If I tell you … I’ll have to kill you: tricks, tips, and ideas for common reproductive procedures
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Objectives
- To present techniques to help differentiate and solve common problems during common reproductive surgical procedures.

Key points
- If you are struggling to see the ovary, uterus, and/or cryptorchid testicle, then extend the surgical incision. You want to make sure to clip and prep for a large abdominal approach.
- Complete agenesis of the ovaries and uterus or testicles are rare occurrences, with more commonly an abnormal, atrophied vestigial structures (mesonephric/Müllerian ducts) identified in their place.
- In patients with uterine hypoplasia, uterus unicornis or with segmental agenesis, both ovaries are usually present, so the second ovary must be searched for and removed.
- Using a miller’s knot for ligation of the ovarian stump can be useful in overweight animals.
- Using the "biological retractors" improves your ability to find the ovary and uterus, as the mesoduodenum/mesocolon will ‘retract’ the intestines from your field of view.
- If a patient comes back into heat after the ovaries have been removed, the most likely cause is that all of the ovarian tissue was not removed.
- To identify an abdominal cryptorchid testicle, follow the ductus deferens from the bladder or the gubernaculum from the inguinal ring, and the testicle should be at the end.

Overview
Although sterilization of dogs and cats are common procedures done at veterinary practices every day, they can be associated with frustration and stress, as not every procedure goes as expected. When the procedure does not go routinely, it often results in increased surgical and anesthetic time for the patient, as well as an increased risk of postoperative complications. Difficult surgeries often occur in patients that are overweight, very young patients where the tissues are more friable, and those with congenital abnormalities where the normal structures are not present or appear abnormal. Higher complications also can occur in patients where the surgical approach is small, so complete identification and evaluation of the structures being removed cannot be appropriately made.

Surgical approach
In my experience, the key to minimizing many of the complications associated with sterilization surgery (ovariectomy [OVE], ovariohysterectomy [OVH], and cryptorchidectomy), is a good surgical approach to permit exposure. This allows the surgeon to fully evaluate structures correctly for removal, evaluate ligature placement, and evaluate for any hemorrhage. For ANY abdominal procedure, the surgeon should make sure that the patient is clipped and prepared for a large abdominal approach. The patient should be draped for a large approach, even if the surgeon chooses to make a smaller approach. In overweight animals there will be increased adipose tissue within the ovarian pedicle, making ligation more difficult, so the approach may need to be extended further cranially to allow all structures to be seen. When abnormal anatomy is present, then a larger surgical approach is necessary to fully evaluate the reproductive tract. Good knowledge of the anatomy is required in those cases where structures are absent or not in the normal location.

The umbilicus is often recommended as the cranial limit for the abdominal incision when performing an OVH. However, there is no anatomic relationship between the umbilicus and the location of the ovaries. The cranial and caudal limits of the abdominal incision for an OVH should provide an
incision of sufficient length to easily and safely remove the ovaries and uterus and to easily and safely ligate the ovarian and uterine vasculature.

Parapreputial approaches are often utilized for cryptorchidectomy procedures. This means that the skin incision is parapreputial, however then the penis is retracted to the side and the abdomen is approached via a midline linea alba incision. If the parapreputial approach is continued through the musculature (rectus abdominus muscle), there will be significant bleeding, tissue trauma, poor visualization, and postoperative pain.

**Ovariectomy/ovariohysterectomy**

When performing an OVE/OVH, the ovary should be present anywhere from below the kidney to the pelvic canal. The uterus, if present, is always located between the colon and bladder. When the surgeon is having difficulty identifying normal structures, then the first thing to do is to extend your incision. Visibility is critical to help identify structures without causing tissue damage.

Using the "biological retractors" improves your ability to find the ovary and uterus, as the mesoduodenum/mesocolon will ‘retract’ the intestines from your field of view. On the right side find the descending duodenum and reflect it to the left exposing the caudal pole of the right kidney, the right ovary and right uterine horn. On the left side the descending colon, reflect it to the right exposing the caudal pole of the left kidney, the left ovary and left uterine horn. Alternatively the bladder can be retroflexed and the uterine body identified between the bladder and colon.

