

**Clinical and Histological Aspects of Cryptorchidism in Dogs and Cats****Othman J. Ali<sup>1,2</sup>, Talib G.M. Ali<sup>1\*</sup>, Goran M. Raouf<sup>3</sup>, O. I. Dana<sup>1</sup>**

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<http://creativecommons.org/licenses/by/4.0/>.**Abstract**

This study was aimed to investigate the incidence of cryptorchidism among dogs and tomcats were undergoing elective neutering. Cryptorchidism is diagnosed through clinical examination, palpation of the scrotum, and the ultrasonic finding of the retained testicles within the inguinal or the abdomen. Eleven cases (11.22%) of cryptorchid were identified from a total of 98 cases (42 dogs and 56 tomcats) that underwent elective castration. It was found that different breeds of dogs and tomcats were affected, including Maltese dog, Anatolian shepherd dog, Terrier dogs, Persian cat, Turkish angora cat, and the Domestic Shorthair cat. The locations of cryptorchid testis were varied from inguinal (3.06%) to intra-abdominal (8.16%) origin with either unilateral (10.2%) or bilateral (1.02%) of retained testis and their ratio was 3:3. The histopathological findings of the cryptorchid testes were showed a decrease and disorganization of the seminiferous tubules with severe hypo-spermatogenesis in both species, dogs, and tomcats. In addition, there was also a typical Sertoli cell-only syndrome (SCOS), which was characterized by larger nuclei and atrophy of many tubules, which were completely replaced by hyaline substances. In conclusion, the occurrence of cryptorchidism in Anatolian Shepherd dogs and the Domestic Shorthair cats were first documented in the literature. Although, no significant differences were found in the incidence of cryptorchidism in both species.

**Keywords:** Cryptorchid, Testes, Testicle, Castration, Inguinal, Abdomen**الجوانب السريرية والنسجية للخصى المحتجزة في الكلاب والقطط****الخلاصة**

هدفت هذه الدراسة إلى التحقيق في فشل نزول الخصية بين الكلاب و القطط التي خضعت للخصى الاختياري. يتم تشخيص الخصيتين الخفيتين من خلال الفحص السريري ، وملامسة كيس الصفن ، واكتشاف الخصيتين المحتجزة بالموجات فوق الصوتية داخل الأربية أو البطن. تم تحديد 11 حالة (11.22%) من الخصيتين المحتجزة من إجمالي 98 حالة (42 كلاب و 56 هر) التي خضعت للإخصاء الاختياري. وقد وجد أن سلالات مختلفة من الكلاب و القطط قد تأثرت ، بما في ذلك:

Maltese dog, Anatolian shepherd dog, Terrier dogs, Persian cat, Turkish angora cat, and the Domestic Shorthair cat.

تباينت مواقع الخصية المشفرة من أصل أربي (3.06%) إلى داخل البطن (8.16%) إما من جانب واحد (10.2%) أو ثنائي (1.02%) من الخصية المحتجزة وكانت نسبتهم 3:3. أظهرت النتائج النسجية المرضية للخصى المحتجزة انخفاضاً وعدم انتظام في الأنابيب المنوية مع نقص شديد في تكوين الحيوانات المنوية في كلا النوعين ، الكلاب ، و القطط بالإضافة إلى ذلك كان هناك أيضاً متلازمة خلوية سيرتولي النموجية (SCOS) ، والتي تميزت بنوى أكبر وضمور العديد من الأنابيب ، والتي تم استبدالها بالكامل بمواد هيالين. الاستنتاجات ، تم توثيق حدوث الخصية الخفية في كلاب Anatolian Shepherd و القطط المنزلية قصيرة الشعر لأول مرة في العراق. على الرغم من عدم وجود فروق ذات دلالة إحصائية في حدوث الخصية في كلا النوعين.

