Use of laparoscopic-assisted cryptorchidectomy in dogs and cats

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Cryptorchidism is the most common congenital defect of the testes in dogs with a reported prevalence as high as 10% of adult dogs.[1] Cryptorchidism is considered to be a sex-linked autosomal recessive trait.[2] Most commonly cryptorchidism is a unilateral condition with the right testicle being most frequently retained.[1,3-5] Abdominally retained testicles are more freely mobile than those within the scrotum and are therefore more susceptible to testicular torsion.[1] Also, the incidence of testicular neoplasia in abdominally retained testicles is 13.6 times higher than descended testicles.[6] Attempts at correction of cryptorchidism through hormonal treatment are not effective in dogs,[1] and orchipexy is considered unethical because of the hereditary nature of the disease. Therefore, the treatment of choice is castration.[2]

The location of the retained testicle can frequently be determined by palpation. However, fat or the inguinal lymph nodes may be mistaken for an inguinal testicle. In a study[7] in cats, palpation to locate the retained testicle was performed successfully only 48% of the time. Inaccurate localization of the testicle can lead to increased complications in the patient caused by unnecessary exploration of the abdomen and inguinal region.

Use of small laparotomy incisions and a spay hook to retrieve testicles retained within the abdomen has been recommended for castration of cryptorchid animals.[8] Because of poor visibility of abdominal contents, this technique can cause inadvertent prostatectomy, urethral avulsions, and ureteral damage.[9-11] Because of these important potential complications, use of caudal minimal laparotomies is no longer advocated.[9-11]

A completely intracorporeal video-laparoscopic technique has been described for castration of dogs with abdominally retained testicles.[a] We modified the previously described technique to gain the advantages of a minimally invasive technique without the need for intracorporeal use of endoscopic clip applicators of pretied ligation devices. The purpose of the study reported here was to describe the use of laparoscopic-assisted cryptorchidectomy for removal of nondescended testicles in dogs and cats. We hypothesized that the technique would be an efficient and effective procedure for cryptorchidectomy.

Surgical Procedure

Client-owned dogs and cats > 4 months old with 1 or 2 nondescended testicles were chosen for laparoscopic-assisted cryptorchidectomy. Animals that were believed to be candidates for the procedure were sedated, and the inguinal region was palpated. The procedure was not performed on animals with nondescended testicles identified by palpation as extra-abdominal within the inguinal region. A mandatory follow-up examination was performed 1 month after surgery.

Owners were informed of the details, benefits, and possible complications of the laparoscopic-assisted procedure and of the more traditional options for treatment. The owner also consented to conversion from the laparoscopic-assisted procedure to open laparotomy if additional exposure of the abdomen was required.

All dogs and cats were premedicated and anesthetized by use of protocols that were determined by the anesthesiologist on duty to be appropriate for each individual animal. The abdomen was shaved from the xiphoid to the scrotum and twice the width of the mammary chain. Care was taken to shave the inner thigh to permit adequate incisions in the inguinal region if required. The urinary bladder was emptied via manual expression or catheterization. Dogs and cats were positioned in dorsal recumbency on a tilting table with the head tilted downward at an angle of approximately 20°. Animals were also tilted slightly laterally away from the side of the retained testicle. Bilaterally cryptorchid animals were positioned such that the lateral tilt could be reversed during surgery. The entire abdomen was aseptically prepared.

A 6-mm trocar was placed just caudal to the umbilicus by use of a Hasson[12] technique. A 1-cm skin incision was made at this site, and subcutaneous tissues were dissected to visualize the external rectus abdominis sheath. Stay sutures were placed on either side of the linea alba. Ventral traction on these sutures was maintained, and a small stab incision was made into the peritoneal cavity. A blunt reusable 6-mm trocar was inserted through the incision.

