more obese the animal is, and the older the animal is, the longer it will take to perform a spay or neuter surgery. Even though most of us were taught to wait until a dog or cat is sexually mature (six to nine months) before sterilization surgery there is growing evidence that there is no reason to wait until the animal is an adult. Pediatric spay neuter has been shown to have little or no adverse physiologic effects on the animal and spay/neuter in the pediatric patient is much easier and quicker than that in the sexually mature patient.

**Conclusions**

Becoming efficient at spays and neuters is a combination of many factors. One of which, of course, is the skill and comfort level of the surgeon. Adoption of specific techniques that are used commonly in high-volume spay neuter clinics is a key factor in improving efficiency. Being willing to question why you were taught specific manipulations in veterinary school and recognizing that it is acceptable to abandon some of them (such as always double ligating pedicles) will improve surgical efficiency greatly.
UNUSUAL SPAY/NEUTER

Philip A. Bushby, DACVS, MS, DVM
Marcia Lane Endowed Chair of Humane Ethics and Animal Welfare
Mississippi State University, College of Veterinary Medicine
Starkville, Mississippi, USA
bushby@cvm.msstate.edu

Introduction

Not all spays and neuters are “routine.” Conditions such as cryptorchidism, hermaphroditism, uterus unicornis, mammary hyperplasia and lactation may present surgical challenges, but approaches to each of these non-typical cases are actually quite simple. Furthermore, many veterinarians are apprehensive about spaying the morbidly obese dog or the dog with pyometra. However, attention to a few basic principles make these surgeries no more difficult than the routine spay.

Cryptorchidism

Cryptorchidism is defined as the failure of one or both testicles to descend into the scrotum. The cryptorchid testicle can be located anywhere along the path from the area of fetal development of the gonads (just caudal to the caudal pole of the kidney) to the subcutaneous tissue between the external inguinal ring and the scrotum. Thus a cryptorchid testicle can be located in the abdominal cavity, in the inguinal canal, or in the subcutaneous tissue between the external inguinal ring and the scrotum.

Testicles should be easily palpated in the scrotum of dogs and cats greater than 2 - 4 months of age. If one or both testicles are not located in the scrotum careful palpation will reveal which testicle(s) are involved and whether the testicle(s) are located in the subcutaneous tissue. Failure to palpate a testicle in the scrotum or the subcutaneous tissue leads to a presumptive diagnosis of abdominal cryptorchidism. Palpation of the testicle in the subcutaneous tissue leads to a diagnosis of subcutaneous cryptorchidism.

Subcutaneous cryptorchidism.

If the cryptorchid testicle is palpated in the subcutaneous tissue, incising directly over the testicle will allow exposure and removal of the testicle.

Abdominal cryptorchidism

Locating an abdominal testicle is very easy. The critical factor to remember is that both ductus deferens enter the urethra at the prostate. If you trace the ductus deferens from the prostatic urethra cranially it is located dorsal to the bladder until it passes the junction of the ureter and the bladder. Cranial to the point where the respective ureter enters the bladder the ductus deferens turns laterally on its course to the inguinal canal and the testicle. This anatomical feature makes it easy to find an abdominal testicle.

In the dog the skin incision is made in the caudal abdominal skin just lateral to the prepuce on the side of the cryptorchid testicle. Entry into the abdomen is either on the midline through the linea alba by undermining under the prepuce to the midline or by a paramedian incision incising the external rectus fascia and separating rectus abdominus muscle fibers. Make a very small incision and pass a spay hook from medial to lateral, lateral to the bladder wall. Often that will catch the ductus deferens allowing exteriorization of the testicle. If that fails extend the incision exposing the urinary bladder. Caudal reflection of the urinary bladder exposes the dorsal surface of the bladder, allowing visualization of both ductus deferens. Gentle retraction of the ductus of the cryptorchid testicle will allow delivery of the testicle into the surgical site, ligation of the testicular vessels and excision of the testicle.

