

## Diagnostic Imaging of Isolated Splenic Torsion in a German Shepherd Dog

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**Abstract :** A 5-year-old male German shepherd dog was presented with a 4 day-history of anorexia and depression. Abdominal radiographs showed a large soft tissue mass and loss of serosal detail. Ultrasonographs revealed splenomegaly with the lacy pattern parenchyma, perivenous hyperechoic region at the splenic hilum, and loss of splenic venous flow. Computed tomographic findings included the enlarged non-enhanced spleen except perivenous region at the splenic hilum and a whirled soft tissue mass at the splenic hilum. Exploratory laparotomy confirmed the diagnosis of splenic torsion. Ultrasonographic findings including lacy appearance, hyperechoic perivenous echogenicity and absence of splenic blood flow and CT findings including no or minimal enhancement of the spleen and a whirled appearance of splenic pedicle could be useful for diagnosing isolated splenic torsion in the dog.

**Key words :** isolated splenic torsion, computed tomography, ultrasonography, dog.

### Introduction

Splenic torsion is a relatively uncommon, and it is most often associated with gastric dilatation volvulus (2). Isolated splenic torsion occurs rarely, and its etiology is unclear (3). Male are affected more often than female in dogs (10). Isolated splenic torsion is difficult to diagnose because of the non-specific and sometimes chronic or intermittent clinical signs and rarity of the disorder (10,16). Investigation of dogs with these nonspecific signs involves careful physical examination, hematology and serum biochemistry, abdominal radiography and ultrasonography (9,14,15). Previous studies demonstrate that among these diagnostic tools ultrasonography, especially spectral or color Doppler, is helpful in the diagnosis (9,10,14). However, more recently, computed tomography (CT) is also considered as accurate diagnostic modality in veterinary medicine (11,12). Frequently, exploratory laparotomy is required to confirm the diagnosis of splenic torsion (10).

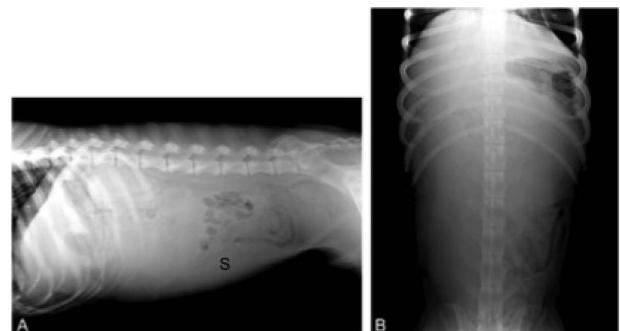
The purpose of this report is to demonstrate the CT and ultrasonographic findings of isolated splenic torsion in a dog.

### Case

A 5-year-old male German shepherd dog was presented with a 4 day-history of anorexia and mild depression and abdominal pain. Vomiting was noted the night prior to presentation. Since then, the dog had become progressively apathetic. Physical examination revealed depression and labored

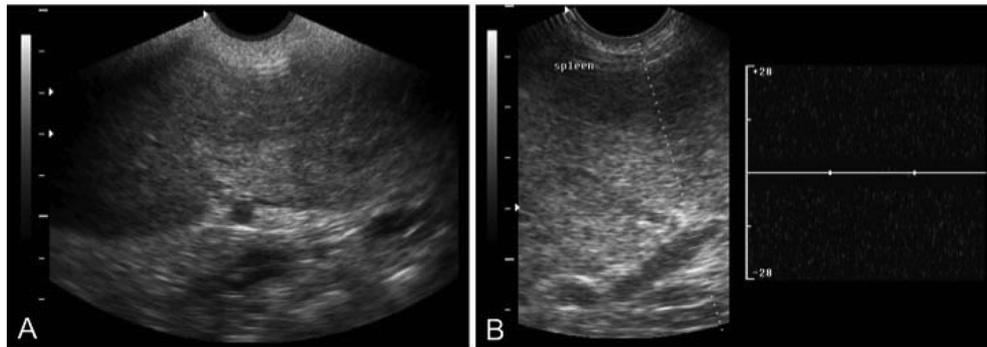
respiration. On abdominal palpation, a firm mass was palpable in the mid-abdomen accompanying pain. The mucous membranes were pink with a capillary refill time of 2 seconds. A complete blood cell count (CBC) indicated mild anemia (PCV 30.1%; reference range, 35.0-55.0%) and neutrophilic leukocytosis (26,100 neutrophils/ $\mu$ l; WBCs, 34,000 cells/ $\mu$ l). Serum biochemical profile revealed mild elevation in amylase (1,225 IU/L; reference range, 224-1,114 IU/L). There were no remarkable findings in urinalysis and analysis of electrolytes.