The abdomen was insufflated with carbon dioxide to an intra-abdominal pressure of 10 to 12 mm Hg and a 0°, rigid 5-mm laparoscope was inserted through the trocar. The abdomen was explored beginning with the inguinal rings. If the ductus deferens and vascular supply to the testicle were observed exiting the inguinal ring on both sides, the laparoscope was removed and the subcutaneous fat in the inguinal region and inguinal canal were explored surgically to identify and remove the testicle. The time of the laparoscopic portion of the procedure was recorded in these animals, and they were included in the follow-up examinations.

When an abdominally retained testicle was detected, a second sharp 6-mm trocar was inserted in a position ventral and slightly lateral to the testicle. Trocar placement was performed by use of direct visualization

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through the laparoscope, and transillumination of the abdominal wall was used to avoid blood vessels. The testicle was grasped with toothed 5-mm grasping forceps (**Fig 1**). The second trocar site was enlarged, and the testicle was extracted from the abdomen. Insufflation of the abdomen was stopped. Once the testicle had been exteriorized, the vascular supply and ductus deferens were ligated separately with simple encircling ligatures of 2-0 or 3-0 polydioaxanone (**Fig 2**). The pedicles were released and inspected for hemorrhage. If a second testicle was detected within the abdomen, the trocar was replaced and moist gauze was used around the trocar to provide an air-tight seal while the abdomen was reinsufflated. The second testicle was removed through the same trocar site. All excised cryptorchid testicles were submitted for histologic examination.

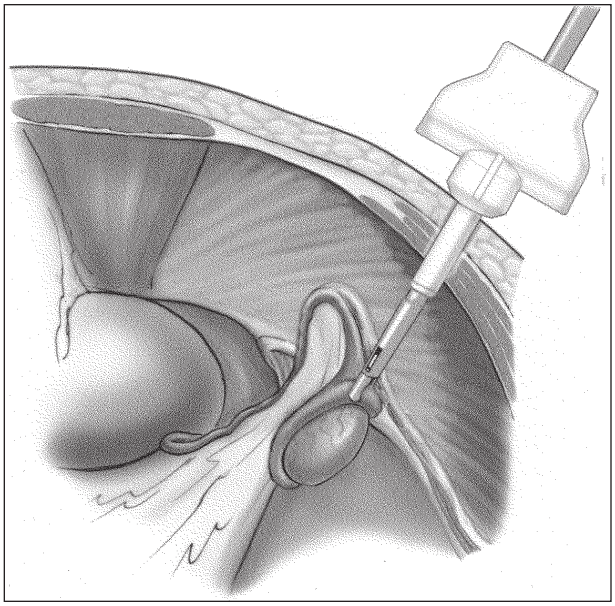

Figure 1—Illustration of laparoscopic-assisted cryptorchidectomy. The animal has been tilted slightly to the contralateral side to facilitate visibility of the retained testicle. The abdominally retained testicle is grasped with toothed 5-mm grasping forceps and elevated to the abdominal wall.

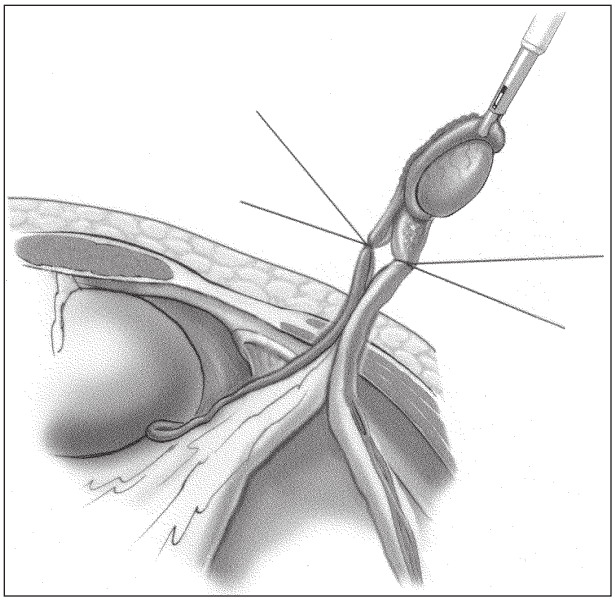

Figure 2—Same procedure as in Figure 1. The testicle is exteriorized for ligation and transection of the vascular supply and ductus deferens. Loss of insufflation pressure permits more of the spermatic cord structures and gubernaculum to be exteriorized for ligation.