## Introduction

Cryptorchidism is defined as the failure of one (unilateral) or both (bilateral) testes to descend into the scrotum, that is retained either in the abdomen or in the inguinal region (1). Dog breeds thought to be more commonly affected include the Chihuahua, German shepherd dog, Miniature schnauzer, Pomeranian, Poodle, Shetland sheepdog, Siberian husky, and Yorkshire terrier. The exact cause is unknown but is considered to be due to the defect in the sex-linked autosomal recessive trait, which is common in certain breeds, such as Chihuahuas, Miniature Schnauzers, Pomeranians, Poodles, Shetland sheepdogs, and Yorkshire terriers, in which smaller breeds are 2.7 time more likely to be affected than the larger breeds (2). It has been demonstrated that the cryptorchids were more common in purebred or pedigreed breeds, tomcats and the commonly inspired breeds include Persians and Himalayans (3). Different studies reported that the cryptorchidism was also affecting other species of animals, in which unilateral cryptorchidism is more common than bilateral cryptorchidism in a rate of 78%, 90%, 45-70%, 81-93%, 66-89%, 59%, 100%, and 62% in tomcats, cattle, dogs, horses, human, pigs, rabbits, and sheep respectively (4).

In most cases of cryptorchidism, the testicle is retained in the abdomen or the inguinal canal but occasionally one or both testicles could be located in the subcutaneous tissues of the groin region, an area between the inguinal canal and the scrotum (5). A Cryptorchid testicle is much smaller than a healthy testicle and this syndrome is rarely associated with discomfort or other symptoms unless when accompanied by complications such as inflammation, trauma, and cancers (6). When both testicles are retained, the animal can be infertile, this is due to the thermal suppression of sperm production, however unilaterally cryptorchid animals are usually fertile because the intact testicles begin to contain testosterone

and produce sperm (2). Nevertheless, it has been reported that the intact testicles develop into cancerous tissues at a rate of 13.6 times than the normal testes (7). Diagnosis of intra- abdominal or inguinal cryptorchidism is difficult because the retained testicles cannot be palpated owing to the smaller size, thus using x-rays or ultrasound is justified to confirm the diagnosis of cryptorchidism conditions (8 and 9). Based on the above information, we aimed to investigate the existence and histopathological aspect of cryptorchidism among dogs, and tomcats were undergoing an elective castration.

## Materials and Methods

### 1. Animals

This study was conducted from 2017 to 2021 on the clinical cases were presented to the Veterinary teaching hospital at the College of Veterinary Medicine/ University of Sulaimani and the VetGreen private veterinary hospital for elective castration in dogs and tomcats. From a total number of ninety-eight cases, including forty-two dogs and fifty-six tomcats with their ages ranged from eight months to five years, it was found that eleven clinical cases were diagnosed as cryptorchidism in both species depending on the clinical examination, palpation, and using ultrasonographic imaging (Sonoscape A6, USA) (Table 1).

**Table 1: Shows the number, ages and breeds of dogs and tomcats affected with cryptorchism.**

Animals	Number	Age/month	Breed	Cryptorchid	Affected testis
Dogs	1	9	Maltese	Inguinal region	Bilateral
	1	36	Anatolian Shepperd	Intra-abdominal	Unilateral
	1	24	Anatolian Shepperd	Intra-abdominal	Unilateral
	1	8	Anatolian Shepperd	Intra-abdominal	Unilateral
	1	20	Terrier	Inguinal region	Unilateral
Tomcats	1	36	Persian	Intra-abdominal	Unilateral
	1	60	Persian	Intra-abdominal	Unilateral
	1	24	Turkish angora	Inguinal region	Unilateral
	2	16	Turkish angora	Intra-abdominal	Unilateral
	1	8	Domestic Shorthair	Intra-abdominal	Unilateral

## 2. Surgical Operation

The cryptorchidism animals were prepared routinely for surgical gonadectomy. They were fastened for 8-12 hours and the anesthesia was made by premedication with atropine sulphate at a dose of 0.04 mg/kg intramuscularly, then Ten minutes later, a mixture of Xylazine 2% (Interchemie) and Ketamine 5% (Alfasan) was followed by intramuscular injection at a dose rate of 5 mg/kg and 15mg/kg, respectively. The abdomen from the xiphoid to the pubis was aseptically prepared by clipping, shaving, and disinfection with tincture of iodine 2.5% and then draped. A surgical midline incision was made through the skin, subcutaneous, and linea alba. A spay hook was used to find the vas deferens of the testicle and the testicular blood vessels. The vas deference and the vessels were severed and ligated using absorbable suture material (Polyglycolic acid, USP 0.2). The testicle was

then removed from the attached cord and the tied cord was inserted back into the abdomen. Finally, the peritoneum and the abdominal muscles closed routinely with absorbable suture materials (Polyglycolic acid USP 0 for dogs and USP 0.2 for tomcats) and the skin with non-absorbable suture material (Nylon size 0 for dog and size 02 for tomcats). Post-operative care included daily injection of antibiotic (Penicillin- Streptomycin) and anti-inflammatory (Meloxicam) drugs for up to 5 days, and then the stitches were removed after 14 days of the operation.