In the cat the skin incision is made in the caudal abdominal skin on the midline. Entry into the abdomen is on the midline through the linea alba and allows exposure of the urinary bladder. Again, using a spay hook and sweeping laterally from the bladder wall will often catch the ductus deferens. If this fails, caudal
reflection of the urinary bladder, exposing the dorsal surface of the bladder, will allow visualization of both ductus deferens. Gentle retraction of the ductus of the cryptorchid testicle will allow delivery of the testicle into the surgical site, ligation of the testicular vessels and excision of the testicle.

On occasion cryptorchid testicles are trapped between the muscles layers in the inguinal canal. When this occurs gentle tension on the ductus deferens will allow visualization of the ductus deferens entering the inguinal canal. Gently teasing the musculature of the internal inguinal ring apart with a blunt instrument is often enough to allow delivery of the testicle back into the abdomen for removal.

However, frequently cryptorchid testicles are smaller than normal and it is possible that the cryptorchid testicle will be in the subcutaneous tissue but not be palpable. Entry into the abdomen, assuming abdominal cryptorchidism, would, therefore, fail to reveal the cryptorchid testicle. Gentle tension on the ductus deferens would confirm that the ductus deferens passes through the inguinal canal. The caudal abdominal skin incision is of value here, as from that incision you can undermine the skin between the incision and the external inguinal ring. Gentle traction on the abdominal ductus will allow you to locate the ductus deferens as it exits the inguinal canal and will lead you to the cryptorchid testicle.

Once the cryptorchid testicle is located, either in the abdomen or the subcutaneous tissue, it can be excised using any standard technique. For very small testicles with small vessels and a small ductus deferens use the cord tie or figure eight knot in the spermatic cord. For larger testicles, with larger spermatic cords double clamp the spermatic cord with hemostats, transect distal to the most distal hemostat and place a ligature using a Miller’s knot in the area of the spermatic cord crushed by the most proximal hemostat. In dogs weighing over 18 kg clamp the spermatic cord with three hemostats, transect distal to the most distal hemostat, place a ligature using a Miller’s knot in the area of the spermatic cord crushed by the most proximal hemostat, and a transfixation ligature in the area of the spermatic cord crushed by the second hemostat.

**Uterus unicornis**

Uterus unicornis is congenital absence of one horn of the uterus, but both ovaries are always present. So when performing a spay and discovering that one uterine horn is absent you must search for the 2nd ovary. It will be in the normal location and, if a broad ligament is present is rather easy to find. If no broad ligament is present on the involved side location of the “orphaned” ovary is more difficult. This is further complicated by the fact that frequently the kidney on that side is also missing. So without the broad ligament use the biological retractors to help localize the ovary. On the left side elevate the descending colon and pull it towards the right side. This isolates most abdominal contents away from the left side allowing you to explore the left side and visualize the ovary. On the right side elevate the descending duodenum and pull it towards the left. This isolates most abdominal contents away from the right side allowing you to explore the right side and visualize the ovary.

**Mammary Hyperplasia/Lactation**

Feral cats, cats with mammary hyperplasia or lactating queens still nursing kittens are ideal candidates for flank spays. Performing a flank spay will avoid any damage to mammary tissue, preventing abscesses due to leakage of milk into the tissues. In nursing queens an additional advantage of the flank spay is that it keeps the incision line and any sutures away from where the kittens nurse. A flank spay should be performed with the patient in left lateral recumbency. An incision is made paralleling the last rib 2/3 the way back from the last rib and cranial to the wing of ilium and just ventral to the transverse spinous processes. Dissect through the subcutaneous tissue, separate fibers of the external abdominal oblique muscle and the internal abdominal oblique muscle entering the abdomen. If the incision is positioned properly the right uterine horn and right ovary will be clearly visible. If not visible they can be retrieved using a spay hook. The spay is then performed the same as with a ventral midline approach. A three-layer closure is performed suturing internal abdominal oblique, external abdominal oblique and subcuticular tissue.

