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Objective—To describe the operative technique for single-port laparoscopic cryptorchidectomy (SPLC) in dogs and cats and evaluate clinical outcome for patients that underwent the procedure.

Design—Retrospective case series.

Animals—25 client-owned dogs (n = 22) and cats (3).

Procedures—Dogs and cats that underwent SPLC with 3 commercially available single-port devices between 2009 and 2014 were retrospectively identified through a multi-institutional medical records review. Surgery was performed via a single-port device placed through a 1.5- to 3.0-cm abdominal incision either at the region of the umbilicus or caudal to the right 13th rib. The cryptorchidectomy was performed with graspers, a bipolar vessel sealing device, and a 30° telescope.

Results—SPLC was performed with a single-incision laparoscopic surgery port (n = 15), a multitrack wound-retractor access system (8), or a metal resterilizable single-port access device (2). Median age was 365 days (range, 166 to 3,285 days). Median body weight was 18.9 kg (41.6 lb; range, 1.3 to 70 kg [2.9 to 154 lb]). Median surgical time was 38 minutes (range, 15 to 70 minutes). Thirty-two testes were removed (12 left, 6 right, and 7 bilateral). Four patients had 1 additional abdominal surgical procedure performed concurrently during SPLC. No intraoperative or postoperative complications were encountered.

Conclusions and Clinical Relevance—Results suggested that SPLC can be performed in a wide range of dogs and cats with cryptorchidism and can be combined with other elective laparoscopic surgical procedures. The SPLC technique was associated with a low morbidity rate and provided a potentially less invasive alternative to traditional open and multiport laparoscopic techniques. (J Am Vet Med Assoc 2014;245:1258–1265)

Since 1976, laparoscopy has been used in human patients as the primary method for localization of impalpable cryptorchid testes,1 and it is now accepted in children that laparoscopy, rather than ultrasonography, is the gold standard for diagnosis of the condition.2 In human patients, laparoscopy also enables minimally invasive treatment of this condition, which typically consists of either orchidopexy or orchidectomy. Thus, treatment can often be combined with diagnosis.1,3,4

In veterinary medicine, cryptorchidism is a hereditary condition and is one of the most common congenital defects in small animal practice.3 Reported incidences of cryptorchidism range from 1.2% to 12.9% in dogs5,7 and from 1.3% to 3.8% in cats.7,8 Undescended testes are 13.6 times as likely to develop neoplasia and are also at an increased risk for torsion; therefore, the surgical removal of both testes is recommended.9,10 Although the open abdominal surgical technique for the treatment of cryptorchid testes has been described in considerable detail,11,12 a smaller amount of literature has existed since 1993 describing the use of the multiport laparoscopic technique to treat this condition in dogs and cats.13–16

The single-port platform in human laparoscopy has shown promise as a potentially less invasive and less traumatic alternative to multiport laparoscopic techniques.17,18 The single-port platform enables all of the individual laparoscopic instruments, including the telescope, to pass through the same single abdominal incision without compromising the safety and efficacy of the surgical procedure. In human medicine, many common laparoscopic procedures, such as cholecystectomy,19 appendectomy,20 and nephrectomy,21 are now routinely performed in adults and children by means of the single-port approach. Recent studies in the veterinary literature have found use of the single-port platform to be a viable surgical approach for a wide range of abdominal procedures in companion animals, including ovarioectomy,22–23 enterotomy and enterectomy,24 and ovarioectomy in combination with gastropexy.25

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ABBREVIATION

SPLC Single-port laparoscopic cryptorchidectomy
In children, single-port laparoscopic orchidectomy and orcheopexy have been shown to be safe and effective techniques for the treatment of impalpable testes. Currently, there are no reports in the veterinary literature describing the use of this method for treating small animals with undescended testes. The purpose of the study reported here was to describe the operative technique for SPLC in dogs and cats that underwent the procedure.

