Ultrasonographic Diagnosis of Splenic Surgical Affections in Dogs and Cats

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ABSTRACT

In the present study 24 dogs and 6 cats were ultrasonographically examined for splenic surgical affections. Nineteen dogs suffered splenic masses with an incidence rate of nearly 79.16% and are considered to be the mostly encountered surgical affection of the spleen in dogs (hemangiosarcoma, carcinoma, nodular hyperplasia, and hematoma). In the second level was splenomegaly 3 cases (12.5%) while traumatic splenic rupture and splenic torsion are considered very rare and each was represented in one case out of the 24 cases. In cats 4 cases with splenic masses, 1 with traumatic splenic rupture and 1 suffered splenomegaly were recorded.

The sonographic picture, cytological and histopathological findings as well as the surgical treatment were described and discussed.

INTRODUCTION

Abdominal ultrasonography helps in obtaining valuable informations that lead to definitive diagnosis or to narrow the list of differential diagnosis obtained by other diagnostic techniques. Ultrasonographic assessment of the splenic size is subjective and pathognomonic. Folding of the spleen upon itself in cats indicates splenic enlargement *(1)*.

Splenomegaly could be encountered secondary to extramedullary hematopoiesis, infectious diseases, splenic torsion, or malignant infiltration, such as lymphoma and mast cell tumors *(1-5)*.

A spotted echotexture of the spleen with multiple small hypoechoic nodules is highly suggestive of benign or malignant lymphoma. Rupture of splenic mass with subsequent haemoabdomen is more frequently encountered in cases of splenic malignancies; however it occurs in benign lesions. Splenic cyst and abscesses are rare and manifested as fluid filled cavities of variable echogenicity within the splenic parenchyma similar to those of the liver. These cannot be differentiated from haematomas or cavitated masses based on their ultrasonographic appearance. Cases suffered splenic infarction, the affected areas appear hypoechoic, sharply demarcated from adjacent parenchyma. They showed decreased or abscent blood flow on colour Doppler or Power Doppler examination. In contrast to splenic masses, infarcts don't tend to distort the normal organ contour in most cases *(5)*.

Splenic torsion is a rare disorder in dogs. Usually there is progressive enlargement of the spleen, with decreased to absent blood flow. The parenchymal echogenicity and echotexture can vary as the congestion, hemorrhage, or infarction progresses. The parenchyma is typically mottled, and lacy anechoic to hypoechoic areas are observed focally or diffusely *(4)*.

Therefore, the aim of the present study was to evaluate the efficacy of ultrasound for diagnosis of different splenic surgical affections as well as to survey such affections as the ultrasonographic pictures which are sometimes controversial.

MATERIAL AND METHODS

In the course of this study a total number of 24 dogs (14 females and 10 males) of 10 different breeds were examined. Eight of the females were castrated. Ages ranged between 6 years till 14 years old and weighted 4.5 kg- 60 kg.

Six cats were examined ultrasonographically for diagnosis of different surgical splenic affections. In cats the most encountered breed

was the European Shorthair 4 out of 6. Also 5 out of the six cats were males of which 3 were castrated, the cats weighted 2.5 to 4.8 kg. Ages ranged between 6 m till 16 years old.

These animals were admitted to the small animal clinic Justus-Liebig University, Giessen, Germany during the period from 2008 to 2010. Ultrasonography was performed using a real-time ultrasound machine (Powervision 8000, SSA-390A; Toshiba) with an 8 to 12 MHz linear transducer and 5-7 MHz convex transducer and (LOGIQ 9 General Electric (GE) - USA) equipped with M7C (4-7 MHz) convex transducer and M12 L (9-12 MHz) linear array transducer. The ventral abdominal wall was clipped and acoustic gel (Sonogel; Bad Camberg) was applied. The entire abdomen was examined ultrasonographically while the animal was in dorsal recumbency.

Fifteen out of the 24 dogs and 2 out of 6 cats were surgically operated for splenectomy.

Percutaneous ultrasound-guided aspiration biopsies were performed using either a 22 gauge spinal needle or a 20 gauge needle. The microcore automated biopsy is performed using a 18 gauge Tru-Cut-like needle, assisted by an automated biopsy gun and also fine-needle aspiration biopsy (FNAB) for cytology were performed using syringe and slide for direct smear.

The ultrasonographic findings and the other examination procedures help in the diagnosis such as cytology, histopathology, which were performed by biopsy needle, and laparotomy was undertaken and results are illustrated in tables 2 & 3.