**Hermaphrodism**
Hermaphrodism is the presence of both ovarian and testicular tissue in the same gonad or the same individual. Most frequently hermaphrodites are presented as a female for ovariohysterectomy. The patient often has female genitalia with an enlarged clitoris. The “ovariohysterectomy” is performed routinely.

**Pyometra / Obesity**

While not really unusual, ovariohysterectomy in the dog with pyometra especially closed pyometra, or the morbidly obese dog is often considered challenging by many veterinarians. Attention to a few basic principles; gentle tissue handling and hemostasis and the use of a few specific techniques; Miller’s knots and transection of the ovarian pedicles prior to ligature allow the veterinarians to spay these animals efficiently and with minimal risk of complications.

**Conclusions**

While conditions such as cryptorchidism, hermaphroditism, uterus unicornis, mammary hyperplasia and lactation, pyometra and obesity may present as challenges to the veterinary surgeon, understanding the conditions, the anatomy involved and the surgical techniques that can be used will make spay neuter in these non-typical conditions relatively easy.
Pediatric Spay/Neuter

Philip A. Bushby, DACVS, MS, DVM
Marcia Lane Endowed Chair of Humane Ethics and Animal Welfare
Mississippi State University, College of Veterinary Medicine
Starkville, Mississippi, USA
bushby@cvm.msstate.edu

Introduction

Each year in the United States 3 to 4 million homeless or unwanted dogs and cats are euthanized in animal shelters and humane societies\(^1\). There are many factors that have led to this overpopulation of dogs and cats and the solution will be multifaceted. Eventually safe and effective chemical or immunological sterilization will be available, but until then spay neuter will be the cornerstone of any program to reduce the overpopulation thereby reducing the numbers of animals relinquished and euthanized each year. One important component of the spay neuter effort to reduce euthanasia is early age spay and neuter.

Early age ovariohysterectomy and castration of dogs and cats (between 8 and 16 weeks of age) is supported by the AVMA and is becoming increasing popular especially in shelter and high-quality, high-volume spay neuter environments. The AVMA position statement says, “The AVMA supports the concept of early age spay/neuter in dogs and cats in an effort to reduce the number of unwanted animals of these species. Just as for other veterinary medical and surgical procedures, veterinarians should use their best medical judgment in deciding at what age spay/neuter should be performed on individual animals\(^2\).” Other organizations supporting early age neutering include the:

- Canadian Veterinary Medical Association\(^3\)
- British Small Animal Veterinary Association\(^4\)
- American Animal Hospital Association\(^5\)

and many more.

Spay or neuter prior to adoption is the most effective way to ensure that animals adopted from shelters do not reproduce. The ASV Guidelines for Standards of Care in Animal Shelters proposes that “animal shelters should require that cats and dogs who are adopted into homes be spayed or neutered\(^6\).” However, voucher programs or prepaid spay neuter programs to have an animal spayed or castrated after adoption are frequently ineffective. With pre-adoption spay and castration there, obviously, is no compliance issue. In the shelter environment spay or neuter can be performed on puppies and kittens as young as 6 weeks of age. In a practice environment for owned animals the recommendation is to establish one more appointment at the end of the puppy/kitten vaccination series. In this manner puppies and kittens are spayed or neutered prior to 5 months of age, before sexual maturity.

Advantages of Early Age spay/neuter

There are many advantages to early age sterilization. The surgical procedures are easier, faster, and less expensive. With shorter surgery times and shorter anesthetic episodes the incidence of perioperative complications is lower\(^7\). Anesthetic recovery and healing time is shorter\(^7,8\). Of course, the commonly accepted health benefits associated with ovariohysterectomy and castration, such as reduction in incidence of mammary neoplasia and reduction in behavioral problems, still exist as well.

