USE OF ULTRASOUND TO LOCATE RETAINED TESTES IN DOGS AND CATS

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Ultrasound was used to locate undescended testes in 30 dogs and 4 cats where the final testicular location was determined surgically. Time between ultrasound and surgery ranged between 0 and 17 days. Forty-three testes (63.2%) were retained and 42/43 (97.7%) were detected ultrasonographically. Retained testes were located in the abdomen ($n = 28$) and inguinal region ($n = 14$). One retained testis could not be identified with use of ultrasound. Locations of retained testes ranged from the caudal pole of the kidney to the inguinal region. Descriptions of testicular echogenicity and size were not available for all testes. A 100% positive predictive value was found for all testes with use of ultrasound in both abdominal and inguinal regions. The sensitivity of ultrasound was 96.6% for abdominal and 100% for inguinal testes. Ultrasound is a sensitive test for location of retained testes, and supports the opinion that preoperative ultrasound can help facilitate location of retained testes prior to surgical exploration or laparoscopy. © 2012 Veterinary Radiology & Ultrasound.

Key words: location, retained, testes.

Introduction

CRYPTORCHIDISM IS THE MOST common congenital anomaly of the testes.[1] The testes in dogs and cats usually descend into the scrotum by 10 days of age, and the diagnosis of cryptorchidism is made if the testes have not descended by 8 weeks.[2] Partial closure of the inguinal ring by 6 months of age precludes further testicular migration.[3] Cryptorchidism may be unilateral or bilateral and the undescended testicle(s) may be located in the abdominal cavity, inguinal canal, or in an ectopic subcutaneous location between the superficial inguinal ring and the scrotum.[4,5] It has been stated that the most common form of cryptorchidism among dogs is a right-sided inguinal testis followed by a right-sided abdominal testis.[6] Among cats, the most common forms of cryptorchidism are left- and right-sided inguinal testes.[6] Unilateral or bilateral testicular agenesis are rare.[7]

The incidence of cryptorchidism is higher in dogs than cats, ranging from 0.80% to 9.80% in the dog and averaging 1.70% in the cat. Cryptorchidism is more common in certain dog breeds, such as toy and miniature poodles, Yorkshire terriers, Chihuahuas, boxers, and miniature Schnauzers.[1] Among cats, Persians are predisposed.[8] Cryptorchidism is a congenital disorder; but the exact mode of inheritance is not known; it may be an autosomal recessive trait.[1] Most believe there is a multiple gene effect.[9]

Cryptorchidism is a risk factor for the development of testicular neoplasia.[6] Neoplastic transformation occurs in the undescended testes of dogs approximately 9.2 to 13.6 times more frequently than in canine scrotal testes.[10–12] Sertoli cell tumors are most commonly associated with retained testes in canines, followed by seminomas.[13] Other complications of cryptorchidism are sterility that can occur in cats and dogs when both testes are retained,[5] and testicular torsion.[14] Although retained testes are incapable of producing sperm, they can still secrete testosterone that often results in unwanted territorial behavior, aggression, and malodorous urine.[15,16]

Diagnosis of cryptorchidism and localization of retained testes can be challenging. The diagnosis of undescended testes in dogs and cats is usually based on knowing whether the patient has been castrated and palpation of the scrotum or inguinal region, but this can be difficult.[17] For example, in one evaluation, the use of palpation to accurately locate retained testis was successful only 48.0% of the time.[18]

Invasive techniques such as exploratory laparotomy or laparoscopy to locate a testicle can result in complications.[17,19] High-resolution ultrasound may be a

sensitive technique to locate retained testes[20] but there are only limited data on this method. Ultrasound is a sensitive and specific technique to locate retained testes in horses.[21, 22] Ultrasound has also been used to locate testes in people[23–26] but there is skepticism due to poor results in some studies, and because ultrasound does not exclude the necessity for laparoscopy.[27–30] Ultrasound has value in children because it is noninvasive, does not utilize ionizing radiation, and facilitates planning of the correct surgical procedure.[23–26, 31] When comparing ultrasound to surgical location of nonpalpable testes in human boys, ultrasound was successful in locating 103/152 (68.0%) nonpalpable testes: 16 within the abdomen and 87 within the inguinal canal. With knowledge of the ultrasound result, 37 testes were palpable on re-examination.[31] Our goal was to evaluate the value of ultrasound in correctly identifying the location of retained testes in dogs and cats.

