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Research Article

LAPAROSCOPIC CRYPTORCHIDECTOMY IN DOGS

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ABSTRACT

Cryptorchidism is a common condition encountered in many canine breeds. Retained testicles are at risk of morphing into masses, both benign and malignant. During a 14 month period, 13 dogs were diagnosed as cryptorchid or monorchid at the TVCC, Nagpur Veterinary College, Nagpur. Laparoscopic cryptorchidectomy was performed on 2 Labrador Retrievers, 1 Boxer, 1 Golden Retriever, 1 Bull Mastiff and 1 German Shepherd Dog. Their average age was 3 years 8 months. Ultrasonography was performed on each dog prior to surgery to attempt to locate the retained testicles. The supine trendelenburg position was adopted for surgery, with a 20 degree cranial tilt (where required) and a three-port placement was achieved using Hasson's Technique. Testicles once excised and exteriorized were sent for histopathological evaluation. Ultrasonography located all but one abdominal testicle and also noted structural abnormalities in one testicle. Laparoscopy easily located all testicles and laparoscopic cryptorchidectomy was performed under general anaesthesia. The University of Melbourne Pain Scale (UMPS) evaluated over three days post-procedurally. Histopathology diagnosed two Seminomas. Both ultrasonography and laparoscopy proved to be excellent at locating retained testes, with laparoscopy being 100% successful. Laparoscopic orchiectomy was found to be a quick and easier alternative to conventional surgery.

Keywords: Canine, Cryptorchidism, Laparoscopy, Orchidectomy

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Canine cryptorchidism, acommonly occurring condition and is an important factor in progeny genetics. Descent of testes into the scrotal sac usually occurs by day 28-49 post birth. This occurs through the so called inguinal ring. Inguinal ring closure occurs by around 6 months of age in puppies and thereafter there is very little scope for abdominal testes to descend into the scrotal sac (Johnston *et al.*, 2001). Major complications associated with retained testes include formation of tumours, benign or malignant and testicular torsion (Tapia-Araya *et al.*, 2015). Seminomas have been observed to be the most common testicular tumours followed by mixed germ cell-sex stromal cell tumours, Sertoli cell tumours and lastly interstitial cell tumours (Liao *et al.*, 2009). Thus, orchiectomy is the preferred method of managing this condition. Laparoscopy affords us with direct visual access to internal organs. All minimally invasive techniques facilitate this vision without the need of large incisions. Laparoscopy includes all endoscopic procedures performed in the abdominal cavity. A complete examination of most abdominal organs can be performed, with simultaneous sampling or procedures of many organs where necessary (Mayhew, 2009). This article elaborates on modalities used to diagnose and ascertain the position of retained testicles and the surgical procedure of laparoscopic orchiectomy in cryptorchid dogs presented at the Teaching Veterinary Clinical Complex, Nagpur Veterinary College, Nagpur.

MATERIALS AND METHODS

Between December 2019 to January 2021, thirteen dogs presented at the Teaching Veterinary Clinical Complex, Nagpur Veterinary College, Nagpur were diagnosed as monorchids or bilateral cryptorchids. These patients were subjected to radiographic and ultrasonographic examination and where required, laparoscopic orchiectomy. Physiological parameters of rectal temperature, respiratory rate, capillary refill time and heart rate were recorded pre-procedurally. Abdo-pelvic ultrasound examination was performed using Fujifilm Sonosite M Turbo machine with a triple frequency sector transducer having frequency of 3.0 to 5.0 MHz. Further, ultrasound examination was performed as per requirement during the postoperative period. Blood samples were collected in Ethylenediaminetetraacetic acid (EDTA) for haematological investigations and in a clot activator vacutainer to estimate serum biochemical parameters and serum glucose, using disposable syringes. The complete blood count, bleeding time, clotting time, blood urea nitrogen and serum creatinine were recorded pre-procedurally. Serum aspartate aminotransferase, alanine aminotransferase and alkaline phosphatase were estimated at 0 hours and then 72 hours post-procedure. Serum glucose was estimated at 0 hours, immediately post-procedure and 1-hour post-procedure as suggested by Devitt *et al.* (2005).