Historical Concerns About Early Age Spay/Neuter

Veterinarians have expressed concerns about the anesthetic and surgical risks or potential long-term physiologic effects of early age sterilization. The adverse physiologic effects mentioned have been obesity, stunted growth, musculoskeletal disorders, perivulvar dermatitis, puppy vaginitis, feline lower urinary tract disease, and urinary incontinence. Most fears appear to be unfounded.

Obesity
Obesity is a multi-factorial problem with a tendency to occur regardless of the age at which an animal is spayed. A long-term study conducted at Cornell found a decrease in obesity for both male and female dogs that had undergone early age ovariohysterectomy. Growth concerns that early age sterilization may result in stunted growth have proven to be false. Removal of the hormonal influence results in a delayed closure of growth plates. The long bones of cats that undergo early age neutering are actually a little longer than those of animals neutered after 6 months of age. While there is speculation that this delayed closure may influence conditions such as slipped capital epiphysis and metaphyseal osteopathy, the age of neutering, whether 7 weeks or 7 months, does not influence the degree of growth plate closure. So any relationship between these conditions and neutering is not specific to early age neutering.

Hip dysplasia

Some veterinarians have questioned if early-age spay neuter results in an increased incidence of hip dysplasia. Research on this has proven to be equivocal. A study at Texas A&M has shown no increase in hip dysplasia, while a study at Cornell showed a slight increase in incidence.

Perivulvar dermatitis

Perivulvar dermatitis has been documented in unspayed and spayed animals regardless of the age at which the surgery was performed. This condition is related to a recessed vulva and made worse by obesity. Age of neutering appears to have no significant influence on the incidence.

Penile urethra

Suspicions that early age castration would result in decreased diameter of the penile urethra in cats and, therefore, lead to urinary obstruction are unfounded. In a long-term study the diameter of the penile urethra was compared in cats neutered at 7 weeks and 7 months with the urethral diameter in intact males. No differences in penile urethral diameters were found.

Estrogen responsive urinary incontinence

Studies have shown differing conclusions with respect to estrogen responsive urinary incontinence. The Cornell study revealed a slightly greater risk of urinary incontinence in dogs spayed younger than 12 weeks of age. The Texas A&M student showed no difference while a study by Arnold et al in 1992 showed a higher incidence of urinary incontinence in dogs spayed after their first estrus cycle. Three studies with conflicting results. More research needs to be done on this issue, but the key factor is that the incontinence is estrogen responsive. Even if the results eventually show a higher incidence in those dogs spayed at an early age, the condition is easily and inexpensively treated.

Anesthetic management

Anesthetic management in the early age patient can be very safe provided attention is paid to a few basic principles and appropriate attention is paid to the unique concerns associated with the early age patient. Given that metabolic development is largely complete by six weeks of age, the same anesthetic protocols that are used in adults can be used safely in early age patients. Early age patients have lower percentage of body fat, a decreased ability to shiver and a larger surface area to volume ration. These factors make attention to maintenance of body temperature critical. Early age patients are, also, at a greater risk of hypoglycemia. Hypothermia and hypoglycemia can be easily managed allowing surgical anesthesia with minimal risk.

The most recommend anesthetic protocols use multimodal analgesia and avoid the use of barbiturates. IM injection of a dexmedetomidine, butorphanol, ketamine HCl combination followed by maintenance with oxygen via either facemask or endotracheal tube and supplemented with Isoflurane®, if needed, is very safe and effective. Following IM injection, a surgical plane of anesthesia is achieved within 5 minutes and will last for up to 30 minutes. The dexmedetomidine can be reversed with atipamezole immediately after surgery and will frequently result in the patient being mobile within 5 to 10
minutes of the conclusion of the surgery. An NSAID like meloxicam should be administered after induction of anesthesia and prior to the start of surgery for post-operative analgesia.

**Hypothermia**

The Association of Shelter Veterinarians guidelines for spay neuter programs state, “warmth is best preserved by reducing contact with cold surfaces, limiting body cavity exposure, and providing carefully protected contact with circulating warm water or heated containers, such as carefully monitored water bottles or rice bags. Forced hot air or convective warming can also be an effective means of maintaining body temperature perioperatively.” These measures in conjunction with short surgical time, less exposure of the abdominal cavity and reversal of anesthetic agents minimize hypothermia.

