Laparoscopic and Laparoscopic-Assisted Cryptorchidectomy in Dogs and Cats

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Abstract: There are many applications for laparoscopy in small animal surgery. A relatively simple one is abdominal cryptorchid castration. Laparoscopic examination of the peritoneal cavity can both aid in the diagnosis of abdominal cryptorchidism and allow treatment using either a totally laparoscopic or a laparoscopic-assisted technique. Minimally invasive cryptorchid castration obviates the need for “open” celiotomy and may thereby reduce postoperative discomfort and wound-related complications in these patients.

During embryonic development in male dogs and cats, contraction of the gubernaculum causes progressive migration of the testes from a location just caudal to the kidney to their normal position in the scrotum. This migration is typically complete by 2 months of age but can take place as late as 6 months of age in some breeds. The cause of cryptorchidism has not been completely elucidated but is likely multifactorial. Migration of the testis can cease at any time, with the result that one or both testes can remain in the peritoneal cavity, within the inguinal rings, or in the inguinal area cranial to the scrotum.

Owners should be advised that there are several important reasons to castrate a cryptorchid pet. First, cryptorchidism is thought to be a sex-linked autosomal recessive trait in dogs. Further breeding could lead to propagation of this undesirable trait. Second, cryptorchid testes are prone to several pathologic states. Testicular tumors develop much more frequently in cryptorchid testes than in scrotal testes. In one study, the risk of tumor development in cryptorchid testes was 13.6 times the risk in scrotal testes. Inguinally retained testes appear to be at even higher risk of developing neoplasia than abdominally retained testes. The risk of testicular torsion is also increased for cryptorchid testes, with torsed testes often being neoplastic.

If, on physical examination, one or both testes are not present inguinally or scrotally, the missing testis is most likely within the peritoneal cavity. Palpation should be performed carefully because cryptorchid testes are often smaller than descended testes and can be difficult to find. Traditionally, abdominal testes have been removed through either a ventral midline celiotomy or a parapreputial laparotomy. Totally laparoscopic or laparoscopic-assisted techniques now exist, allowing removal of intraabdominal testes through much smaller incisions. Neoplastic cryptorchid testes can also be removed laparoscopically, although if the tumor is very large, open surgery may remain more practical.
Advantages
A minimally invasive approach to abdomi-

nal cryptorchid testis removal reduces tissue

trauma and is likely to reduce postoperative

pain and wound healing complications com-

pared with open laparotomy. If localization

of a cryptorchid testis is challenging, laparo-

scopic examination of the caudal peritoneal
cavity and the entrance to the inguinal rings

provides excellent visualization and can help to

rule out the diagnosis of abdominal cryptorchid-

ism. This may help to minimize iatrogenic dam-

age to surrounding structures, which has been

attributed in some cases to inadequate visual-

ization when small paramedian laparotomies

are performed. Such damage includes inad-

vertent prostatectomy and ureteral or urethral

trauma.6–8

Disadvantages
The principal disadvantage of laparoscopy is the

need for specialized equipment and the associ-

ated costs. Adequate training is also necessary
to perform laparoscopic procedures and to use
the equipment appropriately. Although surgi-
cal time can initially be longer than that for an
open procedure, with experience, laparoscopic
cryptorchidectomy is likely to become as effi-
cient, if not faster than, its open counterpart.

Preoperative Assessment
A careful history should be taken for any male
cat or dog in which two testes cannot be pal-
pated in the inguinal area to ensure that one
or both testes have not been removed previ-
ously. Generally, a male dog or cat in which
one or both testes are absent from the scrotum
at 6 months of age is classified as cryptorchid
because scrotal migration of a testis after this
time is extremely unlikely.1 It is important to
assess the inguinal area carefully with the
animal under heavy sedation or general anes-
thesia so as not to miss the presence of an
inguinal testis. If one testis is present scrotally
and one abdominally, it is also helpful to iden-
tify whether the right or left testis is present
within the peritoneal cavity. This can be done
by gentle manipulation of the scrotal testis in
a cranial direction, which will usually reveal
the side on which it is located.

If no inguinal testes are palpated, it can be
assumed that the missing testes are in either
the inguinal canal (which is uncommon) or the
abdomen. Abdominal ultrasound

can be used to confirm the presence of abdominal or inguinal canal testes

in most cases. If doubt still remains

about the presence or absence of testes, a human chorionic gonadotropin

stimulation test can be performed to

confirm the presence of testicular tis-
sue.5 For this test, serum samples are

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QuickNotes
Generally, a male
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collected before and 2 hours after administration of human chorionic gonadotropin (50 IU/kg IM) and submitted for testosterone assay. Unilateral or bilateral monorchidism is very rare; therefore, it is most likely that abdominal testes are present, making exploration of the peritoneal cavity a reasonable next step. Typically, exploration is accomplished via open surgery through a ventral midline celiotomy or a paramedian laparotomy. In cats, a standard ventral midline laparotomy that must usually extend caudally to the pubis is performed. Laparoscopic examination of the caudal abdomen is a minimally invasive modality for confirming the presence or absence of abdominal testes, and laparoscopic or laparoscopic-assisted techniques have been described for removal of abdominally cryptorchid testes.