Materials and Methods

Case selection—Medical records of client-owned sexually intact dogs and cats that underwent SPLC between April 2009 and December 2014 at the Matthew J. Ryan Veterinary Hospital of the University of Pennsylvania, the College of Veterinary Medicine at the University of Florida, the School of Veterinary Medicine at the University of California-Davis, or the Ontario Veterinary College Teaching Hospital at the University of Guelph were reviewed. Dogs and cats were included if the medical record was complete and if the SPLC procedure was performed with a commercially available multitrocar access device. All owners were informed as to the possibility of the need for additional port placement or the need to convert to an open celiotomy if the surgery proved difficult or intraoperative complications developed. Signalment, including species, breed, age, weight, and body condition score assigned on the basis of a standardized scoring system ranging from 1 to 9 (where 1 is too thin, with no discernible body fat; 4 or 5 is ideal; and 9 is obese, with massive fat deposits and clear abdominal distention), was recorded. Operative data, including the surgery time (from the first incision to application of last closing suture), size of the incision, location of port placement, and need for conversion (both to standard multiport laparoscopy and to open celiotomy), and whether any other operative procedure was concurrently preformed were documented. The occurrence of intraoperative complications, including subjective blood loss or tissue injury, was also recorded.

Surgical technique—Hair on the ventral aspect of the abdomen from the xiphoid to the pubis was fully clipped for abdominal surgery. All dogs were positioned in dorsal recumbency. The ventral aspect of the abdomen was aseptically prepared and draped as for a traditional open abdominal procedure to allow for the placement of additional trocar-cannula assemblies or for conversion to open surgery if deemed necessary. The surgical teams and operating room set up varied between procedures and hospitals, but an attending board-certified small animal surgeon proficient in single-port laparoscopic surgery (JJR, PDM, JBC, AS, WTNC, or KNM) was present during every procedure. Other surgical team members consisted of surgical residents with various levels of laparoscopic surgical experience.

Port placement—For patients that underwent SPLC only, a 1.5- to 3-cm skin incision was made through the skin at the level of the umbilicus. The incision was kept on the midline and thus deviation to a paramedian incision was avoided. The incision was continued from the skin through to the deeper subcutaneous tissues with a combination of monopolar cautery and sharp dissection until the incision was made through the linea alba. The peritoneum was then incised at this location, creating a full-thickness 1.5- to 3-cm abdominal incision.

For patients that had SPLC and laparoscopic-assisted gastropexy in combination, a 2- to 3-cm skin incision was made through the skin and muscle just lateral to the rectus abdominis muscle and approximately 2 to 3 cm caudal to the 13th right rib (Figure 1). Dissection through the oblique musculature and the transversus abdominis muscle was continued with a combination of monopolar cautery and sharp dissection. Stay sutures consisting of size 0 polydioxanone were placed on the cauterized or cut edges of the transversus muscle to provide countertraction for port insertion. At this time, the desired commercially available multitrocar access device was inserted into the site and the SPLC portion of the procedure was then completed. Once the SPLC portion of the procedure was started, the laparoscopic-assisted gastropexy portion of the procedure was started. For laparoscopic-assisted gastropexy, the multitrocar access device was reinserted into the initial abdominal incision. Insufflator tubing was attached to the multitrocar insufflation port and the abdomen was insufflated with CO₂ to a pressure of 8 to 10 mm Hg with a pressure-regulating mechanical insufflator. A 30° telescope was then inserted into the multitrocar access device, and standard rigid 5- or 10-mm laparoscopic Babcock or Duvall forceps was inserted through one of the 12- to 15-mm cannulas (depending on which commercially available port was used). The laparoscopic Babcock or Duvall forceps was then directed toward the antrum of the stomach. A relatively avascular region near the pyloric antrum was grasped atraumatically midway between the greater and lesser curvatures for use as the site for incisional gastropexy. While being firmly held with the laparoscopic Babcock or Duvall forceps, a 2- to 3-cm port was inserted via a 2- to 3-cm skin incision made through the skin and muscle just lateral to the rectus abdominis muscle and approximately 2 to 3 cm caudal to the right 13th rib (arrows) in a 1.7-year-old male Mastiff with bilateral abdominal cryptorchidism undergoing elective SPLC in combination with laparoscopic-assisted gastropexy. This port location allowed both SPLC and laparoscopic-assisted gastropexy to be performed.
ceps, the stomach was carefully exteriorized. This was completed by first removing the 30° telescope, then (depending on which multitrocar port was selected, as tissue removal techniques differed) the port was removed from the incision with the laparoscopic Babcock or Duval forceps, still maintaining traction on the stomach. The stomach was then carefully exteriorized through the abdominal incision, and stay sutures were then securely placed to maintain orientation of the stomach axis. An incisional gastropexy was completed as described for conventional multiport laparoscopic-assisted incisional gastropexy or single-port laparoscopic-assisted gastropexy.