The enlarged trocar site in the fascia of the external abdominal oblique was closed with 2-0 or size-0 polydioaxanone in a simple interrupted pattern depending on the size of the animal. The abdomen was insufflated again to permit inspection of the ligatures for proper placement and any signs of hemorrhage. The laparoscope trocar was removed, and the linea alba was closed with 2-0 or size-0 polydioaxanone. Subcutaneous tissues were closed with 3-0 polydioaxanone in a simple interrupted pattern, and skin sutures were placed.

In dogs and cats with 1 descended testicle, the second testicle was removed by a standard closed prescrotal technique. This was performed by senior veterinary students under the supervision of the surgeon and was therefore not included in the recorded time for the laparoscopic procedure. The time of the laparoscopic procedure was defined as the time from the initial incision to insert the first trocar to the time of closure of the skin incisions used for laparoscopy.

One dose of an opioid analgesic was administered after surgery. The specific analgesic was determined by the anesthesiologist on duty. Dogs and cats were discharged from the hospital the day after surgery. No additional analgesics were administered. Owners were instructed to limit the animal's activity for 1 week.

A follow-up examination was performed on all dogs and cats 1 month after surgery. Attention was focused on the healing of the trocar sites and any evidence of herniation of abdominal contents. Owners were asked to complete a questionnaire at the time of the follow-up examination, which contained questions about observed signs of illness (including loss of appetite, change in behavior, general signs of discomfort, and decreased activity level), complications (including licking or irritation at the incision sites), and overall satisfaction (on the basis of outcome, signs of discomfort after surgery, and cosmetics) with the procedure on a scale of 1 (very displeased) to 5 (very pleased).

Results

Ten dogs and 3 cats met the inclusion criteria. Breeds represented among dogs were Boxer (n = 2), German Shepherd Dog (2), Weimeraner (1), Golden Retriever (1), Border Collie (1), Miniature Schnauzer (1), Chihuahua (1), and Fila (1). Mean age of dogs was 1.5 years (range, 4 months to 8 years). Mean weight of dogs was 27.9 kg (61.4 lb; range, 1.5 to 53.9 kg [3.3 to 118.6 lb]). None of the dogs were considered obese. Breeds represented among cats were domestic longhair (n = 2) and domestic shorthair (1). Mean age of cats was 1.1 years (range, 7 months to 2 years). Mean weight of cats was 4.5 kg (9.9 lb; range, 3.6 to 5.2 kg [7.9 to 11.4 lb]). None of the cats were considered obese.

Two of 10 dogs were bilaterally cryptorchid, 3 of 3 cats and 7 of 10 dogs were unilaterally cryptorchid, and 1 dog was monorchid. Of the unilateral cryptorchid animals, 4 of the testicles were on the left and 6 were on the right side of the abdomen.

In the 2 bilaterally cryptorchid dogs, both testicles were detected within the abdomen. There was sufficient laxity of the vascular supply and ductus deferens to permit both testicles to be removed through a single trocar site.

Seven of the 10 unilaterally cryptorchid animals had abdominally retained testicles. In the 3 remaining animals, the testicle could not be palpated externally during general anesthesia. Two cats had testicles located in the inguinal region. One of those cats had previously undergone exploratory laparotomy; however, the testicle was not found.