## 3. Histopathology

Tissue samples were taken from normal and abnormal testicles for histopathological study. The samples were fixed in 10 % neutral buffered formalin and processed for paraffin embedding. A 5µm paraffin section stained with hematoxylin and eosin according to the (10).

## Statistical analysis

The data were analyzed using Chi square ( $X^2$ ) test (version 24.0 of the Statistical Package for Social Sciences (SPSS) software (by IBM, USA). The odds ratio with 95% confidence interval were used to express the ratio of incidence of interested variable in cases of cryptorchidism occurrence in dogs and tomcats.

## Results and discussion

### Macroscopic findings

The results revealed that the rate of cryptorchidism was (11.9%) and (10.71%) in dogs and tomcats respectively. The higher incidences were in Anatolian shepherd dog and Turkish Angora and Persian cat, they were 27.3%, 18.2%, 18.2%, respectively. The second most affected breeds were Maltese, Terrier dogs, and Domestic Shorthair cats, which represented 9.1% for each animal. Nevertheless, the location of the cryptorchids were also varied, generally, in two areas the retained testicles were identified,

they were intra-abdominal and the inguinal region (area between the thigh muscle and the ventral midline) directly under the skin. In dogs, it was found that Maltese and Terrie’s breeds were suffering from inguinal cryptorchidism and the Anatolian Shepperd breed was suffering from intra-abdominal cryptorchidism. In tomcats, all the cases were suffering from intra-abdominal cryptorchidism with the except for only one case of Turkish angora breed that suffered from inguinal cryptorchidism (Table 1). In addition, all the cases were diagnosed as unilateral cryptorchids except for only one case of Maltese dog was diagnosed with bilateral inguinal cryptorchidism. This condition was identified in different ages; they were ranged from 8 months to 60 months old in both species (Table 1).

**Table (2). Shows the percentage of the unilateral and bilateral affection of cryptorchidism in dogs and tomcats.**

Species	No	No. and % Cryptorchid	Affected testes		Location of Cryptorchid		
			No and %		No and %		
			Unilateral	Bilateral	Inguinal	Abdominal	Both
Dogs	42	5 (11.90)	4 (9.52)	1 (2.38)	2 (4.76)	3 (7.14)	1 (2.38)
Tomcats	56	6 (10.71)	6 (10.71)	-	1 (1.78)	5 (8.92)	-
Total	98	11 (11.22)	10 (10.20)	1 (1.02)	3 (3.06)	8 (8.16)	1 (1.02)

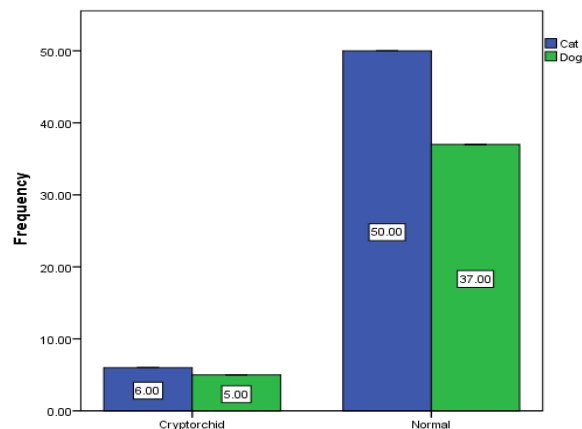


Figure 1: shows the numbers of cryptorchidism in the dogs and tomcats. No significant differences were found in the frequency of occurrence between dogs and tomcats using Chi square test with a p-value 0.085.