Laparoscopic Cryptorchidectomy was performed in 6 male dogs-Labrador Retriever (02) Boxer (01), Golden Retriever (01), Bull Mastiff (01), aged between 1 year 2 months to 6 years. Pre-medicants administered included: Inj. Atropine Sulphate@ 0.04 mg/kg BW s/c, Inj. Ranitidine @ 0.2 mg/kg BW I/M, Inj. Ondansetron @ 0.2 mg/kg BW

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I/M and Inj. Meloxicam @ 0.2 mg/kg BW I/M. Intraoperatively Inj. Ceftriaxone was given @ 20 mg/kg BW I/M. Patients were sedated with Inj. Xylazine HCL @ 1.1 mg/kg BW; dissociative anaesthesia was induced using a combination of Inj. Diazepam@ 0.5 mg/kg BW and Inj. Ketamine @ 5 mg/kg BW in Inj. Normal Saline and anaesthesia was maintained using 1.5-3% isoflurane.

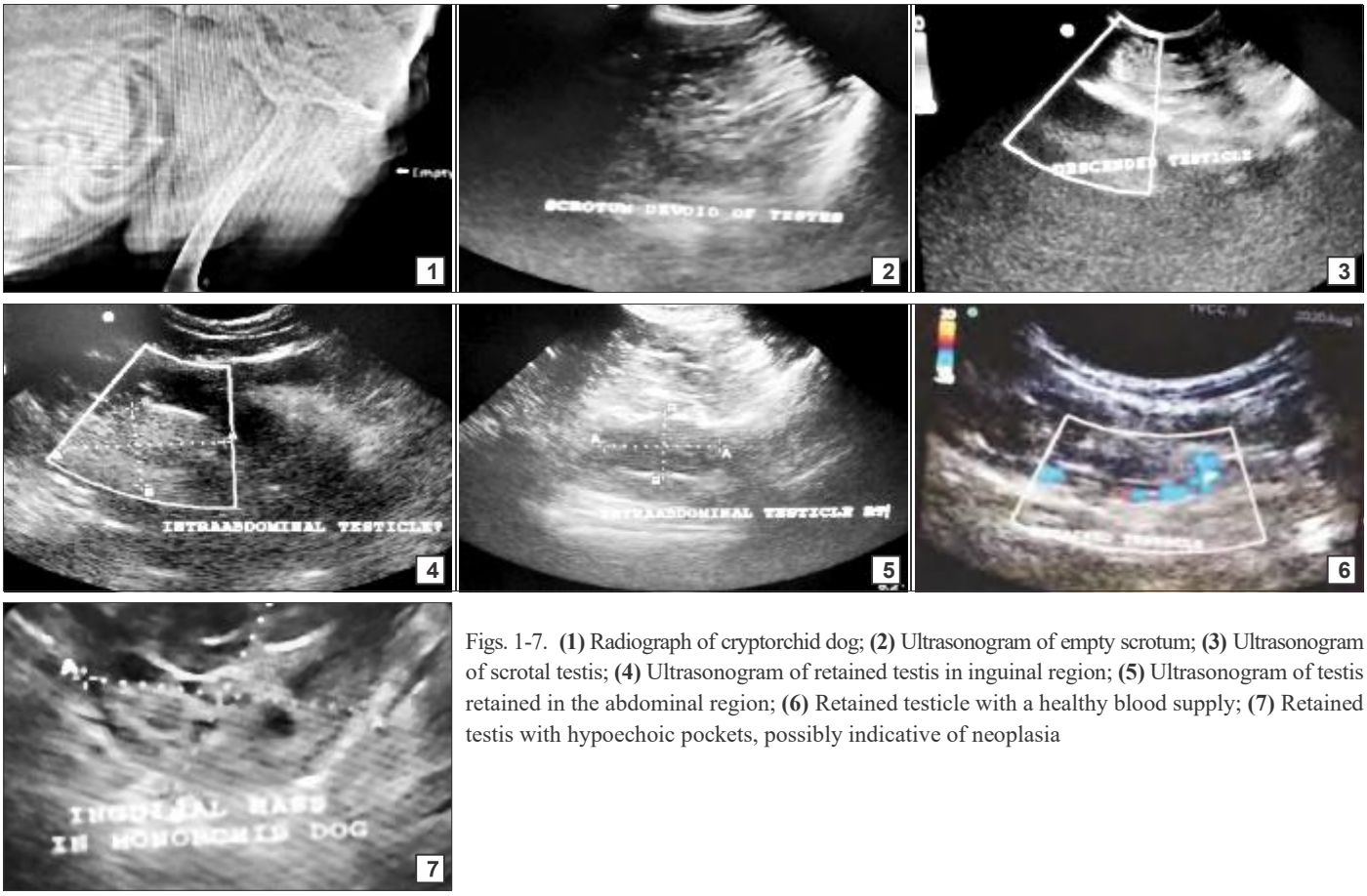
After anaesthesia was induced, each patient was placed in supine position. A urinary catheter was passed to evacuate the bladder. Patients were placed in Trendelenburg position with a 20 degree tilt (where required) and the location and size of the spleen was ascertained via ultrasonography to avoid injury during the placement of the first trocar. The first port was placed lateral to right of the umbilicus; the second port was positioned cranio-lateral to the left cranial abdominal teat and the third port was placed lateral to the left caudal abdominal teat. A 5mm skin incision was made using a number 11 Bard Parker blade. For the first two surgeries, the Veress Needle technique (Hancock *et al.*, 2005; Case *et al.*, 2011) was used. For the remaining 4 procedures, Hasson's Technique (Hasson, 1971) of open laparoscopic entry was followed where the fascia, rectus abdominis (or just the lineaalba) and peritoneum were dissected and the first 6mm cannula was placed into the abdominal cavity. CO_2 insufflation was commenced and pneumoperitoneum was achieved. A straight, forward telescope, 30 degrees, 5 mm diameter and 36 cm length was inserted through the port. The CO_2 insufflation rates varied between 7-10 mm Hg intra-abdominal pressure, with a flow rate of 4-6.6 L/hr.