For patients that underwent SPLC and a cystotomy, a 1.5- to 2-cm incision was created at the umbilicus to allow for placement of the single-port device. Following exteriorization of the cryptorchid testis, the single-incision laparoscopic surgery port \( \text{a} \) was replaced and pneumoperitoneum was reestablished. A 5-mm blunt probe \( \text{b} \) was introduced into the abdomen. A second portal was established by inserting a 6-mm trocar-cannula assembly at the cranial aspect of the prepuce on the ventral midline under laparoscopic guidance. Laparoscopic Babcock forceps \( \text{f} \) was inserted into the abdomen through the 6-mm portal. The urinary bladder was visualized, and the apex was grasped with the laparoscopic Babcock forceps. Abdominal insufflation was removed, and the instrument portal was enlarged to approximately 1 cm on the ventral midline, allowing for exteriorization of the urinary bladder. Laparoscopic-assisted cystotomy was performed as previously described.

Descended orchidectomy procedure—Prescrotal orchidectomy was performed in dogs with a descended testis by exteriorizing the testis through a standard prescrotal incision followed by ligation of the vascular pedicle, spermatic cord, and gubernaculum with either an energy-based sealing device or traditional encircling sutures by means of the previously described traditional closed approach.

Insertion techniques for the commercially available single-port devices—The single-incision laparoscopic surgery port \( \text{a} \) was inserted as described previously. To insert this single-port device, a small amount of sterile lubricant was applied to its base. The port was inserted into the abdominal incision by clamping 2 curved Rochester-Carmalt forceps at the base in a staggered fashion. A variety of techniques were used for port insertion. Insertion of the single-incision laparoscopic surgery port \( \text{a} \) was performed without abdominal wall countertraction or with a form of countertraction such as grasping the incised facial edges with 2 large rat-toothed tissue forceps, Army-Navy retractors, or stay sutures. The tips of the Rochester-Carmalt forceps that were clamped on the port were then carefully directed into the incision in a cranial direction toward the diaphragm. Once within the incision, the clamps were then released to allow the bottom portion of the port to expand and fit snugly within the incision. Three 5-mm cannulas (supplied with the port) were then inserted into the 3 inner cylinders with the aid of a 5-mm blunt obturator. The heights of the cannulas were then staggered. Insufflator tubing was then attached, and the abdomen was insufflated with CO\textsubscript{2} to a pressure of 8 to 10 mm Hg with a pressure-regulating mechanical insufflator. The multitrocar port was positioned to have the three 5-mm cannulas at the 2, 6, and 10 o’clock positions relative to the surgical site (Figure 1).

The multitrocar wound-retractor access system \( \text{b} \) was inserted as described previously \( \text{c} \) (Figure 2). Briefly, to insert this device, the internal ring of the wound-retractor portion of the port was released from the supplied introducer within the incision to the abdominal cavity. The ring was then adjusted to sit just on the inside of the incision. The transparent sleeve attached to this inner ring was pulled up and away from the patient, and the outer ring was simultaneously pushed down toward the incision. The inner and outer rings of this entry system were firmly pushed together, and the plastic sleeve was pulled to ensure the rings were tight against the abdominal wall. The excess transparent plastic sleeve was cut, allowing 1 to 2 cm of excess to be folded into the incision. The soft plastic trocar cap was then firmly fitted to the outer ring. Insufflator tubing was then attached, and the abdomen was then insufflated with CO\textsubscript{2} to a pressure of 8 to 10 mm Hg with a pressure-regulating mechanical insufflator.

The metal resterilizable single-port access device \( \text{c} \) was inserted as described previously \( \text{d} \) (Figure 3). Briefly, the bulkhead was removed and a small amount of sterile lubricant was applied to the positive threads of the conical port. The flanged edge of the port was then inserted into the 3-cm incision and threaded 360° in a clockwise direction. During port insertion, the abdominal viscera were observed to ensure that no entrapment or inclusion of intestine or omentum occurred. Once the threaded cannula was in place, it was capped by snapping the bulkhead into position. The insufflation tubing was then connected to the gas valve on the port and insufflation commenced as described for the other devices.