RESULTS AND DISCUSSION

Table 1. Illustrated the number and percentage of the ultrasonographically diagnosed different splenic affections in dogs and cats.

Splenic affections	Dog (number and percentage)	Cat (number)
Splenic masses	19 (79.16%)	4
Traumatic splenic rupture	1 (4.1%)	1
Splenomegaly	3 (12.5%)	1
Splenic torsion	1 (4.1%)	-
Total number	24	6

Through the assessment of the affected dogs, it was found that the breed, sex, and weight did not play any role in the incidence of these pathologies or surgical affections. On the other hand considering the age, the affected cases were the older (aged more than 6 years till 14 years old) and they were mainly affected with ruptured splenic hemangiosarcoma. The incidence of malignancy in relation to body weight indicated no special relationship.

In cats the most encountered breed was the European Shorthair (4 out of 6). Also 5 out of 6 cats were males and of which 3 were castrated.

In dogs it was found that the most commonly encountered splenic affections were the splenic masses (19 out of 24) as they constituted nearly 79.16% of the ultrasonographically diagnosed splenic affections. In the second level, splenomegaly and hyperplasia constituted 12.5%, then the traumatic splenic rupture (1) and splenic torsion (1), each constituted 4.1% and considered very rare.

Lymphoma was recorded in one year old cat and splenomegaly due to fibrosarcoma was recorded in a 16 years old cat.

1. Splenic masses

In dogs it was found that the most commonly encountered splenic affections were the splenic masses (19 out of 24) as they constituted nearly 79.16% of the ultrasonographically diagnosed splenic

affections. They were mostly hemangiosarcoma (12 out of 19 cases). Of these 12 cases, 5 dogs were with ruptured splenic tumour and the other 7 cases were other types of hemangiosarcoma. There were also splenic nodular hyperplasia (3), hematoma (2), and carcinoma (2) cases. This elevated incidence of splenic masses was also reported by several authors ***(2, 6, 7).***

The ultrasonographic picture of the cases with splenic masses demonstrated round anechoic to hypoechoic areas or nodules in the splenic parenchyma with well defined borders (Fig. 1 A&B), sometimes of mixed echogenicity or inhomogenous and sometimes with hypoechoic septa which represented unclotted blood in cases of hematoma. The round focal changes of the different sizes were highly inhomogenous with hyper and hypoechoic areas. In cat hematoma appeared as anechoic mass with unclotted blood (Fig.1C).

In the 5 cases with ruptured tumour, there were areas of mixed echogenicity and sometimes with free abdominal fluids; splenectomy was done in one case (Fig. 3, 4 and 6). These findings are supported previous studies ***(1, 6, 7).*** These findings are considered non specific and definitive diagnosis requires cytologic or histopathologic examination ***(1, 8).***

Of the 14 cases suffered splenic masses, 5 were not surgically treated and the other 9 cases were subjected to splenectomy operation.

Considering the splenic surgical affections in cats, 4 cases suffered splenic masses demonstrated ultrasonographic inhomogenous spleen with multiple anechoic to hypoechoic round nodular structures or masses in the spleen (Fig. 5). The same ultrasonographic picture as described in dogs and supported by previous several studies ***(1, 6, 9).***

Table 2: Ultrasonographic, surgical, cytological, histopathological findings in the splenic surgical affections in dogs

Dog (number)	Ultrasonographic findings	Surgical interference	Cytology and histopathological findings	Figures in the text
Splenic mass (14 cases) Ruptured tumor (5 cases)	round anechoic to hypoechoic areas in the splenic parenchyma, sometimes of mixed echogenicity or inhomogenous with hypoechoic septa which represented unclotted blood in 2 cases of hematoma. The round focal changes of the different sizes were highly inhomogenous with hyper and hypoechoic areas	Of the 14 cases suffered splenic masses 5 were not surgically treated according to owner's opinion and 9 cases were operated with splenectomy.	They were mostly hemangiosarcoma 12 out of 19 cases	1,2,3,4,6
	In the 5 cases with ruptured tumour, there were areas of mixed echogenicity with free abdominal fluid	Splenectomy was done in one case		
Traumatic rupture of spleen (1 case)	in one case, there was a hypoechoic structure subcutaneously diagnosed as a part of the spleen due to traumatic ruptured spleen	Splenectomy	----	7,8
Splenomegaly (3 cases)	demonstrated splenic enlargement at the hilus region in one case and in the other one it was in homogenous with rounded border while in the third case, there was a hypoechoic area in the cranial pole.	Splenectomy was done in 3 cases	Infarction, carcinoma and moderate hyperplasia of erythropoiesis	10,11,12
Torsion (1 case)	torsion demonstrated enlarged spleen with diffuse anechoic area and multiple parallel echogenic lines in the parenchyma	Splenectomy	torsion pyogranulomatous chronic inflammation with hemorrhage and serosa cell hyperplasie and dysplasia	14,15