**Table 3: shows the odds ratio and confidence interval of different variables in related to dogs and tomcats.**

Variable	Odds ratio	95% confidence interval	
		Lower	Upper
species (Dog/Cat)	1.1	0.32	3.97
location (Abdominal/Inguinal)	3.3	0.2	54.5
For cohort species (Dogs) in inguinal region	1.77	0.5	5.9
For cohort species (Tomcats) in abdominal region	1.87	0.3	10.1

**Microscopic examination**

Microscopic examination of the normal testes in dogs illustrated the stages of spermatogenesis in the seminiferous tubules which were exhibited maturation of the germ cells from the peripheral to the center of the lumen including the spermatogonia, primary spermatocytes, secondary spermatocytes, spermatids and the spermatozoa (Figure 2). In the cryptorchid testes, the affected testes showed disorganized germ cells including the Sertoli cells were sloughed into the lumen of seminiferous tubules with

severe hypo-spermatogenesis features (Figure 3). A testicular biopsy from eight months dog with intra-abdominal cryptorchidism showed pure Sertoli only cell syndrome (SCOS), that characterized by a complete absence of germ cells associated with interstitial hemorrhage (Figures 4, 5). Generally, these testicular sections were demonstrating the testicular tissue featuring more than 500 mature seminiferous tubules exhibiting a mild reduction in tubular diameter that was lined only by a single layer of mature Sertoli cells with no germ cells. The nuclei of the cells were irregularly distributed and contained prominent nucleoli. These cells were rested on a normal thickened basement membrane and associated with chronic inflammatory cells mainly lymphocytes suggesting an autoimmune process. In addition, there was moderate Leydig cell hyperplasia in the interstitial areas and no germ cells were identified within the seminiferous tubules (Figure 6). In tomcats, the testicular biopsies were revealed typical pure Sertoli cell-only syndrome (SCOC), however, the tubules were appeared normal in diameter, and architecture. The nuclei of the Sertoli cells were intact, uniform, and located at the basal compartment of the cell. The cytoplasm was abundant and contained no germ cells but a notable number of intermediate filaments were identified around the nuclei (Figure 2).

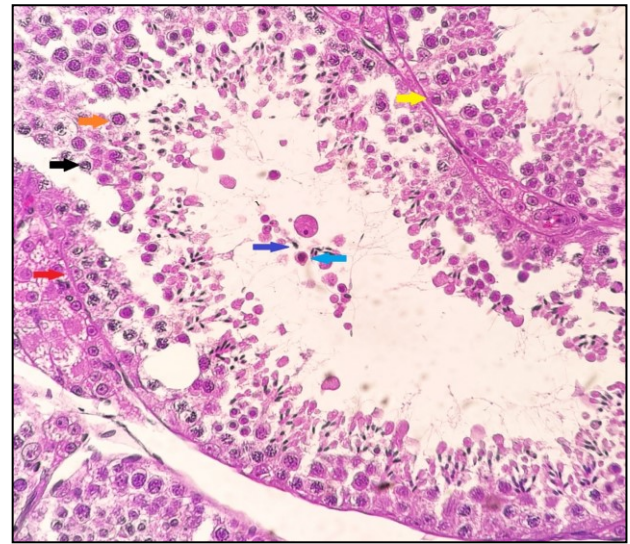


Figure 2: Normal and regular spermatogenesis exhibiting maturation of germ cells from the periphery to the center of the lumen Sertoli cell (red arrow), spermatogonia (yellow arrow), primary spermatocytes (black arrow), secondary spermatocytes (orange arrow), spermatids (light blue arrow), and spermatozoa (dark blue arrow), and normal histological structure of seminiferous tubules and inter-tubular spaces.