SPLC technique—Prior to the procedure, the urinary bladder was manually expressed to ensure working space in the caudal aspect of the abdomen. In some cases, patients were maintained in dorsal recumbency and not tilted or placed in a Trendelenburg position...
In some cases, a mechanical or Tankersley tilt table was used for positioning the patient laterally or in a Trendelenburg position. In other cases, a tilt table was not available and patients were tilted manually > 20° laterally after port placement was established. In some cases, a lateral tilt of 20° to 45° to the right or left was required, depending on which testis was being removed. In these cases, the tilting enabled the caudal abdominal viscera to shift with gravity to expose the testis (Figure 4). A 30° telescope was then positioned through the single-port device to visualize the caudal portion of the abdomen. Either a 5-mm blunt probe, Maryland grasper, 5-mm articulating grasper, or coaxial deviating Babcock forceps was used to manipulate tissue and locate the testis within the abdomen. The testis was then grasped and elevated, enabling visualization of the vascular pedicle, spermatic cord, and gubernaculum. The surgeon then inserted a laparoscopic bipolar vessel-sealing device through the single-port device into the abdomen, and the bipolar vessel-sealing device was used to seal and transect the vascular pedicle (testicular artery and testicular vein), spermatic cord, and gubernaculum in that order (Figure 5). With the single-incision laparoscopic surgery port technique, the single-incision laparoscopic surgery port was removed prior to exteriorization of the testis. Briefly, the resected testis was maintained within the grasp of the forceps and brought to the base of the port under laparoscopic visualization. The peritoneal cavity was then evacuated of CO₂ and the inner cannulas were removed from the foam portion of the port. The inner cannula of the grasping forceps was slipped up the length of the instrument shaft to facilitate removal of the foam port from the abdominal incision. The foam port was also slipped up the shaft of the grasping forceps. The grasping forceps and tests were then removed from the abdomen through the original single-port access device and the multitrocar wound-retractor access system did not require entire port removal for exteriorization of the tests. With the metal resterilizable single-port access device, the testis was removed through the port after detaching the bulkhead (Figure 3). With the multitrocar wound-retractor access system, the testis was similarly removed, except that the outer soft cap was detached from the inner wound retractor to enable removal of the testis (Figure 2). With bilateral cryptorchidism, the single-port devices were replaced, pneumoperitoneum was reestablished, and the patient was repositioned in the opposite lateral recumbency to visualize the contralateral undescended testis. The testis was resected and exteriorized in a similar fashion.

**Incision closure**—The 1.5- to 3-cm incision was closed with either size 0 or 2-0 polydioxanone in an interrupted or continuous pattern for the abdominal wall. Closure of the subcutaneous tissue was done with 3-0 poliglecaprone 25. For the skin, a continuous intradermal pattern with 3-0 or 4-0 poliglecaprone 25 in a cruciate pattern was used for closure.

**Results**

**Signalment**—Between September 2010 and January 2014, 22 dogs and 3 cats that underwent SPLC were identified. For all cases combined (dog and cat), median body weight was 18.9 kg (41.6 lb; range, 1.3 to 70 kg [2.9 to 154 lb]), median
age was 365 days (range, 166 to 3,285 days), and median body condition score was 5 of 9 (range, 3 to 6). Dogs had a median body weight of 21.9 kg (48.2 lb; range, 4.9 to 70 kg [10.8 to 154 lb]), median age of 377 days (range, 188 to 3,285 days), and median body condition score of 5 of 9 (range, 3 to 6). The canine breeds in the cohort included Husky (n = 3), English Bulldog (3), Golden Retriever (2), mixed breed (2), Mastiff (2), Boxer (1), Doberman Pinscher (1), English Springer Spaniel (1), Maltese (1), Miniature Poodle (1), Nova Scotia Duck Tolling Retriever (1), Portuguese Water Dog (1), Pug (1), Silken Wind Hound (1), and Whippet (1). Cats had a median body weight of 3.8 kg (8.4 lb; range, 2.3 to 4.2 kg [5.1 to 9.2 lb]), median age of 219 days (range, 166 to 346 days), and median body condition score of 5 of 9 (range, 5 to 6). Feline breeds in the cohort were domestic longhair (n = 2) and domestic shorthair (1).