Materials and Methods

Patients in which ultrasound was used to locate retained testes in dogs and cats were requested via emailing American College of Veterinary Radiology members. Submitted material spanned February 2004 through September 2011. Only patients who had surgery less than 30 days after ultrasound examination were included. Animals presenting solely for cryptorchidism as well as animals presenting for other disease processes were included.

Four cats and 30 dogs were identified. Patients ranged from 4 to 156 months of age, with a median age of 12 months. Breeds consisted of Boxer (5), two each of German Shepherd, Miniature Schnauzer, Cavalier King Charles Spaniel, Weimaraner, and Chihuahua, and one each Domestic longhair cat, Domestic shorthair cat, Scottish Fold cat, Ragdoll cat, Old English Sheep Dog, mixed canine, Border Terrier, Viszla, Scottish Terrier, Great Pyrenees, Labrador Retriever, Golden Retriever, Welsh Corgi, Mastiff, Newfoundland, Bichon Frise, English Springer Spaniel, Giant Schnauzer, and Standard Dachshund.

A variety of ultrasound machines, probes, and frequencies was used.* Time between ultrasound and surgery ranged from 0 to 17 days, with a median time of 0 days. Twenty-nine patients (85.3%) had surgery within 1 week of the ultrasound examination, and 18 patients (52.9%) had surgery the same day as the ultrasound examination.

*GE logic 7, Biosound Esoate Mylab 30, Philips HDI 5000, Phillips IU22, GE Logic E, Acuson Sequoia 512, Biosound Esoate Mylab 70 ultrasound machines, or Siemens Acuson Sequoiah. Probes used to ultrasound all patients consisted of either 12 MHz linear, 8.5 MHz curvilinear, 10V4 phased array (frequency 4–10 MHz), 15L8 linear (frequency 8–14 MHz), 8C4 curvilinear (frequency 4–8MHz), CA 123 microconvex (frequency 3–9 MHz), CA 631 curvilinear (frequency 1–8 MHz), LA435 linear (frequency 6–18 MHz), 8C4w (frequency 8 MHz), 10V4 (frequency 10 MHz), 6C2 (frequency 4 or 6 MHz), or 15L8w (frequency 14 MHz)

Ultrasound examinations and subsequent castrations were performed at the same hospital in all but 7 patients. Ultrasound techniques varied but both complete and focused ultrasound examinations included evaluation of the area between kidneys and scrotum. Surgical removal of testes consisted of traditional intraabdominal, inguinal, or prescrotal surgical approaches. Nine patients had prior surgical attempts at castration.

Locations of retained testes determined by use of ultrasound were compared to surgical findings and histopathology, when performed. Ultrasound was considered to be successful in locating a retained testis when the testis was found in the same location during both ultrasound and surgery. Statistical analysis was performed using commercially available software.[†, ‡] Medians and ranges were determined for continuous data. Sensitivity and positive predictive value were calculated for ultrasound using surgery as a gold standard for comparison.

Results

Based on surgical findings, 43 testes (63.2%) were retained (26 right and 17 left), 18 (26.4%) were in the normal scrotal position, and seven (10.3%) were absent due to previous surgical removal. Of the 25 patients with no known previous surgery, 17 patients (68%) had unilateral and eight (32%) had bilateral cryptorchidism.

Ultrasound was used to identify retained testes in the abdomen ($n = 28$) and in the inguinal region ($n = 14$). The location of abdominally retained testes ranged from just caudal to the kidney to lateral to the urinary bladder trigone. Some were adjacent to the colon, small intestine, aorta, and caudal vena cava (Figs. 1 and 2). Inguinal testes were in various regions from immediately cranial to the pubis to the inguinal region (Fig. 3).

Descriptions of testicular echogenicity and size were not available for all testes. Two testes had a uniform echogenicity, with an easily identifiable linear hyperechoic mediastinum testis. Two retained testes were oval and subjectively decreased in architectural detail, however a hyperechoic mediastinum testis could still be identified in both. In one patient, the retained testicular size was compared to that of the normal scrotal contralateral testis; in this patient, the inguinal retained testis measured 1.69×0.97 (cm) while the scrotal testis measured 2.12×0.92 (cm).