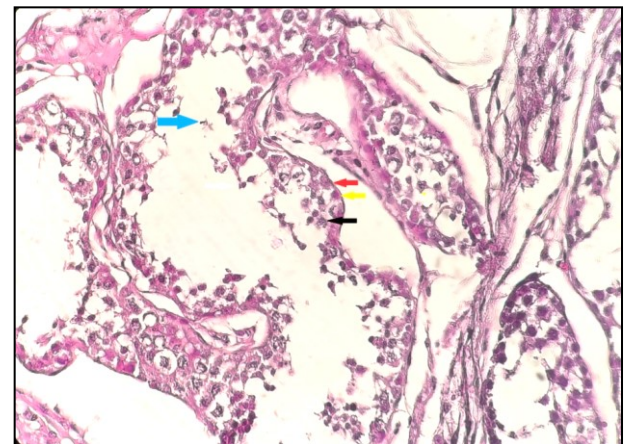


Figure 3: Testicular biopsy from cryptorchid dog, showing germ cell disorganization and sloughing into Lumina with severe hypo spermatogenesis, presence of Sertoli cells (red arrow) and spermatogonia (yellow arrow), primary spermatocytes (black arrow) and spermatozoa (blue arrow).



Figure 4: Testicular biopsy from cryptorchid dog showing pure Sertoli only cell syndrome, demonstrating complete absence of germ cells within the seminiferous tubules but the Sertoli cells (red arrow) were present and there were areas of interstitial hemorrhage (white arrow).

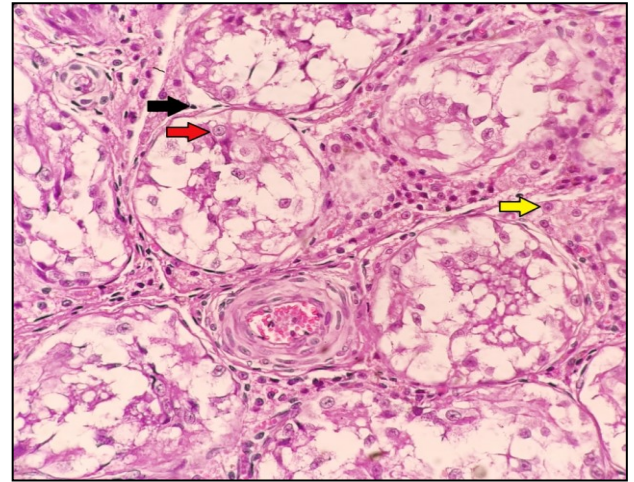


Figure 6: Testicular biopsy from cryptorchid Tomcat showing Pure Sertoli only cell syndrome demonstrating complete absence of germ cells with presence of Sertoli cells (red arrow) and Ledger cell hyperplasia (yellow arrow) admixed with mild lymphocytic infiltrations (black arrow).

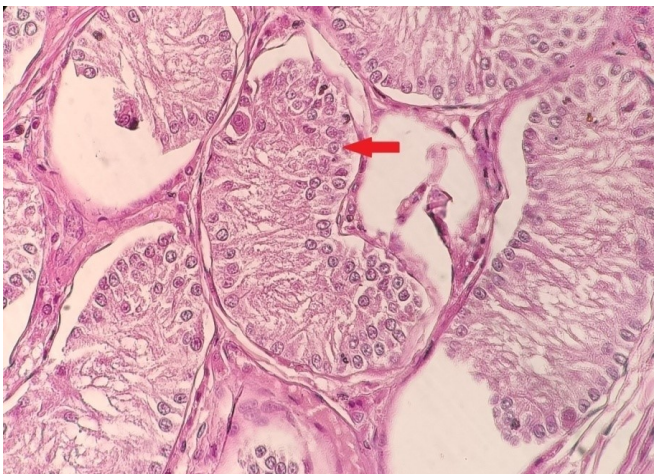


Figure 5: Testicular biopsy from cryptorchid dog with cryptorchidism showing Pure Sertoli only cell syndrome demonstrating complete absence of germ cells with presence of Sertoli cells (red arrow).

Cryptorchidism is the genital disorder in the descending process of either one or both testicles from the abdomen into the scrotum <sup>1</sup>. In this study, 11 (11.22%) clinical cases of cryptorchidism were recorded from a total of 98 pet animals (42 dogs and 56 tomcats), that were undergoing elective castration. Similarly, it was recorded that the canine species has the highest frequency of this abnormality, it was accounting for 10% with their tendency was possibly increasing (5). Additionally, the other studies were showing that the most commonly affected species including equine, canine, and swine, whereas, it was occurring less frequently in the other species (11 and 12). As well as, the former researchers suggested that cryptorchidism was the most common pathological condition of the sexual development in dogs, which was accounting for 13% (13). Over a period of 54 months, (4) found that 6.82% and 1.31% of dogs and tomcats were suffered from cryptorchidism respectively, and the most predisposed breeds were German shepherd dog, Boxer, and Chihuahua, while in tomcats they were reported among the pedigree cats <sup>4</sup> and the Persian breed of tomcats were mentioned with a larger