**SPLC—**Three commercially available single-port devices were used for SPLC. Overall median surgical time for SPLC was 39 minutes (range, 15 to 70 minutes). The single-incision laparoscopic surgery port was used 15 times in dogs only, with a median patient weight of 25 kg (55.0 lb; range, 9.2 to 70 kg [20.2 to 154 lb]) and median SPLC operative time of 40 minutes (range, 16 to 65 minutes). The multizone-car wound-retractor access system was used 8 times (in 5 dogs and 3 cats) with a median patient weight of 4.6 kg (10.1 lb; range, 1.3 to 13.8 kg [2.9 to 34.8 lb]) and median SPLC operative time of 41.5 minutes (range, 15 to 70 minutes). The metal resterilizable single-port access system was used in 2 dogs, with a median patient weight of 30.0 kg (65.9 lb; range, 26.4 to 33.5 kg [58.1 to 73.7 lb]) and median operative time of 25 minutes (range, 18 to 32 minutes).

Thirty-two testes were removed (12 left, 6 right, and 7 bilateral). Surgery time was calculated as only the duration of the SPLC abdominal portion of the surgery. The time required for the 13 prescrotal (canine) and scrotal (feline) castrations that were performed was not included in the SPLC surgical time. Time required for other abdominal procedures was also not included in the calculation of operative time. Four dogs had one other abdominal surgical procedure performed concurrently through the same single-port incision site during the same anesthetic episode: laparoscopic-assisted gastropexy (n = 3) and laparoscopic-assisted cystotomy (1). One dog had concurrent upper airway surgery, which included staphylectomy and an alar wing resection. No intraoperative or immediate postoperative complications were encountered in any patients undergoing SPLC. All patients were discharged either the day of the procedure or the day after the procedure. Short-term follow-up information was obtained 2 weeks after the date of the procedure for 23 patients; this was recorded either via a recheck examination at the hospital or, when not available, by a telephone conversation with the owner. Twenty-three of the 25 patients had a completely healed incision with no evidence of postoperative complications at the 2-week recheck examination. Two of the patients did not return to the hospital for a recheck examination, and their owners were not reachable by phone call or voicemail.

**Histopathologic findings—**Results of histologic evaluation were available for only 12 of the 32 testes removed by means of the SPLC technique. Of those 12 testes, 5 had evidence of neoplasia, which included seminoma (n = 3), interstitial cell tumor (1), and testicular mixed cell tumor (1).

**Discussion**

Results of the present retrospective multi-institutional study of 25 dogs and cats treated over a 5-year period suggest that SPLC can be performed on a wide range of patient sizes and may be combined with other elective surgical procedures. No surgical complications were observed during any of the procedures, and 23 patients had confirmed excellent short-term clinical outcomes. In view of these results and the minimally invasive nature of the procedures, we suggest that SPLC may have clinical benefits, compared with previously reported methods.8,13–15

Since the early 1990s, the laparoscopic approach to small animal cryptorchidism has gained popularity within the worldwide veterinary community.8,13–16 A few small case series and descriptive surgical reports of laparoscopic management of cryptorchid testes exist in the veterinary literature. The present retrospective multi-institutional study evaluated the largest number of laparoscopic cryptorchidectomy patients to date.

Owing to recent innovations within the human minimally invasive surgical arena, some surgeons have focused on further reducing the invasiveness and trauma associated with multiport laparoscopy by consolidating all points of instrument entry to a single abdominal incision. Surgeons in both the veterinary and human surgical fields are exploring the versatility of single-port surgery as an alternative to the traditional multiport laparoscopic approach. In addition to the advantages of traditional minimally invasive surgery, limiting the port incisions to a single site of entry may translate into less postoperative incisional pain, fewer wound complications, and improved cosmetic outcomes.35 A number of single-port devices have been developed in recent years that enable an array of surgical procedures to be performed in both children and adults. These devices can accommodate a wide spectrum of human body configuration, body wall thickness, and body mass index. In the present study, we report broadly on the versatility of these devices in companion animals, similarly to initial reports37,38 describing versatility of single-port platforms in pediatric surgery.