One dog with an inguinal testicle had been castrated over 5 years previously. Because a diagnosis of prostatitis was made, the concentration of testosterone in plasma was measured. The concentration of testosterone was > 500 pcg/mL (reference limit for castrated male dogs, < 100 pcg/mL), indicating that testicular tissue was present. Laparoscopically, both ductus deferens were identified and terminated within the abdomen; presumably, they had been severed during the original castration. A small enlargement at the end of the left ductus deferens was identified, removed, and submitted for histologic examination. No testicular tissue was identified. Further testing of the plasma testosterone concentration indicated that testicular tissue was present. Ultrasonography revealed a mass in the left inguinal region. Exploration of this region was performed, and a large, soft testicle was removed. The testicle was devoid of any epididymis. In retrospect, the testicular vessels had entered the left inguinal ring even though the ductus deferens was completely within the abdomen.

Laparoscopic exploration of the abdomen was performed in 1 monorchid dog. The ductus deferens was identified and abruptly terminated within the abdomen. The vascular supply to the testicle was also identified and appeared to terminate in the same peritoneal reflection as the ductus deferens with 1 cm of peritoneal reflection between the termination of the testicular vascular supply and the termination of the ductus deferens. However, no testicle was identified. Because of the limited experience with the technique, the procedure was converted to an open laparotomy but no testicle was identified. The ductus deferens and pampiniform plexus were ligated, and the ductus deferens, pampiniform plexus, and tissue in between were submitted for histologic examination. No testicular tissue was identified on histologic examination. The absence of remaining testicular tissue in this dog was confirmed by the absence of a normal testicular tissue response to human gonadotrophic hormone after removal of the single descended testicle. The baseline testosterone concentration in plasma was 9.4 pcg/mL. Two and 4 hours after stimulation with human gonadotrophic hormone, the testosterone concentration in plasma remained at 9.4 pcg/mL.

Mean ± SD time for the laparoscopic portion of all procedures was 36.3 ± 18.9 minutes. Mean ± SD time for laparoscopic removal of a single abdominal testicle was 27.8 ± 11.6 minutes. Mean ± SD time for the first 3 procedures was 39 ± 9.4 minutes, which was reduced to 18.3 ± 1.7 minutes for the final 3 procedures. Mean ± SD time for laparoscopic exploration of the inguinal ring and identification of an extra-abdominal testicle was 18.5 ± 1.5 minutes. Mean ± SD time for removal of bilateral abdominal testicles was 55.0 ± 10 minutes.

Histologic examination revealed testicular hypoplasia or degeneration in 11 of 13 animals. In 1 dog suspected of being monorchid, the removed tissue was identified as normal epididymis and pampiniform plexus with no testicular tissue.

There were no intraoperative complications. Complications observed by the owners after surgery included licking of the abdomen (n = 5) and redness at both incision sites (2). No change in appetite was observed by any owner. Activity level was reported to be normal in all but 1 animal, which was reportedly lethargic for a few hours after the animal was brought home. Abdominal herniation, signs of abdominal discomfort, or other complications were not observed at the follow-up examination 1 month after surgery. In 8 of 13 animals, thickening and irregularity of the abdominal wall was palpated in the area of the enlarged trocar site used to exteriorize the testicle. The mean ± SD value for overall satisfaction with the procedure reported by the owners was 4.6 ± 0.7.

Discussion

Differential diagnoses for nondescended testicles include cryptorchidism, monorchidism, and anorchidism. The diagnosis is usually determined by history and palpation of the scrotal and inguinal regions. In obese dogs and in many cats, accurate location of the retained testicle by external palpation can be difficult. This may result in excessive surgical exploration of the inguinal and abdominal regions.

Laparoscopy offers 2 important advantages in animals with nondescended testes. Insertion of the laparoscope permits rapid exploration of the inguinal ring to determine if the testicle has exited the abdomen. This can be done through a 0.5-cm incision. In animals in which the testicular vasculature and ductus deferens are observed exiting the inguinal ring, exploration for the testicle can be limited to the inguinal region.