Table 3: Ultrasonographic, surgical, cytological, histopathological findings in the splenic surgical affections in cats

Cat (number)	Ultrasonographic findings	Surgical interference	Cytology, histopathological findings	Figures in the text
Splenic mass (4 cases)	Inhomogenous spleen with multiple anechoic to hypoechoic round structures or masses in the spleen. The case with splenomegaly was of inhomogenous parenchyma with free abdominal fluid	Splenectomy in one cat	The histopathological findings were lymphoma, follicular hyperplasia and congestion	5
Splenomegaly (1 case)	Inhomogenic parenchyma, the thickness is 1.7 cm. Free abdominal fluid	No surgery (according to owner's opinion)	Histopathology: malignant fibrosarcoma	13
Rupture spleen and septic peritonitis (1 case)	Free fluid with corpusculars. hyperechoic and inhomogenous surroundings	Surgery: necrotic omental fat and the spleen is ruptured in to 2 parts. splenectomy	Cytology: septic peritonitis	9 A and B

2. Traumatic splenic rupture

In one dog, there was a hypoechoic structure subcutaneously located and was diagnosed as a part of the spleen due to its traumatic rupture (Fig 7 and 8 A & B). The cause of this condition is attributed to severe trauma due to an accident. While the cat with ruptured spleen and septic peritonitis demonstrated free fluid with corpuscle. The surrounding was also hyperechoic and inhomogenous (Fig.9 A&B).

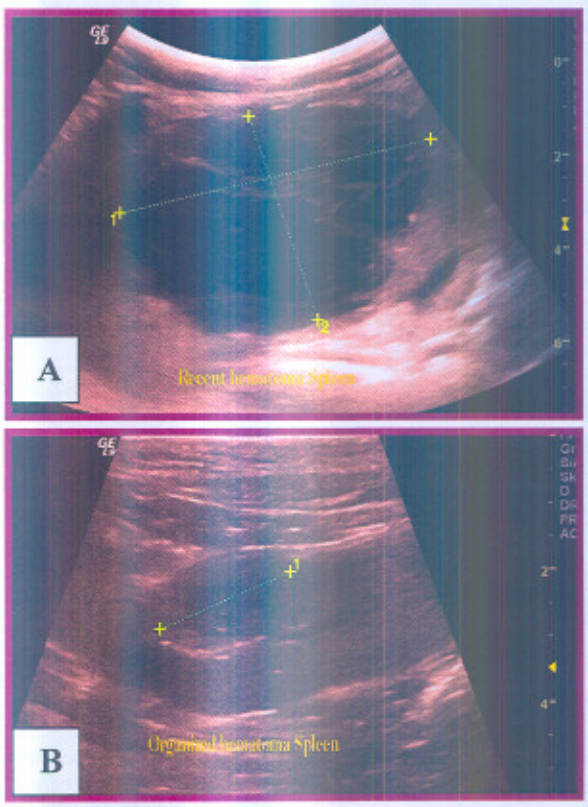

Fig. 1 (A): Recent splenic hematoma in a dog, ultrasound longitudinal scan: anechoic to hypoechoic swelling of mixed echogenicity with hyperechoic septae, which represents unclotted blood of 6.5x 4.5 cm in diameter.

(B): After three months, it appears shrinked hypoechoic with thick hyperechoic wall with central cavitation and retracted to only (2 cm).

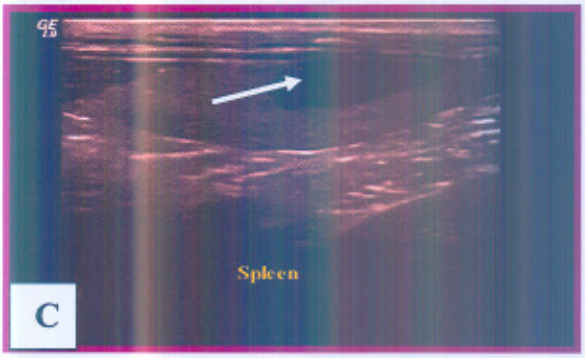

Fig. 1 (C): Hematoma with unclotted blood ultrasound longitudinal scan in a cat with anechoic mass in the spleen (arrow).