Congenital abnormalities of the reproductive tract are not common, with minimal information in the veterinary literature. These abnormalities can present difficulties for veterinarians when found incidentally during OVH or OVE. In the female, the more common abnormalities include uterine hypoplasia (poorly developed uterus or uterine horn), uterus unicornis (complete agenesis of one uterine horn), and segmental agenesis (an underdeveloped or absent portion of a uterine horn). In 2010, McIntyre et al reported that congenital anomalies of the uterus were identified in 0.09% (49/53,258) of female cats and 0.05% (15/32,660) of female dogs. Uterine anomalies identified included unicornuate uterus (33 cats and 11 dogs), segmental agenesis of 1 uterine horn (15 cats and 3 dogs), and uterine horn hypoplasia (1 cat and 1 dog). Ipsilateral renal agenesis was present in 29.4% (10/34) of cats and 50.0% (6/12) of dogs with uterine anomalies in which kidneys were evaluated. Mummified ectopic fetuses were identified in 4 cats with uterine anomalies. Both ovaries and both uterine tubes were present in most animals with uterine anomalies.

So when performing a spay and discovering that one uterine horn is absent or abnormal you must search for the ovary that is associated with that uterine horn. If a broad ligament is present, then it can be followed cranially to the ovary. If no broad ligament is present on the involved side, use of the biological retractors will help localize the ovary, just caudal to the kidney.

In female cats, if no ovarian or uterine structures are identified after persistent exploration of the abdomen, the odds are that you are spaying a male cat! Have someone check under the drape.

**Dropped pedicle/hemorrhage**

Standard technique for ligation of the pedicle is a three clamp technique. The number of clamps used is not as critical as the security of the ligature. The ligature should be placed in the ‘crush’ zone of a clamp. The hemostat allows the adipose tissue in the crush area to be pushed out, leaving only vasculature and connective tissue within the ligature. When using multiple clamps, a common mistake is placing a ligature too close to a second clamp. The clamp will keep the tissues spread apart, and not allow the ligature to be tightened securely. Often this is noted when the second clamp is released and the ligature is loose, or when the pedicle is transected and bleeding occurs. To prevent this, the second clamp can be ‘flashed’ when placing the ligature close by. The clamp is released, the ligature is tightened, and then the clamp is reclosed.

Ligatures can be tied with a square knot, a surgeon's knot, or a miller's knot depending on the size of the pedicle and the preference of the surgeon. Of these, the miller's knot is the most secure especially in patients with large, fatty ovarian pedicles.
If an ovarian pedicle tears, retracting back into the abdominal cavity prior to ligation, you must retrieve and ligate the pedicle. Each pedicle must be checked for any bleeding prior to closure as well. Observation of the pedicle is the best way to assure no bleeding is present. To check the ovarian pedicle or retrieve a dripped pedicle, using the "biological retractors" improves ability to see the pedicles. On the right side, find the descending duodenum and reflect it to the left exposing the caudal pole of the right kidney, the right ovary and right uterine horn. On the left side the descending colon, reflect it to the right exposing the caudal pole of the left kidney, the left ovary and left uterine horn. To evaluate the uterine body for bleeding, the bladder can be retroflexed to visualize the tied ligated uterus between the bladder and colon.

Although bleeding from a dropped pedicle can be stressful, the patient will not exsanguinate before your eyes. Depending on the size of the surgical incision, it may need to be extended to better evaluate the affected pedicle. Once the pedicle is identified, then it can be either exteriorized with two fingers or with forceps grasping the tissue where the bleeding is occurring. There is absolutely no need to reach in with forceps and start grasping large sections of retroperitoneum randomly in the pedicle area, as this will increase the chances of damaging the ureter inadvertently. Care should be taken if gauze squares are used to clear the blood from the area. Know how many gauze squares you are putting in and taking out. Once the pedicle is exteriorized you can place two hemostats and ligate in the crushed area of the most proximal (deep) hemostat. Alternatively, if there is not much tissue present, you can place a miller’s knot around the pedicle to control the bleeding, and then place your circumferential ligature in the crushed area from the hemostat.