In animals with intra-abdominal testes, this laparoscopic-assisted technique offers excellent visibility of important structures with minimal trauma to the patient. Traditionally, abdominally retained testicles are usually removed through a combined ventral median and paraprepucial abdominal skin incision.[13] To reduce operative time, patient trauma, and risk of herniation or evisceration after surgery, minimal laparotomies and use of a spay hook have been recommended for castrating cryptorchid animals.[8] However, the reported complications are unacceptable. Complications with minimal laparotomies include hemiprostatic urethral avulsion, inadvertent prostatectomy, and ureteral and urethral trauma.[9-11] Retained testicles vary in location and gross appearance, making excision difficult and increasing the risk of complications.[11] Laparoscopy provides all the advantages of a minimal laparotomy without the disadvantages of poor visibility and exposure of the abdomen.

Laparoscopic-assisted removal of abdominal testicles has been previously described.[14,a] In these techniques, the testicular vasculature and ductus deferens is ligated by use of laparoscopic stapling devices or ligatures tied within the abdomen. To remove the testicle, the trocar site must

be enlarged or a specialized retrieval bag is required. In the laparoscopic-assisted technique presented here, exteriorizing the testicle and performing ligation externally simplify ligation of the testicular vasculature and ductus deferens. Loss of insufflation pressure at the time of testicular extraction permits good exposure of these structures externally. Enough laxity in these structures was present to permit removal of bilateral cryptorchid testicles from a single trocar site. Removing the testicle from the abdomen before ligation reduces the need for specialized devices and should reduce operative time.

The operative times reported for laparoscopic-assisted cryptorchidectomy reflect the learning curve associated with a new procedure. As the surgeon gained experience with the laparoscopy technique, the operative time decreased. When learning laparoscopy, instrumentation of the abdomen frequently requires more time than that required for an open laparotomy. As the surgeon's level of comfort with the equipment increases, the time required to instrument the abdomen decreases. Location and removal of a retained testicle is rapid. Because of the smaller size of the incisions, time may be saved during closure of the abdomen, compared with open laparotomy.

In the report presented here, anesthetic complications were not encountered; however, in dogs, decreases in caudal vena caval flow and cardiac output are proportionally related to increases in intra-abdominal pressure.[15] Therefore, intra-abdominal pressures > 20 mm Hg are potentially dangerous and should be avoided.[16-18] An intra-abdominal pressure of approximately 12 mm Hg was sufficient to permit excellent visualization of the appropriate structures.

The head down position along with abdominal insufflation can cause hypoventilation because of increased intra-abdominal pressure and the weight of abdominal viscera on the diaphragm. Monitoring of end-tidal carbon dioxide and oxygen saturation are advisable and were performed during this study. Manual or mechanical positive-pressure ventilation may be required. Limiting intra-abdominal pressure to that required for visualization can help minimize hypoventilation. Additional personnel may be required to monitor and ventilate the animal.

Potential complications reported[19-21] for laparoscopy include cardiovascular and pulmonary changes associated with carbon dioxide pneumoperitoneum; trocar injuries to the urinary bladder, small and large intestines, or major vessels; subcutaneous emphysema; visceral herniation; and wound infection or hematoma formation at the trocar entry sites. None of these complications were encountered during the procedures reported here.

Differences in complications associated with laparoscopic-assisted cryptorchidectomy, compared with open cryptorchidectomy, were not investigated. However, in humans, various laparoscopic procedures are associated with substantially less complications than the corresponding open procedures.[22-24] Results of studies[22-24] in humans indicate that decreased use of analgesics, decreased duration of hospitalization, and faster return to work are associated with use of laparoscopic procedures, compared with similar open procedures. Similar findings may be detected in animals when the invasiveness of the procedure is minimized.

Laparoscopic-assisted cryptorchidectomy is an efficient and effective procedure for castration of dogs and cats in which 1 or both testicles cannot be definitively palpated in the scrotal or inguinal regions. The technique is minimally invasive and provides good visibility and exposure of the abdomen.

[a]Gallagher LA, Freeman LJ, Trenka-Benthin S, et al. Laparscopic castration for canine cryptorchidism (abstr). *Vet Surg* 1992;21:411–412.

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