Seven testes had focal lesions and histopathologic evaluation was performed in six of these. There were four Sertoli cell tumors, one seminoma, and one mixed Sertoli cell tumor/seminoma. Data were incomplete for these testes and therefore descriptions of size and echotexture were not included for all. One testis measured $4.1 \times 2.6 \times 1.4$ (cm),

†Microsoft Excel®, Microsoft Corp., Redmond, WA
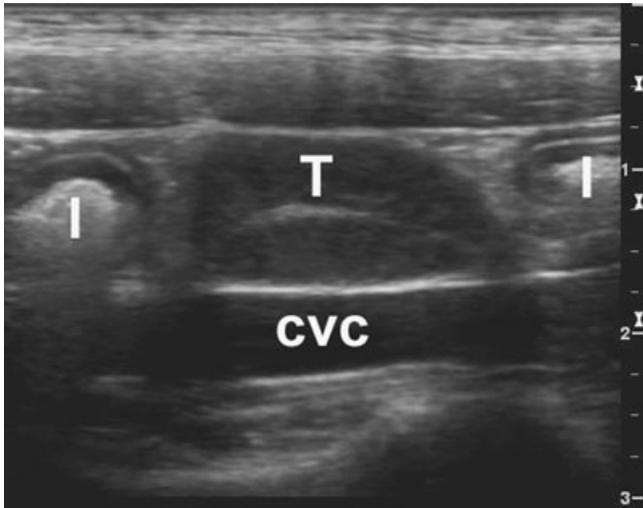‡SigmaStat® 3.1, Systat Software Inc., Richmond, CA

FIG. 1. Sagittal ultrasound image of the right testis (T) in a dog. It has homogenous parenchyma with a hyperechoic mediastinum. It is located between small intestines (I) and the caudal vena cava (CVC).
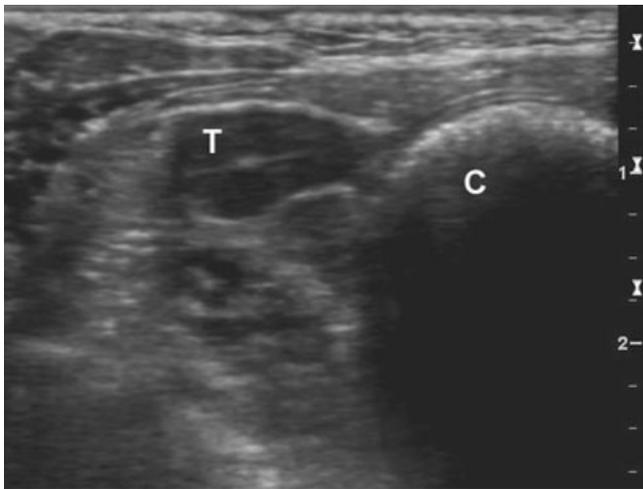

FIG. 2. Oblique ultrasound image of a dog where the right testis (T) is adjacent to the colon (C). It is uniform in echogenicity with a linear hyperechoic mediastinum testis.
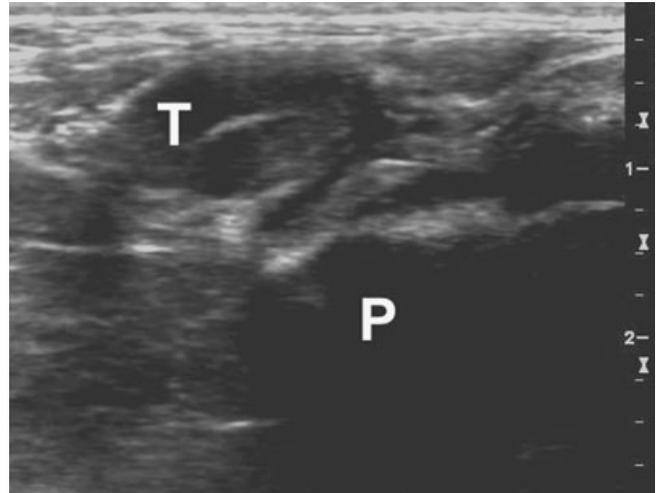

FIG. 3. Sagittal ultrasound image of a cat. The right testis (T) cranial and ventral to acoustic shadowing caused by the pubic bone (P). This cat had three prior unsuccessful surgical attempts to remove the right testis.
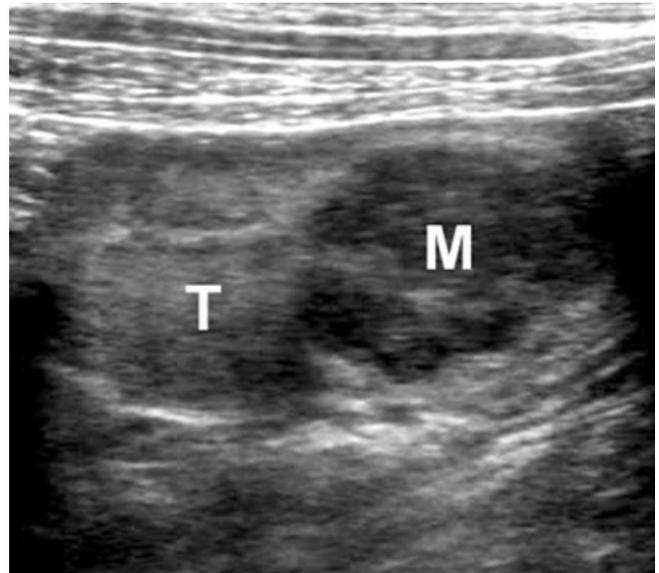