**Hypoglycemia**

Hypoglycemia can be avoided or minimized by restricting preoperative fasting to 2 to 4 hours, avoiding preoperative excitement, and feeding the animal immediately upon anesthetic recovery.

**Pediatric Surgeries**

Dr. Tracy Land, in 2000, conducted a survey of spay/neuter veterinarians regarding pediatric spay/neuter. Eighty-five veterinarians who had performed over 235,000 early spay/neuter surgeries responded. They were unanimous that pediatric spay/neuters procedures were easier, faster, and safer than the same procedures in older dogs and cats. Studies have shown that short-term complication rates are lower and that there are minimal adverse physiologic effect long term.

Recognizing the shorter anesthetic and surgical times and lower complications rates for younger patients, many practitioners have begun performing spays and neuters at an earlier age in privately owned pets. A national campaign has been developed to encourage practicing veterinarians to reduce by four to six weeks their recommended age of spay and neuter. Put simply the recommendation is for veterinarians to add one more appointment at the end of their routine puppy and kitten wellness schedules for the spay or castration surgery.

**Pediatric Feline Castration**

Castration of pediatric cat is performed the same as castration of the adult cat. The patient is placed in dorsal recumbency with the rear legs pulled forward. Scrotal hair can be clipped or plucked and a surgical scrub performed. One of the testicles is grasped between thumb and index finger and secured within the scrotum. A scrotal incision is made over the testicle exteriorizing the testicle with digital pressure. Traction is applied to the testicle and spermatic cord and fat and fascia are stripped from the spermatic cord using a gauze sponge. A cord tie is used for hemostasis and the testicle is excised. The cord tie is accomplished by placing the tip of a hemostat under the cord and rotating the tip around the cord. The jaws of the hemostat are opened and the distal end of the cord is advanced into the jaws and clamped. The cord is then transected between the clamp and the testicle using a scalpel blade or scissors. Following removal of the testicle, the surgeon pushes the knot off of the end of the hemostat. The knot is tightened to ensure security. It is important to leave approximately 5 mm of spermatic cord distal to the knot to ensure that the knot does not unravel. The choice of open or closed technique is left up to surgeon preference. The identical technique is used on the second testicle and the incisions are left open to heal by second intention.

**Pediatric Canine Castration**

Castration of the pediatric dog is performed essentially the same as castration of the cat. The patient is placed in dorsal recumbency. The scrotum is clipped of hair and a surgical scrub performed. An incision is made in the scrotum just as in the cat. In most patients only one scrotal incision is needed. The first testicle is grasped between thumb and index finger and secured within the scrotum. A scrotal incision is made over the testicle exteriorizing the testicle with digital pressure. Gentle traction is applied to the testicle and spermatic cord and fat and fascia are stripped from the spermatic cord with a gauze sponge. The cord tie is used to for hemostasis and the testicle is excised. The second testicle can be moved into the surgical wound and the testicular fascia incised. The excision and hemostasis of the second testicle is performed in an identical
manner to the first testicle and skin glue is applied to the incision. As in the cat the decision to perform open or closed
castrations is left up to surgeon’s preference.

**Pediatric Feline Ovariohysterectomy**

Feline pediatric ovariohysterectomy is performed the same as ovariohysterectomy in the adult cat. The structures are smaller
and the exposure can be significantly less. The patient is placed in dorsal recumbency and an incision is made at the
midpoint between umbilicus and the cranial brim of the pubis on the ventral abdominal midline. The incision can be as small
as 1 to 2 cm in length. Any subcutaneous fat (and there usually is very little) in the surgical field can be excised exposing the
linea alba. An incision is made in the linea alba. With the abdominal incision this far caudal the urinary bladder can
generally be easily visualized. Elevation of the bladder allows direct visualization of the uterine body and / or uterine horns.
If the bladder is not visible the uterine horn can be exteriorized with a spay hook. Deliver one uterine horn through the
incision. Apply caudal traction to the uterine body to expose the proper ligament and ovary. Clamp the proper ligament with
a mosquito hemostat and apply slight upward traction exposing the suspensory ligament. Transect the suspensory ligament
with a scissors or scalpel and tear a hole in the broad ligament just caudal to the ovarian vessels. The ovarian vessels can be
tied off and transected using the same hemostat technique as in a feline castration.