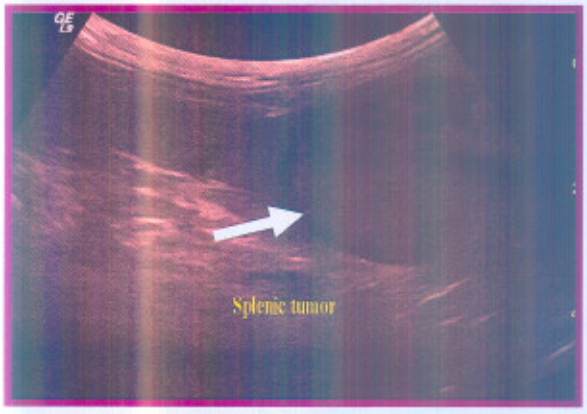

Fig. 2: Splenic mass in a dog (5x 5cm) (arrow): ultrasound longitudinal scan, the spleen is inhomogeneous, and chambered with mixed echogenicity.

Fig. 3: Splenic large inhomogenous mass in a dog: ultrasound longitudinal scan demonstrated multifocal areas which are poorly defined, an- to hypo-echoic, and complex in echotexture (4cm) inhomogenous.

Fig. 4: Showed bluish black spleen in a dog with multiple masses and bloody ascites due to a rupture of one of these tumors.

Fig. 5 (A): Splenic mass in a cat ultrasound longitudinal scan with inhomogenous spleen and multiple anechoic round structures. (B): Macroscopic picture of the spleen after splenectomy.

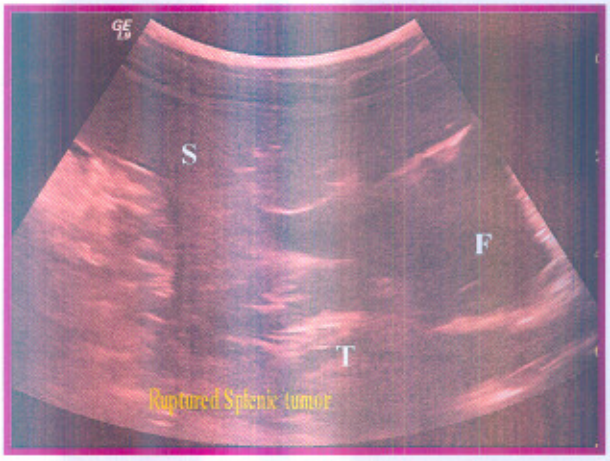

Fig. 6: Ultrasound longitudinal scan of a case suffered ruptured splenic mass with hemangiosarcoma demonstrated undefined edges of the spleen and area of mixed echogenicity in spleen edge. Free abdominal fluid was clear. S: spleen, F: free abdominal fluid, T: ruptured mass

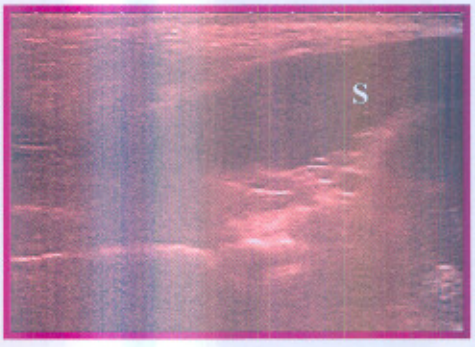

Fig. 7: Traumatic splenic rupture in a dog, ultrasound longitudinal scan: hypoechoic structure with rounded end lying subcutaneously Spleen (S)

Fig. 8 (A&B): Ruptured spleen into 3 parts.

Fig. 9 (A): Splenic rupture in a cat, ultrasound longitudinal scan with hypoechoic spleen (S) and sharp definitive edges.

Fig. 9 (B): Ruptured spleen in to 2 parts in a cat.

3. Splenomegaly

Cases with splenomegaly (3) dogs demonstrated its enlargement at the hilus region in one case (Fig. 10) and in another one was inhomogenous with rounded border while in the third case; there was a hypoechoic area in the cranial pole (Fig 11 & 12).