FIG. 4. Sagittal ultrasound image of an abdominally retained right testis (T) in a dog. The parenchyma of the testis is abnormal. A mildly heterogeneous hypoechoic mass (M), diagnosed as a Sertoli cell tumor, is present in its caudal portion.

and contained a heterogeneously hypoechoic lesion in its caudal medial portion measuring 2.1 × 1.8 × 1.4 (cm) (Fig. 4).

Comparing the ultrasound results to surgical findings, there was a 100% positive predictive value for the 28 abdominal and 14 inguinal testes seen on ultrasound; all were found in their respective locations during surgery. One abdominal retained testicle could not be identified with use of ultrasound and was later found in the abdomen during surgery. Overall, surgery and ultrasound findings were the same for 42/43 (97.7%) retained testes. The sensitivity of ultrasound was 96.6% for abdominal and 100% for inguinal testes. The positive predictive value was 100% for both abdominal and inguinal testes (Table 1).

Discussion

We found ultrasound to be highly sensitive (96.6% and 100% for abdominal and inguinal retained testes, respectively) for determining location of undescended testes when compared to surgery. All inguinal testes were located accurately and only one abdominal-retained testis was not identified with use of ultrasound. When a testis was located in either the abdomen or inguinal region using ultrasound, it was also found at that site during surgery 100% of the time. These findings are similar to those described in people, where sonographic detection of nondescended

TABLE 1. Comparison of Ultrasonographic and Surgical Location of Retained Testicles

Location of retained testicle	Number located with ultrasound	Number located with surgery	Sensitivity (%)	Positive Predictive Value (%)
Abdomen	28	29	96.6	100
Inguinal	14	14	100	100

testes has an 88% sensitivity, a 100% specificity, and a 91% accuracy.[24] Similar results were found in horses, where the sensitivity and specificity of ultrasound under optimal clinical conditions was 97.6% and 100%, respectively.[21] Our results are also comparable to a previous canine study, where there was agreement between ultrasonography and surgery/histopathology in 91% of dogs.[32]

The locations of retained testes vary.[33, 34] In an equine study addressing the use of ultrasound to detect retained testes, scanning the entire ventral aspect of the abdomen instead of just the inguinal canal contributed to successful location of retained testes.[21] In dogs and cats, retained testes can be located anywhere between the caudal pole of the kidneys to the inguinal area.[33] We found a similar distribution of testicle locations and therefore an ultrasound examination including all areas between the kidneys and scrotum is recommended when attempting to locate retained testes in companion animals.

Normally descended canine testes have a coarse, homogeneous sonographic texture with a centrally located hyperechoic mediastinum testis.[35] Canine-retained testes that have not undergone neoplastic transformation are small, oval, echo-poor structures that are architecturally normal.[33, 36] We did not have data pertaining to echogenic appearance and size for all retained testes. Moreover, many patients did not have a contralateral scrotal testis for comparison. For the testes with available echotexture assessment, our results are similar to that described above.

In horses, retained testes were discriminated from other abdominal organs by identification of characteristic testicular structures, such as the hyperechoic albuginea, and a central vein or epididymis.[21] In a similar way, identification of characteristic testicular structures in dogs and cats, such as a hyperechoic mediastinum testis, is helpful when trying to distinguish retained testes from other organs. Recognition of the mediastinum testis may not be as beneficial when attempting to identify neoplastic testes as neoplastic testes often lack a discernible mediastinum testis, and echogenic appearance of canine neoplastic testes range from well-defined small nodules to large multifaceted masses with disruption of normal testicular anatomy.[33, 37]

In conclusion, in the hands of experienced operators, ultrasound is a sensitive diagnostic technique with a high positive predictive value to locate retained testes in companion animals. Use of preoperative ultrasound can help facilitate location of retained testes prior to surgical exploration or laparoscopy.

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