Fundamentally, the goal of cryptorchid surgery is to remove the undescended abdominal testis. Regardless of which procedure is used (open, multiport, or single port), the surgeon is required to make at least 1 incision to accommodate exteriorizing the testis. The advantage of SPLC is that this initial single abdominal incision is all that is needed to accommodate testis removal and maintain all benefits of laparoscopic surgery. A disadvantage of the multiport approach is that multiple abdominal incisions (up to 3 and sometimes 4) are required, although this provides adequate instrument triangulation and allows for tissue extraction. Unfortunately, as described with the multiport approach, at least one of the parapreputial port incisions requires enlargement for safe exteriorization and removal of the undescended testis.8,13 In dogs with bilateral cryptorchid testes, both testes cannot always be exteriorized though the same incision and a second parapreputial incision might be required to allow for removal.13 Single-port laparoscopic cryptorchidectomy allows the entire procedure to be performed successfully through the initial 1.5-cm incision while simultaneously...
enabling the surgeon to treat patients with bilateral disease without the need for any additional incisions in the pararepuital region. However, if the size of the testis dramatically exceeds the length of the incision, such as in patients with a large neoplastic testis, there may be a requirement for extending the single port incision to accommodate the safe removal of that testis from the abdomen. All of the single-port devices in this study enabled simultaneous insertion of laparoscopic grasping, vessel sealing, and optical instrumentation; therefore, no additional abdominal incisions were required for the placement of additional trocars, except in 1 patient in which laparoscopic-assisted cystotomy was performed. In that case, the surgeon needed to place a 6-mm trocar-cannula assembly, with the incision later extended to 1 cm for bladder exposure. The primary surgeon determined that a second incision was required to perform this additional procedure, although SPLC and laparoscopic-assisted cystotomy could have been performed through the same single abdominal incision if the initial incision had been placed in a location that would accommodate a laparoscopic-assisted cystotomy. It is likely that SPLC can be performed through a caudal midline port where the traditional laparoscopic-assisted cystotomy access point is made.

Another advantage of SPLC that we observed in this study was that each of the single-port devices enabled specimen retrieval at any point during the surgical procedure and pneumoperitoneum could be re-established quickly and efficiently. This is because the single-port device can remain in situ and partially open through a ballast cap or the single-incision laparoscopic surgery port can be entirely removed and subsequently reinserted without loss of the tight seal between the port and abdominal wall. This feature is not typically observed with multiport laparoscopy. Often, once tissue is removed from a trocar site, the port is not easily reinserted and leakage around the port is common, requiring sutures to be placed to reestablish the seal. In this cohort of patients, we found that regardless of abdominal testis location (including bilateral cryptorchidism), SPLC could be performed in all 25 dogs and cats through a single abdominal incision (1.5 to 3 cm). Single-port laparoscopic cryptorchidectomy enabled access to the entire caudal portion of the abdomen, and we suggest that SPLC decreases surgical invasiveness and enables access without the loss of dexterity that would otherwise be experienced with multiport laparoscopy when both testes are abnormally located. The single-port devices used in the present study were found to accommodate a wide range of patient sizes (including both dogs and cats), with median body weight of 18.9 kg (range, 1.3 to 70 kg) and median body condition score of 5 of 9 (range, 3 to 6). These devices, which are primarily designed for the human abdominal wall, were shown to have the versatility to also accommodate a variety of abdominal wall thicknesses in both feline and canine patients.

In the present study, SPLC was performed in all 3 cats with the multitrocar wound-retractor access system. This was due to the existing literature that reported successful use of this system in children with undescended testes. We found that this single-port system did accommodate the thin abdominal walls of our feline patients without the loss of pneumoperitoneum. Of note, the smallest patient that underwent the SPLC procedure was a 1.3-kg dog, and this patient also had the multitrocar wound-retractor access system used. The smallest patient to receive a single-incision laparoscopic surgery port had a body weight of 9.2 kg. Direct evaluation between the single-port devices was beyond the scope of this study. Further studies are needed to determine the true limitations of these ports in smaller patients.

In this study, 4 of 25 patients had an additional abdominal surgical procedure performed. Three of the 4 had this completed through the same single-port incision site used for SPLC. The procedures included laparoscopic-assisted gastropexy (n = 3) and laparoscopic-assisted cystotomy (1). Combining multiple procedures may be in a patient’s best interest, especially when elective procedures are performed. In most instances, the addition of a gastropexy would require additional ports to be placed on the midline for an intracorporeal sutured laparoscopic gastropexy or in a paramedian location at the gastropexy site, as described for the traditional multiport laparoscopic-assisted approach or conversion to a midline abdominal incision for an open approach. In the present study, in the 3 dogs in which gastropexy was performed, the single-port device was placed 2 to 3 cm caudal to the right 13th rib and laparoscopic-assisted gastropexy was performed. One particular advantage observed with the single-port platform was that surgeons were able perform multiple procedures through this single-incision without any additional port placement or conversion to open laparotomy. This advantage has been reported in female dogs when combining ovariecctomy and gastropexy, where the single-port device was also positioned just caudal to the right 13th rib.