The case with splenomegaly in cat was of inhomogenous parenchyma with free abdominal fluid (Fig.13). These findings are also reported previously *(10)*. However, differential diagnosis for splenomegaly included splenic torsion, septicaemia, toxaemia, splenic vein thrombosis, diffuse cellular infiltration caused by lymphoma or erythropoiesis, which has been described by several authors *(11, 12)*. Therefore for accurate diagnosis exploratory laparotomy and histopathological examination should be performed.

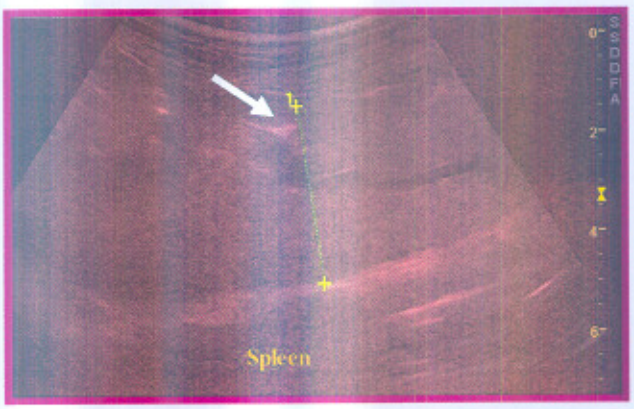

Fig. 10: Splenomegaly in a dog, ultrasound longitudinal scan: demonstrated large splenic diameter at the hilus region (3.6 cm) (arrow).

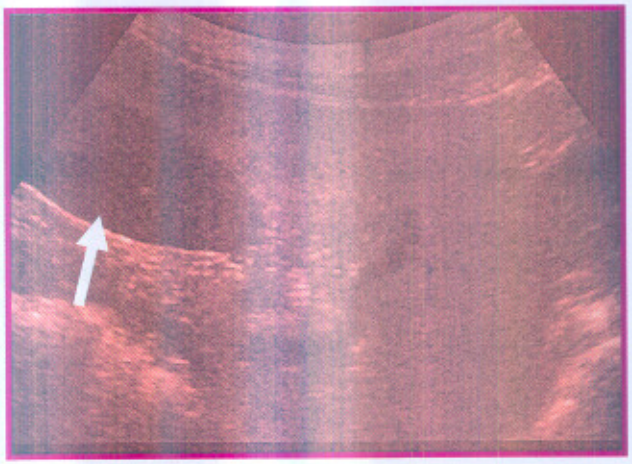

Fig. 11: Splenomegaly in a dog, ultrasound longitudinal scan demonstrated area of infarction appears as hypoechoic area in the cranial pole of the spleen (arrow).

Fig. 12: Splenic infarction in the same dog with rounded border of the spleen and of blackish colouration (arrow).

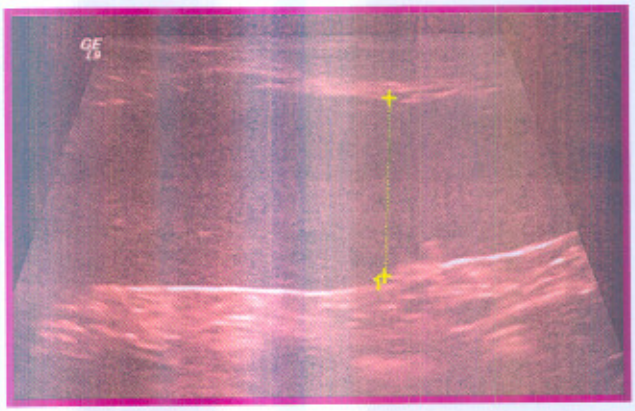

Fig. 13: Splenomegaly in a cat, ultrasound longitudinal scan spleen is inhomogenous and thick (1.7 cm).

4. Splenic torsion

The case with torsion demonstrated enlarged spleen with diffuse anechoic area and multiple parallel echogenic lines in the parenchyma (Fig. 14).

During ultrasonographic examination the spleen was enlarged with diffuse anechoic areas and multiple parallel echogenic lines within the parenchyma. There were anechoic dilated sinusoids from splenic congestion and torsion. This case was diagnosed as chronic splenic torsion and splenectomy was undertaken (Fig. 15). Cytology of the spleen showed pyogranulomatous chronic inflammation with hemorrhage and serosa cell hyperplasie and dysplasia.