Most testicles were apparent on a simple laparoscopic abdominal scan. Those which were deeper seated were located by either tracing the vas deferens to the testicle from its insertion into the prostatic urethra or by following the gubernaculum cranially from the inguinal canal as suggested by Kennedy and Fransson (2015). The testicle was grasped with laparoscopic Babcock forceps. The vascular pedicle, gubernacular attachment, vas deferens and any peritoneal attachments were dissected and ligated using monopolar cautery via Maryland laparoscopic forceps. In case of a bilateral cryptorchid, once a testicle was detached from all its attachments, it was placed near the inguinal canal while the other testicle was being freed from its visceral attachments. For removal of testicles, one paramedian port incision was extended and the testicle was grasped and brought close to the placed port. The trocar was replaced with normal artery forceps and the testicles were pulled out in a corkscrew fashion one after the other from the same extended incision. In monorchid patients, routine castration was performed for the scrotal testicle. Muscle and skin were closed as per routine.

After every procedure, the abdomen was scanned for any signs of haemorrhage Upon finding none, it was completely deflated. The muscle layer was sutured using Vicryl No. 1 or 0, depending on the dog's size and the skin incision was sutured using polypropylene No. 2-0.

RESULTS AND DISCUSSION

Testicular abnormalities was recorded in 13 dogs, 3 were unilaterally cryptorchid with one scrotal testis, 4 were unilaterally cryptorchid with the second testes subcutaneously placed in the inguinal region and 6 were bilaterally cryptorchid. Of these, only one cryptorchid dog had abdominal testes with all the other retained testicles found in the inguinal region. In all 7 unilateral cryptorchids, the right testis was the undescended one. Similar observation was made by Yates *et al.* (2003) who recorded that in unilateral cryptorchids, the right testicle was more affected than the left one. While radiography could identify the absence of well-formed (Fig. 1) scrotal sac per say the intra-abdominal location of the testicles was not seen in radiograph. Retained testicles were ultrasonographically observed as defined, isoechoic structures, with the cranial pole and blood supply identifiable with colour doppler. Ultrasonography could structurally identify an empty scrotum (Fig. 2), testicular parenchyma and blood supply in naturally testes (Fig. 3) and all intra-abdominal and subcutaneous testicles accurately barring one of the abdominal testicles in a bilaterally cryptorchid dog. Ultrasound also accurately located the position of the retained testicles (Figs. 4 to 6). Testicular parenchyma was isoechoic and clearly defined against the surrounding tissue except for in one unilateral cryptorchid dog for which the ultrasonogram showed hypoechoic pockets within the testicular mass possibly indicative of neoplastic changes (Fig. 7). The cranial pole with the epididymis and blood vessels were identifiable via colour Doppler. The ultrasonographic length of the retained testes ranged from 1.2 cm to 3.7 cm. This correlated with the testicular measurements after surgical removal which were 1.07 to 4.2 cm in length. Sonography fell short in diagnosing one retained testicle in the abdominal region in a bilaterally cryptorchid dog. Felumlee *et al.* (2012) expressed that ultrasonography was a good diagnostic aid for retained testes and found a 96.6% accuracy rate of ultrasound diagnosis with the anatomy observed during open surgery. Laparoscopy was successful in locating all the retained testicles. The laparoscopic surgical technique of cauterisation and cutting via monopolar cautery was found