Ovarian remnants

Ovarian remnant syndrome (ORS) is defined by the presence of functional ovarian tissue in a previously spayed bitch. An ovarian remnant occurs when ovarian tissue is left in the abdomen after an OVE or OVH. Recurrence of estrus following OVH has been reported in 17-43% of dogs. The most common cause for this occurrence is either crushing part of the ovary or cutting part of the ovary off with the ovarian pedicle during removal of the ovary. Ovarian tissue could also be dropped into the abdomen inadvertently (during laparoscopy). The ovarian tissue can revascularize and actively secrete hormones, causing patients to exhibit signs of estrus again. This can occur days, weeks or years after the original procedure. Confirmation of the patient being in estrus should be done via vaginal cytology. If this is consistent with estrus, then further bloodwork may not be necessary. However, a serum luteinizing hormone (LH) assay can be done. If LH concentration is high, no estrogen is present. If the LH is low, there is estrogen present, and without an exogenous source, then ovarian tissue must be present.

If a patient comes back into heat after the ovaries have been removed, the most likely cause for this is that ovarian tissue remains. There are no reports in the veterinary literature of true ectopic ovaries. Accessory ovarian tissue can be small and have been reported in cats to be located in the proper ligament of the ovary but separated by connective tissue from the normal ovary. If the normal ovary is removed, the accessory ovary may become functional. One study published in 2010 evaluated patients presenting for ORS. The most common clinical signs were those associated with proestrus and estrus. More dogs than cats were affected, and all residual ovarian tissues were found in the region of the ovarian pedicles. The right ovary in dogs was affected significantly more often than the left ovary. Seven animals had neoplasms of the reproductive system. These animals had a significantly longer interval between OVH and diagnosis of ORS than did the 14 animals without neoplasms. Surgical removal of residual ovarian tissue resulted in resolution of clinical signs. Based on these findings, ORS is usually a result of surgical error during an OVH or OVE procedure and surgical exploration and removal of the ovarian remnant is recommended.

To avoid this complication, make sure you have fully exteriorized the ovaries. In order to avoid clamping part of the ovary off, either fully observe the ovary or have a thumb and index finger on the ovary so you can feel where the ovary ends, allowing safe placement of your surgical clamps. Always examine the transected tissue, opening the bursa to make sure you have the entire ovary. In cats, the ovary is not in a bursa. This should be done on every OVE and OVH procedure.
If a functional ovarian remnant is present, you must surgically remove it. Performing the surgery while the animal is in heat will make locating the remnant easier. Use of the "biological retractors" for exposure and grasping with fingers are the best methods to expose and exteriorize the ovarian pedicles and find the ovarian remnant. Once the remnant is exteriorized, place two clamps proximal to the remnant, and ligate in the crushed area of the most proximal clamp.

When exploring the abdomen, both sides should be evaluated, although the right side is the most common location. Palpate the tissue in the area for a firm mass or a full ovary. If no obvious tissue is identified, both ovarian pedicles should be resected. Careful evaluation of the rest of the abdomen should be done as well in the event that a section of ovary was dropped during the initial procedure. Often the remnant is easily identified. However, provide a good surgical approach to allow adequate ability to see all abdominal contents and always allow plenty of time to thoroughly evaluate the abdomen. It is also recommended to send the tissue that was removed for histopathologic evaluation to confirm the resected tissue is ovarian in origin. Some surgeons like to explore during estrus in hopes that increased vasculature makes remnants more visible. Others like to administer human chorionic gonadotropin during estrus in order to cause ovulation, in hopes that luteal tissue will be present and the remnant more easily identified.