Gentle caudal traction on the first uterine horn will expose the uterine body and the second uterine horn. The second ovary is
exposed and the second ovarian pedicle is tied off and transected in a manner identical to the first.

The broad ligaments are incised to the uterine vessel on both sides allow exposure of the uterine body. It is not necessary to
remove the entire uterine body to the level of the cervix. One ligature placed with a Miller’s knot without clamping the
uterus is sufficient for hemostasis. The Miller’s knot is created by passing a length of suture material around the uterine body
twice, creating a loop. Needle holders are then passed through the loop and the surgeon proceeds by creating a standard
square knot throw. The knot is secured, ensuring that both loops are tightened evenly. Elevating the loops as they are
tightened will facilitate this, ensuring that the tissue is thoroughly compressed. The Miller’s knot is then finished with a series
of square knots to prevent loosening. The uterine body is then transected distal to the ligature.

Closure consists of simple continuous pattern in the body wall followed by simple interrupted or continuous subcuticular
sutures to close the skin.

**Pediatric Canine Ovariohysterectomy**

Canine pediatric ovariohysterectomy is performed similar to ovariohysterectomy in the adult dog with only a few differences.
The structures are smaller than those in the adult dog, the ovaries are more easily exteriorized and it is slightly more difficult
to exteriorize the uterine body. For these reasons the abdominal incision in the young dog is somewhat caudal to that in the
adult dog. The patient is placed in dorsal recumbency and an incision is made just cranial to the midpoint between the
umbilicus and the cranial brim of the pubis on the ventral abdominal midline. Subcutaneous dissection on the midline
exposes the linea alba which is nicked with a scalpel blade. The linea incision is extended with a scissors exposing the
abdominal contents. The urinary bladder may be visible and if so it can be elevated allowing direct visualization of the
uterine body and / or uterine horns. If the bladder is not visible the uterine horn can be exteriorized with a spay hook
delivering one uterine horn through the incision. Apply enough caudal traction to the uterine body to expose the proper
ligament and ovary. Clamp the proper ligament with a mosquito hemostat and apply slight upward traction exposing the
suspayory ligament. Transect the suspensory ligament with a scissors or scalpel and tear a hole in the broad ligament just
caudal to the ovarian vessels. A standard 3-clamp technique may be used on the ovarian pedicle and the pedicle is transected
and ligated. Generally only one ligature is necessary on each pedicle in a pediatric canine spay. Gentle caudal traction on the
first uterine horn will expose the uterine body and the second uterine horn. The second ovary is exposed and the second
ovarian pedicle is transected and ligated in a manner identical to the first.

The broad ligaments are incised to the uterine vessel on both sides allowing exposure of the uterine body. One ligature placed
with a Miller’s knot without clamping the uterus is sufficient for hemostasis. The uterine body is transected distal to the
ligature. Closure consists of simple continuous pattern in the body wall followed by interrupted or continuous subcuticular
sutures to close the skin.
Conclusions

Research over the past 20 to 30 years has dispelled most of the myths related to early age spays and castrations. There are few, if any, proven long-term negative physiological effects associated with early age spay/neuter and the advantages far outweigh the disadvantages. The anesthetic and surgical techniques used in early age spay/neuter are easier, faster and have fewer complications than spay/neuter in older dogs and cats. Recovery from anesthesia and surgery is also much faster in early age patients.

References