prevalence of cryptorchidism<sup>3</sup>. As well, in a study by Millis (14), it was reported that the most predisposed breed to cryptorchidism was recorded in Poodle breeds (14). Similarly, the current study showed that the prevalence of cryptorchid was greater in dogs than the tomcats, but the most affected breeds were recorded in the Anatolian shepherd dog and the Turkish angora cat. Owing to the most prevalence of local breed Anatolian shepherd dog in the north of Iraq, it was found that the higher incidence of cryptorchidism was reported in this breed, which was representing 27.3% from a total number of recorded clinical cases, because the number of Anatolian dog in the study was greater than other, 68 Anatolian, and the others 29. Moreover, from a total of eleven cases of cryptorchidism, it was found that ten cases (10.20%) were unilateral and only one case (1.02%) was suffered from bilateral cryptorchidism. As well as, it was documented that locations of the retained testicle were varied in both species, they were (3.06%) inguinal and (8.16%) intra-abdominal. Similarly, different studies mentioned that unilateral cryptorchidism is more frequent than bilateral, where the right testicle seems to be more frequently affected than the left testicle, this is due to the longest migration of the right testicle from the caudal region of the right kidneys which is more cranial than the left kidney (14 and 15) The normal period for the testicles to descent from the abdomen into the scrotum is not strictly identified, however, it has been suggested that they are usually present in the scrotum since birth in dogs (16). As well as other researchers proposed that they are usually descent in about 10 days of age (17). In the current study, these cases were identified in different ages, they were aged between 8 to 60 months old, which they considered being up to the age of maturation. The lack of descent testicles in dogs was twice more affecting the right side with their relationship of 2.3:1 for testis that retained in the inguinal region, and 2:1 for abdominal retention. While, in a study on different animal species, it was reported that the right unilateral

cryptorchidism is less frequent than left in (2). Contrary, other researchers, explained that there was no difference between the prevalence of left or right cryptorchids in tomcats and dog (9).

The size of the cryptorchid testicles were varied according to their locations, which showed gross pathological changes such as atrophy and/or congestion of the testicles. The microscopic examination revealed germ cell disorganization and sloughing into the lumen, severe hypo spermatogenesis, absence of Sertoli cells, hyperplasia of Leydig cells, and interstitial hemorrhages (17). These pathological alterations caused a reduction in the diameters of the seminiferous tubules which subsequently leads to a decrease in the number of spermatogonia and this results in a reduction in fertility of the animal (18 and 19). In this study, the microscopic finding indicated that the Sertoli cells in the cryptorchid testis had the potential to proliferate, this may be associated with the high prevalence of Sertoli cell tumors in cryptorchid testes. This finding was also reported by the other researchers, the cryptorchid testes showed a typical Sertoli Cell-only syndrome (SCOS), the nuclei were enlarged, part of the seminiferous tubules was normal but few were tiny, some others were completely lost and a large number were undergoing hyaline sclerosis. A similar finding was mentioned by (20 and 21), in which there was collagen deposition in the interstitial spaces, hyaline thickening of the basal membrane, and atrophy of the germinative epithelium, with only a few spermatogonia remaining combined with Sertoli cells (15). In advanced stages of cryptorchid testes, researchers found that cryptorchid testes have no spermatogenesis and have a lower amount of germ cells (22).

### Conclusion

In conclusion, Anatolian Shepperd dogs and the Domestic Shorthair tomcats were also vulnerable to cryptorchism in addition to the other recorded breeds in the literature and the

occurrence rate of cryptorchidism in dogs was 1.1 times greater than in tomcats, and the inguinal form was 1.77 times greater in dogs, and microscopically showed a typical Sertoli Cell-only syndrome with hypo-spermatogenesis.

### Conflict of interest

The authors declare that this paper it does not have conflict of interest.

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