**Instrumentation**

As well as the basic components of an endoscopic tower, other equipment required to perform laparoscopic and laparoscopic-assisted cryptorchidectomy includes a laparoscope, two or three trocar–cannula assemblies, and laparoscopic surgical instruments. The most commonly used laparoscope size is 5 or 10 mm, and the most common lens angles are 0° and 30°. Trocar–cannula assemblies can be disposable or reusable and are usually 6 mm in diameter to fit 5-mm instrumentation. Typically, sterilizable, reusable cannulas are more cost-effective than single-use devices for veterinary use.

Instruments essential for laparoscopic cryptorchidectomy include a blunt probe for tissue manipulation and Kelly or Babcock forceps for grasping the testis, spermatic cord, and gubernaculum. For hemostasis during totally laparoscopic cryptorchidectomy, either a vessel-sealing device (e.g., Ligasure [Valleylab Inc., Boulder, CO], Enseal [Ethicon Endosurgery, Cincinnati, OH], Harmonic Scalpel [Ethicon Endosurgery, Cincinnati, OH]) can be used. If these devices are not available, hemostasis can be achieved using either hemostatic clips dispensed by a laparoscopic clip applier or extracorporeal suturing. A knot pusher is used.

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to place extracorporeal sutures. If a testicular tumor is suspected, resection and placement into a specimen retrieval bag before removal from the peritoneal cavity is advised to avoid port site metastasis.

**Surgical Techniques**

**Patient Preparation and Positioning**

Dogs and cats with cryptorchid testes should be positioned in dorsal recumbency on the surgical table. The inguinal area should be thoroughly palpated again to rule out an inguinally located testis and prevent unnecessary laparotomy or laparoscopy. The entire ventral abdomen from the scrotum to the xiphoid process and laterally to the midabdominal level should be aseptically prepared, as the possibility of conversion to an open approach should always be anticipated with any laparoscopic procedure. After initiating the pneumoperitoneum, place the animal in a 20° to 30° “head down” (Trendelenburg) position to allow caudal peritoneal organs to move cranially, thus improving visualization of the area. In some cases, it may also be beneficial to tilt the animal laterally to better visualize one or both testes.

**Port Position**

Laparoscopic-assisted cryptorchidectomy can be performed using a two-port technique. A telescope port is established in a subumbilical location, using either the Hasson technique or a Veress needle technique. These techniques were described in an earlier Surgical Views article.10 Once the telescope port has been established, an instrument port can be established using a 5- or 10-mm trocar–cannula assembly under direct visualization in a paramedian location (lateral to the prepuce in dogs; in the left or right caudal quadrant of the abdomen in cats) on the right or left side, depending on which testis is located in the abdomen. Every effort should be made to avoid iatrogenic damage to the caudal superficial epigastric vessels during cannula placement. In most bilaterally cryptorchid animals, the side that the instrument port is placed on is not critical because both testes will still be retrievable from the same port.9

A totally laparoscopic technique is usually performed using a three-port technique. A two-port technique can be used if an operating laparoscope with a working channel is used. A camera port should be placed in a subumbilical position. Two more instrument ports are established in paramedian (lateral to the prepuce) positions on both sides of the prepuce in dogs (FIGURE 1) and in a triangulating position around the caudal abdomen in cats.

**Exploration of the Caudal Peritoneal Cavity**

In many cases, after establishment of a pneumoperitoneum, the abdominal testis can be seen immediately on entering the peritoneal cavity with the laparoscope (FIGURE 2). However, if confusion exists, the area of the internal inguinal ring should be visualized. If the spermatic cord and vascular pedicle of the testis are seen entering the ring, the testis is within the abdomen, and a thorough examination of the caudal peritoneal cavity should reveal its location.

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neal location, either within the inguinal canal or (more likely) in an inguinal location (FIGURE 3). The surgeon should reevaluate the inguinal area if no testis was palpated in that location previously. If only the gubernaculum is seen entering the inguinal ring, the testis is located within the peritoneal cavity, and further inspection of the caudal abdomen usually locates it. Gentle traction can also be placed on the gubernaculum to help in localization (FIGURE 4). In some cases, the testis is obscured by the bladder or other surrounding structures.

Laparoscopic-Assisted Cryptorchidectomy
The laparoscopic-assisted cryptorchidectomy technique provides a rapid, simple way to recover an abdominal testis and ligate the vascular pedicle and spermatic cord outside the abdominal cavity, thereby obviating the need for intracorporeal ligation techniques. In this technique, laparoscopic Kelly or Babcock forceps are placed through the instrument port to grasp the testis or the spermatic cord. At this point, it is helpful to evacuate the pneumoperitoneum to decrease tension during elevation of the testis. Enlarge the port incision by separating the parallel fibers of the rectus abdominus just enough to remove the testis from the peritoneal cavity. Once the testis has been exteriorized, clamp and double ligate the spermatic cord and vascular pedicle before sectioning. It is important to ensure that ligated pedicles are not bleeding and do not become caught in the subcutaneous fat or muscular tissue of the body wall as they are returned to the peritoneal cavity.