Lateral and ventrodorsal radiographs of the abdomen showed a large, ill-defined, space-occupying lesion through the mid-ventral to the right caudal abdomen, reduced serosal detail



**Fig 1.** Right lateral (A) and ventrodorsal (B) radiographic views of the abdomen. There is a large, ill-defined, space-occupying lesion through the midventral to the right caudal abdomen. Small intestine is displaced dorsally and caudally due to the mass effect. Serosal detail is decreased, suggesting the presence of peritoneal effusion. The spleen (S) can also be seen caudal to the mass in lateral radiograph.

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**Fig 2.** B-mode image (A) and spectral Doppler image (B) of the spleen. The splenic parenchyma is diffusely hypoechoic with interspersed hyperechoic linear foci (lacy pattern) and perivenous hyperechoic region at the splenic hilum. Hyperechoic mesentery is seen around splenic vein. No flow velocity was recorded compatible with venous obstruction.

and dorsal and caudal displacement of the small intestine (Fig 1). Thoracic radiographs were unremarkable.

An ultrasound examination was performed to determine the origin of the space-occupying lesion. Ultrasonography revealed a markedly enlarged, diffusely hypoechoic spleen with interspersed hyperechoic linear foci characteristic of the lacy pattern and perivenous hyperechoic region in the splenic hilum (Fig 2A). The adjacent mesentery was markedly hyperechoic, and small amount of peritoneal effusion was observed. Spectral Doppler for evaluating blood flow in the splenic veins at the level of the splenic hilar border failed to detect blood flow (Fig 2B). Spleen fine-needle aspirates were unremarkable.

CT examination (CT Max 640™, GE, USA) was performed under general anesthesia. The spleen was markedly enlarged and extended from the caudolateral portion of the abdomen 145 mm cranially (descending part), then turned to the right and extended 230 mm caudally (ascending part) at the right

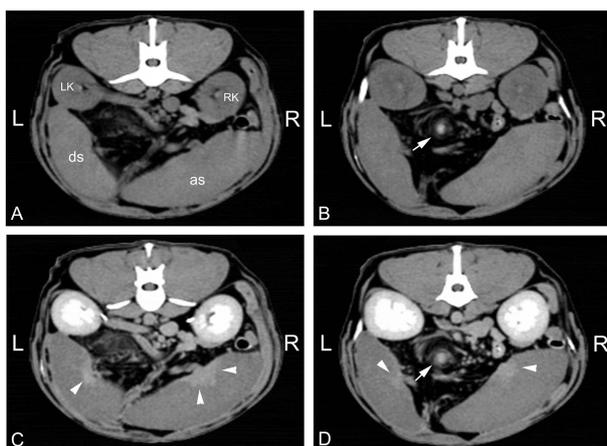
ventrolateral portion of the abdomen (Fig 3). The right kidney was displaced caudally due to splenomegaly. The splenic parenchyma was homogeneous with attenuation appearing lower than that of the liver but higher to the renal cortex. A whirled focus of soft tissue, representing the rotated pedicle, was seen in the mid-abdomen (Fig 3). Following intravenous injection of 2 ml/kg Iohexol (Omnipaque™, Nycomed, Norway) contrast medium the splenic parenchyma showed no change in density except perivenous region at the splenic hilum but normal contrast enhancement was seen in adjacent organs including liver and kidneys.

An exploratory laparotomy and total splenectomy were performed on the day of presentation. The spleen was dark purple to black in color, severely enlarged, firm, and twisted more than 360° around the pedicle. The splenic veins were thrombosed. The remainder of the abdominal organs was macroscopically normal. Splenic torsion was identified so that splenectomy was performed without untwisting the splenic pedicle in order to prevent reperfusion injury. Histopathology of the spleen revealed severe vascular congestion and hemorrhage. There was no evidence of malignancy. The dog recovered well from surgery and was discharged without complication 3 days later.

## Discussion

Isolated splenic torsion has been previously reported in dogs (10,11,12,16). It generally occurs in large- or giant-breed, deep-chested dogs, such as Great Danes, German shepherd dogs, and retrievers (8,10,12,16), although there has been report of isolated splenic torsion in small- or medium-sized dogs, including Boston terrier (11) and Shih-tzu dog (7). Great Danes and German shepherd dogs are statistically predisposed to developing isolated splenic torsion (10).

The etiology of isolated splenic torsion is poorly understood. It may be related to congenital abnormalities or traumatic disruption of the gastrosplenic or splenocolic ligaments (10). It has been hypothesized that splenic torsion may occur after spontaneously resolving gastric dilatation volvulus or



**Fig 3.** Transverse non-contrast (A, B) and postcontrast (C, D) CT images of abdomen. The descending (ds) and the ascending (as) parts of the enlarged spleen are visible. The whirled soft tissue mass (arrows) represents the rotated pedicle. In contrast enhanced CT the spleen shows no change in density except perivenous region (arrowheads) at the splenic hilum (LK = left kidney, RK = right kidney).

partial gastric torsion (6). Another theory is that stretching of the suspensory ligaments from gastric dilatation volvulus (GDV) can cause a loosening of the splenic attachments and may predispose the spleen to torsion (6). Previous reports (10) of prior GDV episodes in the histories of some dogs with isolated splenic torsion support these hypotheses. However, in the present report, the dog was 5-year-old and congenital abnormality was difficult to consider as the etiology of isolated splenic torsion. In addition, the dogs did not have previous histories of trauma and GDV. Therefore, the cause of the present case could not be confirmed.