Figs. 1-7. **(1)** Radiograph of cryptorchid dog; **(2)** Ultrasonogram of empty scrotum; **(3)** Ultrasonogram of scrotal testis; **(4)** Ultrasonogram of retained testis in inguinal region; **(5)** Ultrasonogram of testis retained in the abdominal region; **(6)** Retained testicle with a healthy blood supply; **(7)** Retained testis with hypoechoic pockets, possibly indicative of neoplasia

convenient and easy to perform. Miller *et al.* (2004) also opined that laparoscopy-assisted orchiectomy in small animals had a 100 percent success rate in identifying the gonads and the following surgical procedure was effortless.

The trendelenburg position with a 20 degree tilt was found to be optimum for locating and removing the testes. Miller *et al.* (2004) while conducting laparoscopy-assisted cryptorchidectomies in dogs and cats also found the 20 degree incline to be advantageous. In cryptorchid patients, post-cauterisation and cutting, the testis was placed near the inguinal opening and the dissection of the second testis was undertaken prior to exteriorising the organ. This was done because for removal of a testicle, one paramedian port incision was required to be extended adequately enough which might have resulted in reduction of pneumoperitoneum and the vision is relatively impaired before removal of the other testicle.

The first port was placed lateral to right of the umbilicus; the second port was positioned cranio-lateral to the left cranial abdominal teat and the third port was placed lateral to the left caudal abdominal teat. Once inside the abdomen, the cavity was scanned. The spleen was found touching the left abdominal wall and in contact with the liver. The anterior border of the spleen was usually observed to extend to the level of the 12^{th} or 13^{th} thoracic vertebrae. The testicles were typically located, lying on the omental folds laterally. The spermatic cord or the gubernaculum were always easily observed and were used to trace gonads that were deeper seated. Babcock forceps were used to hold the testicle (Fig. 8). The vascular pedicle, gubernacular attachment, vas deferens and any peritoneal attachments were dissected and ligated using monopolar cautery via Maryland laparoscopic forceps (Figs. 9 to 11). The vascular structures were double checked for signs of bleeding (Fig. 12 and 13).