If both testes are in the peritoneal cavity, they can usually be recovered through the same port incision. To locate the second testis, reestablish the pneumoperitoneum. If the instrument port was enlarged to recover the first testis, use a larger cannula, hold a moistened sponge around the cannula, or place a temporary purse-string suture around the cannula to prevent leakage of carbon dioxide during reinsertion of the cannula. The second testis can then be withdrawn and ligated in the same manner as the first. If the second testis cannot be advanced to the port site, establish a third port on the opposite side of the prepuce (FIGURE 1) and follow the above steps to withdraw the second testis, although in my experience, this is unlikely to be necessary. The port site incision(s) should then be closed, making sure that the ventral sheath of the rectus abdominus is adequately sutured to prevent herniation of abdominal contents, which can occur through defects as small as 5 mm. After closure of the instrument port incisions and before closure of the telescope port, it is advisable to briefly reestablish the pneumoperitoneum and reinsert the telescope to ensure that good hemostasis has been maintained. Finally, remove the telescope, thoroughly purge the pneumoperitoneum from the peritoneal cavity, and close the telescope portal routinely.

Totally Laparoscopic Cryptorchidectomy
In the totally laparoscopic cryptorchidectomy technique, the vascular supply and spermatic cord are ligated within the peritoneal cavity before the testis is removed from the abdomen. If the testis is directly visible, it can be grasped with laparoscopic Kelly or Babcock forceps and elevated (FIGURE 5), allowing the vascular pedicle and spermatic cord to be moved away from surrounding structures in readiness for ligation. A vessel-sealing device can be placed into the second instrument port, and the guber-
The vascular pedicle can be substantial in large dogs, and care should be taken to ensure adequate hemostasis. The Ligasure and Enseal devices are both indicated to seal vessels up to 7 mm in diameter, and I have used them to seal the pampiniform plexus effectively. However, it is suggested that the vascular pedicle be double sealed—once proximally and once distally—before sectioning (FIGURE 6). If a vessel-sealing device is not available, hemostasis can be achieved using hemostatic clips delivered via a laparoscopic clip applier. Although 5-mm laparoscopic clip appliers are available, medium or large clips are generally delivered in a 10-mm clip applier. To reduce costs associated with the use of expensive single-use disposable clip appliers, multifire sterilizable clip appliers that can be loaded with cartridges of clips are available (M/L-10, Microline Pentax, Beverly, MA).

Another alternative for achieving hemostasis of the pedicle is the placement of extracorporeal ligatures. To place extracorporeal sutures, pass a piece of suture material through one cannula and around the pedicles. Withdraw the suture through the same cannula, tie a modified Roeder knot outside the peritoneal cavity, push the knot into place through the cannula, and tighten it around the pedicle using a laparoscopic knot pusher. Although this is the least expensive technique (it does not require any expensive disposable equipment), it is likely to be the most time-consuming because these sutures are tedious to place; however, a rapid learning curve has been seen in studies that used extracorporeal suturing.

When laparoscopic cryptorchidectomy is performed, the testis must be withdrawn through one of the ports. One of the pararepital ports can be used for this purpose, or the telescope can be replaced into one of the instrument ports and the testis withdrawn through the subumbilical port. If the subumbilical port is used, any enlargement of the port incision will be through the linea alba, resulting in less muscular trauma and therefore possibly less postoperative pain than if a paramedian instrument port is enlarged. After laparoscopic cryptorchidectomy, it is not necessary to reestablish the pneumoperitoneum because the pedicles are inspected for hemostasis immediately after they have been sealed or ligated and sectioned. After the testis has been removed, all remaining ports can be closed routinely.

Resection of Neoplastic or Torsed Cryptorchid Testes

Cryptorchid testes are predisposed to neoplasia and torsion, both of which are indications for surgical excision. Whether a laparoscopic approach is feasible in these situations depends on several variables. If the testis is very large (8 to 10 cm), a laparoscopic approach may be less practical because a large incision will be required to retrieve the testis after its pedicles have been ligated. A second potential problem...
is the presence of adhesions to other structures, specifically the bladder, ureters, prostate, and lower gastrointestinal tract. If the surgeon has any concern about the involvement of these structures or encounters technical difficulties while dissecting adhesions, conversion to an open approach should be considered. However, laparoscopic resection of a neoplastic testis has been reported in the veterinary literature. In my experience, most neoplastic abdominally cryptorchid testes remain small and mobile enough to be resected laparoscopically in a manner similar to those described above for removal of nonneoplastic testes. If a testis is suspected to be neoplastic, it should be placed in a specimen retrieval bag before being pulled through the instrument port to reduce the possibility of port-site metastasis.

References
8. Schultz KS, Waldron DR, Smith MM. Inadvertent prostecto-