Accurate preoperative diagnosis of isolated splenic torsion in dogs is difficult without diagnostic imaging. Abdominal radiography and ultrasonography are the routine imaging modalities that have been used in the diagnosis of splenic torsion in veterinary medicine (4,9,14). The radiographic signs observed in the dog of the present report were not conclusive for isolated splenic torsion.

Ultrasonography is widely available and noninvasive modality for the diagnosis of splenic torsion in dogs (11). Splenomegaly, mottled hypoechoic or diffusely hypoechoic or anechoic parenchyma with interspersed linear echoes (lacy appearance), splenic vein enlargement at the splenic hilum and hyperechoic perivenous triangular echo continued with the hyperechoic mesentery/omentum have been reported in dogs with splenic torsion (9,14). However, ultrasonographic abnormalities such as splenomegaly with a lacy parenchyma are not specific to torsion, as these findings can be observed in necrosis and infarction from other causes than torsion (5). In addition, the presence of the hyperechoic perivenous triangular area depends on the degree of splenic torsion (9). Spectral or color Doppler evaluation is necessary for accurate diagnosis of splenic torsion (14). However, splenic blood flow may or may not be present, depending on the degree of torsion. Absence of flow might also be due to splenic vein thrombosis (9). Previous study reported that ultrasonography was not conclusive for diagnosing isolated splenic torsion (12). In the present case, ultrasonography revealed a perivenous hyperechoic area but it was neither triangular shape nor continuous with the hyperechoic mesentery. Spectral Doppler failed to detect blood flow but we could not rule out the possibility of thrombosis.

CT provides topographic and functional assessment of the spleen and hilar splenic vessels and it has been established as an accurate method for splenic torsion diagnosis in human medicine (13). However, there are only two published reports on isolated splenic torsion diagnosed by CT in veterinary medicine (11,12). Characteristic findings including an enlarged, minimally enhancing spleen and a whirled appearance of non-enhancing splenic vessels have been reported in human (13) and dog (12) with splenic torsion. The whirled appearance or the corkscrew-like soft tissue mass represents the rotated splenic pedicle (12). This finding has been described as the most specific sign of the splenic torsion in human medicine (13) and should not be interpreted as bowel intussusceptions

(1). The lack of enhancement of the large spleen and the whirled appearance at the splenic hilum in the present case were similar to those described in previous report of the dog (12) and could be considered as characteristic CT findings of isolated splenic torsion in dogs.

Evaluation of contrast enhancement of the spleen offers important information concerning the viability of splenic parenchyma (13). Partial or total failure of the spleen to enhance with intravenous contrast medium is a strongly indicating compromised splenic perfusion (13). The lack of enhancement of splenic parenchyma except splenic hilum, as seen in the present case, was indicative of compromised splenic perfusion and total splenectomy was recommended.

In conclusion, ultrasonographic findings including lacy appearance, hyperechoic perivenous echogenicity and absence of splenic blood flow and CT findings including no or minimal enhancement of the spleen and a whirled appearance of splenic pedicle could be useful for diagnosing isolated splenic torsion in the dog. In addition, CT should be considered as an alternative imaging modality in when the ultrasonographic findings are not conclusive.

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## 독일셰퍼드 견에서 단독으로 발생한 비장 염전의 영상진단

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**요 약** : 5년령의 수컷 독일 셰퍼드견이 4일 동안의 식욕부진, 침울 등의 증상으로 내원하였다. 복부의 일반 방사선 사진에서 연부조직 밀도의 대형 종괴가 관찰되었다. 또한 종괴 변연과 주변에 장막세부음영의 소실이 관찰되었다. 복부 초음파 검사를 통해 고에코를 나타내는 비장문의 비장정맥 주위를 제외하고 전반적으로 저에코를 나타내는 비장 종대를 관찰하였고, 펄스파 도플러검사서 비장정맥에 혈류신호가 없음을 확인하였다. 복부 CT 검사에서 비장문에 위치한 비장정맥 주위에서의 조영증강효과를 제외한 비장의 나머지 부위에서의 조영증강효과는 관찰되지 않았다. 비장의 혈관줄기의 염전을 나타내는 소용돌이 모양의 연부조직 밀도의 종괴를 확인하였다. 탐색적 개복술을 통해 단독으로 발생한 비장 염전을 진단하였다. 초음파 검사에서 레이스 형태의 실질 변화와 도플러 검사시 비장 정맥의 혈류 신호 소실, CT 영상에서 비장 뿌리 부위의 소용돌이 모양의 소견 등이 비장 염전의 유용한 영상학적 특징으로 생각된다.

**주요어** : 비장 염전, 컴퓨터단층촬영술, 초음파, 개