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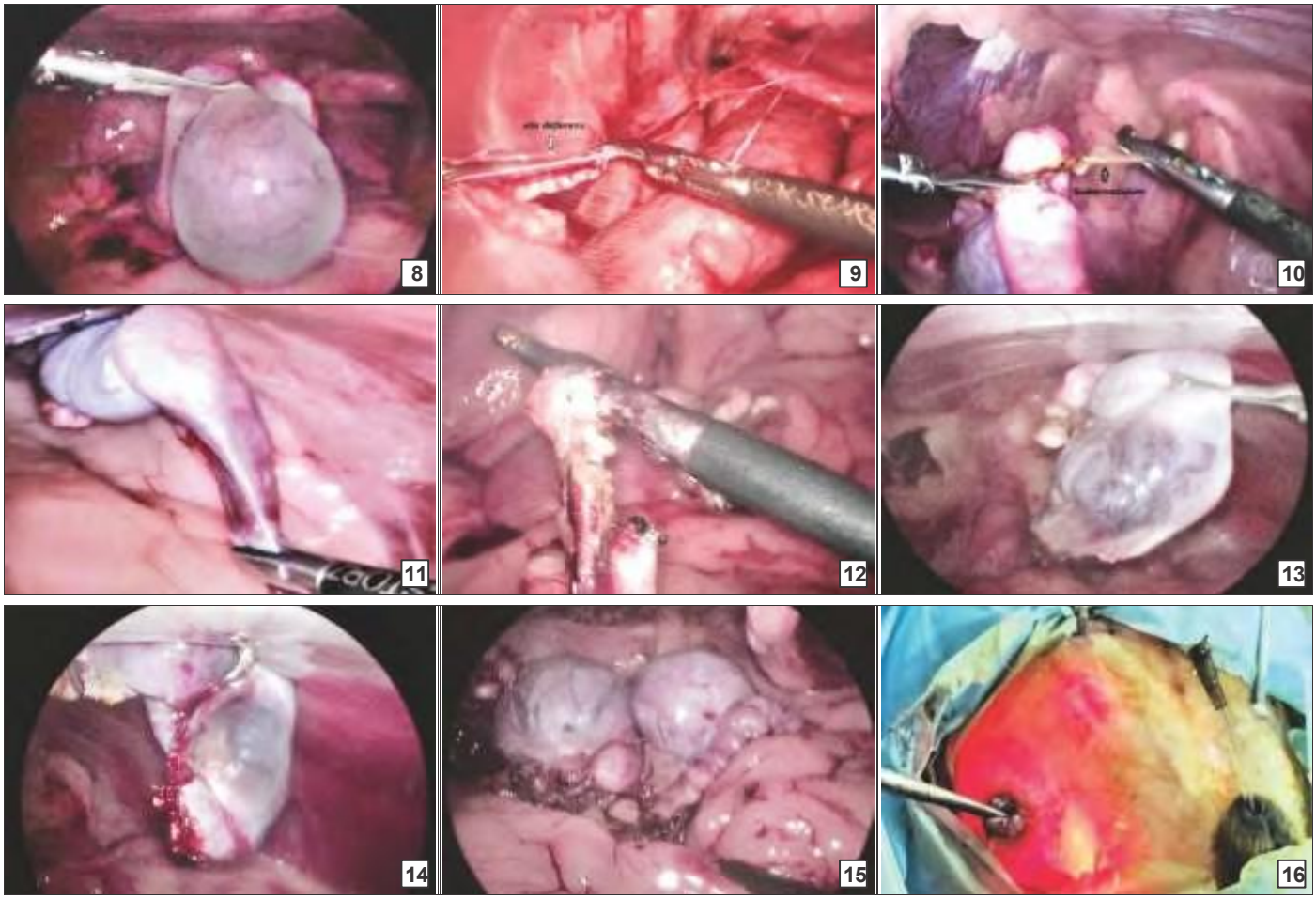

Figs. 8-17. **(8)** Retained testicle grasped with atraumatic Babcock forceps; **(9)** Cauterising the spermatic cord; **(10)** Cauterising the gubernaculum; **(11)** Cauterising the testicular blood supply; **(12)** Checking the vessels for bleeds after cauterisation and cutting; **(13)** Intra-abdominal testis freed from all attachments; **(14)** Grasping the cut testis with artery forceps; **(15)** Placement of both testes in the inguinum prior to exteriorising them; **(16)** Exteriorisation of the testicle from on port site; **(17)** Excised testes

routine castration. Muscle and skin were closed as per routine. Spinella *et al.* (2003) used titanium clips to ligate the blood supply to cryptorchid testicles and then placed the testicle inside an extraction bag until the second cryptorchid testicle was ligated. They then placed the second testis in an extraction bag too and removed both the ligated testicles from a slightly increased incision at one port. Present study achieved a similarly clean surgical procedure with minimal loss of pneumoperitoneum by placing the first testicle in the inguinal region while cauterising the second testicle in case of cryptorchids. Once both testes were ready to be removed, they were placed close to each other on one side of the inguinum (Fig. 15) and the nearest port incision was increased to

Table 1

Mean ± S.E of ALT, AST and ALP for Laparoscopy Group (Group I) and Ultrasound-Guided Procedure Group (Group II)