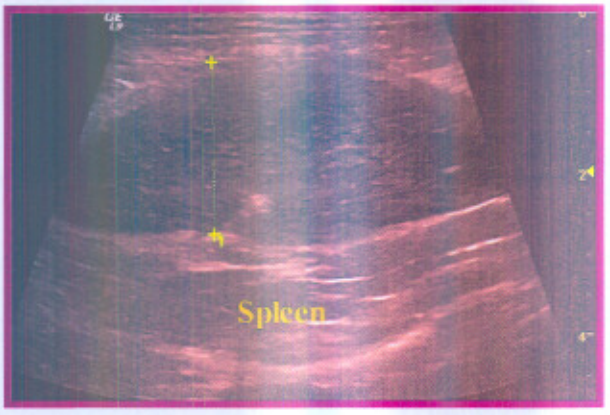

Fig. 14: Splenic torsion in a dog, ultrasound cross scan showing enlarged spleen with diffuse anechoic areas and multiple parallel echogenic lines within the parenchyma.

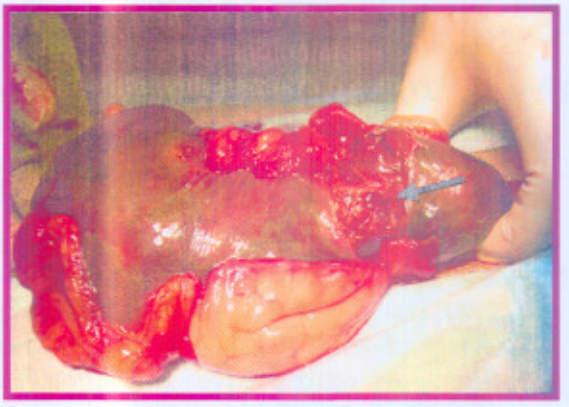

Fig. 15: Splenectomy for the case with splenic torsion in a dog appears grey in colour with tearing (arrow). Chronic splenic torsion with loss of the capsule and with ischemic area.

It could be concluded that the causes of splenomegaly are numerous and are categorized as inflammatory (splenitis) hyperplastic, congestive and infiltrative forms *(13)*. Therefore, splenic torsion should be considered in dogs and cats presented with splenomegaly.

The pathogenesis of splenic torsion is unknown; it is hypothesized to cause or is a sequele of gastric volvulus *(14)*. Torsion of the spleen around its pedicle, produce vascular congestion due to compression of the thin wall splenic veins, whereas the thicker wall arteries remain patent *(14)*. Ultimately, blockage of the artery occurs. Therefore, thrombosis of the splenic veins and eventually of the splenic arteries occur with splenic torsion. Splenic congestion, hemorrhagic infarction and necrosis are histopathological findings with splenic torsion *(15)*.

The ultrasonographic picture showed the splenic parenchyma as diffusely hypoechoic with linear echoes separating large anechoic regions *(3)*.

CONCLUSION

It could be concluded that in dogs, the most encountered splenic surgical affections were splenic masses (hemangiosarcoma, carcinoma, nodular hyperplasia, and hematoma) (19 out of 24). In cats splenic masses were 4 out of 6 cases, of which lymphoma, hematoma and splenomegaly due to fibrosarcoma were recorded.

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الملخص العربي

تشخيص الإصابات الجراحية للطحال بالموجات فوق الصوتية في الكلاب والقطط

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أجريت الدراسة الحالية على ٢٤ كلب و٦ قطط وقد تم الفحص بالموجات فوق الصوتية لهذه الحالات لتوقع حدوث اصابات جراحية بالطحال. وقد تم تأكيد التشخيص باستخدام ابرة البزل للدراسة الخلوية و الهستوباثولوجية. وقد وجد ان ١٩ كلب به أورام بالطحال بنسبة تصل الى ٧٩,١٦% وتعتبر الأكثر إصابة جراحية في طحال الكلاب. ويأتى فى المركز الثانى تضخم الطحال بنسبة ١٢,٥% بينما حالات تمزق الطحال والتوائه تعد من الحالات النادرة الحدوث وتتمثل فى حالة واحدة لكل منهن من عدد ٢٤ كلب. وعند فحص عدد ٦ قطط قد وجد ان ٤ قطط بهم اورام بالطحال وقطة واحدة بها تمزق بالطحال واخرى بها تضخم. وقد تم التدخل الجراحى عن طريق فتح البطن واستئصال الطحال فى ١٥ كلب و ٢ قطة.