The aim of the present study was to describe the operative technique for SPLC and evaluate the clinical outcome. Although it may appear from the results that the operative times differ between the ports, potentially indicating that a particular port may have an advantage over the others (including a faster operative time), readers should be cautious in drawing this type of conclusion because there were no predetermined criteria in place for selecting the access devices at each institution. Possible reasons operative times varied between the different devices likely included variations in patient size, the addition of other operative procedures such as laparoscopic-assisted gastropexy and laparoscopic-assisted cystotomy, and variations in the experience levels of surgeons comprising the surgical teams performing the procedure (primary surgeons included residents in training and highly experienced board-certified surgeons). Future prospective studies are required to determine individual advantages and disadvantages among the single-port devices used in this study.

In this study, 32 testes were successfully removed by means of the SPLC technique, but results of histologic evaluation were available for only 12. Of the 12 testes that were submitted, 5 had evidence of neoplasia, including seminoma (n = 3), interstitial cell tumor (1), and testicular mixed cell tumor (1). The incidence of testicular neoplasia in abnormally retained testes is 13.6 times as high as that in de-
Single-port laparoscopic cryptorchidectomy was successfully performed in all 25 animals (22 dogs and 3 cats) in the present study. No intraoperative or immediate postoperative complications were observed during hospitalization time for the SPLC procedure; and the 23 patients who were available for a recheck examination at 2 weeks had no evidence of postoperative complications at the recheck examination. These findings differ greatly from those reported for open surgical treatment of cryptorchid dogs insofar as complications unique to the open procedure, including inadvertent prostatectomy, have been reported. The laparoscopic approach may all but eliminate this complication, which has only been reported with open surgery and is likely avoided owing to the superior visualization and magnification the telescope provides, enabling accurate tissue identification and prevention of inadvertent tissue resection. Previous reports of multiport laparoscopic-assisted cryptorchidectomy have also documented fewer complications in comparison to the open approach. Although 1 report of a conversion was described with laparoscopic-assisted cryptorchidectomy, it was concluded that it has been due to operative difficulty from limited experience associated with the laparoscopic-assisted technique. No other intraoperative or postoperative complications have been described for any of the multiport minimally invasive techniques described in the veterinary literature. The absence of intraoperative complications in the present study parallels the results of previous studies on the use of the multiport laparoscopic technique. However, it is possible that the low incidence of complications in the present study reflects the surgical proficiency and experience of the attending surgeons performing the procedures and may not reflect the outcomes that a novice laparoscopic surgeon would experience.

The results of this multi-institutional study suggest SPLC is an effective method for treating cryptorchidism in dogs and cats, but future studies are indicated to determine whether clinical benefits exist compared with traditional open and multiport approaches. We believe that the single-port platform offers certain advantages, including relative technical ease, minimal morbidity, minimization of tissue trauma, and the ability to achieve precise and reliable tissue ligation. Future prospective studies are indicated to compare SPLC with open and multiport procedures to determine which technique can be considered the gold standard for the treatment of cryptorchidism in dogs and cats.

References

New Veterinary Biologic Products

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<thead>
<tr>
<th>Product name</th>
<th>Species and indications for use</th>
<th>Route of administration</th>
<th>Remarks</th>
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<td>Salmonella Choleraesuis-Typhimurium Vaccine, Avirulent Live Culture</td>
<td>For vaccination of healthy susceptible swine 2 weeks of age or older as an aid in the prevention of disease due to Salmonella choleraesuis and S Typhimurium. Efficacy was demonstrated in piglets that received 1 dose and were challenged 28 days later with virulent S choleraesuis or S Typhimurium.</td>
<td>Individual oral dosing</td>
<td>First modified-live oral vaccine against S Typhimurium for swine</td>
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<td>Bronchitis Vaccine, Georgia Type, Live Virus (Merial Inc, Athens, Georgia, US Vet Lic No. 298)</td>
<td>For vaccination of chickens at day of age as an aid in the prevention of disease caused by infectious bronchitis virus, Georgia Type, Georgia 2008. Safety was demonstrated in day of hatch birds receiving the product via spray</td>
<td>Spray at day of age</td>
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