Parameter	Group	Mean ±SE	
		Day 0	Day 3
ALT	Laparoscopy (Group I) (n=13)	49.392±4.778	52.315±3.696
	USG (Group II) (n=6)	123.15±23.92	132.4±23.534
AST	Laparoscopy (Group I)	54.877±4.452	60.731±4.172
	USG (Group II)	139.633±34.197	146.733±33.298
ALP	Laparoscopy (Group I)	108.231±14.295	121.777±13.31
	USG (Group II)	356.333±61.866	369.667±64.872

Table 2

Mean ± S.E of Serum Glucose for Laparoscopy group (Group I) and Ultrasound-Guided Procedure Group (Group II)

Glucose	Pre-op Mean±SE	Immediate Post-op Mean±SE	1 Hour Post-op Mean±SE
Group I	78.42±5.00	83.00±4.08	85.50±4.39
USG Group	78.67±7.73	81.83 ±4.93	85.00±6.19

Table 3

Mean ± S.E of UMPS for Group I, Group It and Group II

	Day 1 Mean±SE	Day 2 Mean±SE	Day 3 Mean±SE
Group I	6.154 ± 0.99	3.538 ± 0.87	2.462 ± 0.64
Group It	6.67 ±1.4	4 ± 1.24	2.89 ± 0.89
Group II	4.5 ± 0.22	3.17 ± 0.4	1.83 ± 0.17

accommodate each gonad (Fig. 16). The testicles were measured prior to formalin fixation (Fig. 17). Single-Port Laparoscopic Cryptorchidectomy (SPLC) as an operative technique was described by Runge *et al.* (2014) wherein the authors accessed the abdominal cavity via a single multi trocar device placed 2-3 cm below the xiphoid along the ventral midline. This method was considered to be less invasive and may prove to be the next step in minimally invasive laparoscopic procedures. The testicles were measured prior to formalin fixation.

The mean values of the biochemical parameters of serum aspartate aminotransferase, alanine aminotransferase and serum alkaline phosphatase increased insignificantly by day 3 and always remained within the normal physiological limits during the observation period (Table 1).

The mean Serum Glucose values showed an increasing trend immediate post-operatively and 1 hour post-operatively. However, the differences in glucose levels at allintervals were insignificant and the values remained within normal physiological limits throughout the observation period (Table 2).

The University of Melbourne Pain Scale (UMPS) was used to assess the post-operative pain and discomfort faced by the patient. The scores were filled in based on owner feedback from days 1 to 3 post-procedurally. The mean pain scores showed a significant and decreasing trend indicative of reduction in pain (Table 3). Laparoscopic procedures are however considered to be less painful than open surgical procedures. Devitt *et al.* (2005) also noted in their study that a majority of the patients who underwent open panhysterectomy versus those who underwent laparoscopic-assisted panhysterectomy scored above 6 in their postoperative pain scores and required rescue analgesia. Similar observations were made by both Hancock *et al.* (2005) and Stedile *et al.* (2009) in their research comparing open and laparoscopic ovariohysterectomy and splenectomy, respectively.

Histopathological examination of the retained testes showed varying degrees of degeneration and fibrosis, with spermatogenesis being completely absent in most testicles. Neoplastic changes were found in two testes, each from a different dog and were classified and a well differentiated diffused Seminoma and a moderately differentiated Seminoma. A majority of the testicular changes observed were benign and indicated under developed or atrophic testicles. Moon *et al.* (2014) reported histological findings in a cryptorchid testicle including reduced number of Sertoli cells in the seminiferous tubules and the infrequent presence of spermatocytes and spermatozoa.

Laparoscopy procedures are minimally invasive surgical procedures and so in their category were be less traumatic than open procedures. They provided unparalleled visual access to the abdominal cavity and its organs. Yefimova *et al.* (2019) opined that the temperature at which retained testes exist in the abdomen speeds up the process of autophagy. This correlates with the findings of vacuolar degeneration, impairment of germ cell maturation and the absence of mature sperm in all the testicular samples analysed in this study. It was also observed that the open approach to the abdominal cavity (Hasson's technique) proved safer than the Veress Needle technique, with no instances of splenic injury observed when applied. This study concludes that both ultrasonography and lapararoscopy are efficient modalities for diagnosing and locating retained testicles, while laparoscopy is a safe and easy method to surgically remove these testicles in dogs.

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