Cryptorchid testicle

Testicular agenesis is an extremely rare condition in dogs or cats, so if a testicle is not in the scrotum, the odds are that the patient is cryptorchid. One study described a 13.6 fold risk of testicular neoplasia in cryptorchid testes. The risk of torsion of the spermatic cord also is increased, with affected testes often being neoplastic. Due to these risks, removal of cryptorchid testicles is always indicated.

Preoperatively, the side of the cryptorchid testis should be determined. Under heavy sedation or anesthesia the inguinal regions should be palpated. If a testicle is present within the scrotum, it can be gently manipulated cranially to determine from which side it originates. Cryptorchid testicles are usually abdominal or inguinal. Very rarely, a testis is retained within the inguinal canal. Palpation can be challenging in some cases, as often the cryptorchid testis is smaller than normal, and if present within the inguinal canal, then inguinal adipose tissue may make palpation difficult. Ultrasonography of the inguinal region or abdomen can be helpful in some cases to identify the location of the testicle. In cats, if a retained testicle is suspected, the simplest way to determine if testosterone is present is to check for testosterone-dependent penile spines. Penile spines will atrophy by six weeks following complete castration.

For inguinal cryptorchid testicles, an incision is made over the testicle and a routine neuter is performed. For abdominal cryptorchid testicles, a standard midline/parapreputial approach entering the abdomen via a linea alba incision is recommended. The cryptorchid testicle is usually very mobile and can be easily exteriorized. Full parapreputial approaches through the rectus muscle for unilateral cryptorchidectomy are discouraged due to poor ability to see abdominal content, increased bleeding, and increased soft tissue trauma and pain. Inadvertent prostatectomy due to decreased ability to see and identify abdominal structures has been described in the literature. When performing a cryptorchidectomy, the abdominal testicle should be present anywhere from below the kidney to the inguinal ring. If the spermatic cord and vascular pedicle are seen entering the inguinal ring, then the testicle is outside of the abdomen. If the gubernaculum is seen entering the inguinal ring, then the testis is within the abdomen, and gentle traction of the gubernaculum will bring the testis into view. The bladder can also be retroflexed, and the ductus deferens located dorsal to the neck of the bladder. The ductus can be followed to the testicle.

If the testicle is truly not identified during surgery and ruling out monarchism or anarchism is desired, then a gonadotropin releasing hormone stimulation test will tell you if there is functional testicular tissue anywhere in the dog.
**Hermaphrodite/pseudohermaphrodite**

Disorders of sexual development are not straightforward. A "true" hermaphrodite has the presence of both gonads (ovarian tissue and testicular tissue). The gonadal tissue can be present as a complete ovary, complete testicle or any variation, such as an ovotestes. This definition is used regardless of the presence of either male, female or both external genitalia.

An animal is termed a "pseudo" hermaphrodite when the phenotype (external genitalia) does not match the gonadal tissue (ovary or testicle). These are further classified as either a "male" or "female" pseudohermaphrodite based on the gonadal tissue that is present. A male pseudohermaphrodite has the external genitalia of a female and testicular tissue present (often abdominal and not apparent externally). A female pseudohermaphrodite has the external genitalia of a male and ovarian tissue. These patients can also have ambiguous external genitalia but are still named by the gonadal tissue present.

Finding a testicle in the place of an ovary can certainly be confusing, however, bottom line, when sterilizing a patient, be it a male or a female organ, it needs to come out. If you are searching for a cryptorchid testicle and find a hypoplastic uterus and an ovary, then proceed to perform an OVH. Most patients will still have two gonads (male, female, or one of each), so removal of both should be done as you normally would for that particular gonad. If you are going to spay a patient with a prominent os clitoris, then be prepared to find testicular tissue within the abdomen. These situations are the reason that you always want to have your patient clipped and prepped for a more extensive approach.

**Selected references**


