

## Addome acuto in pronto soccorso: quando chiamare la radiologia in aiuto

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Diagnostic Mindset



## Objectives

- Acute abdomen can be challenging
- Radiology and ultrasound are often complementary to each other



## Missy, Dogue de Bordeaux, FI, 2 years

- Yesterday, She ate normally
- This morning, She ate less
- Distended abdomen from the afternoon
- Under treatment for severe dermatitis



Missy, FI, 2 years

Blood works



RBC (milioni /µL):	4.62	5.70	8.56	Acantociti:	Elliptociti:
HGB (g/dL):	11.2	14.1	21.2	Anisocitosi:	Ipcromia:
HCT (%):	33.7	39.0	59.2	Agglutinazione:	Macroci:
MCV (fL):	72.8	63.1	72.6	Codociti:	Microci:
MCH (pg):	24.3	21.8	25.4	Cheratoцитi:	Parassiti eritrocitari:
MCHC (g/dL):	33.4	33.3	36.8	Cnizociti:	Policromasia:
CHCM (g/dL):	34.3	37.8		Corpi di Heinz:	Punteggiature basofille:
MCHC/CHCM:	0.94	1.01		Corpi di Howell-Jolly:	Rouleaux:
CH (pg):	22.0	26.0		Cristalli di Hb:	Schistociti:
CHDW (pg):	0.57	3.34		Dacriociti:	Selenociti:
RDW (%):	14.2	11.6	14.7	Drepanociti:	Sferociti:
HDW (g/dL):	1.63	2.22		Eccentricociti:	Stomatociti:
NRBC/100 WBC:	0	0	0	Echinociti:	Torociti:
Varie RBC:					
WBC (x 1000 /µL):	19.8	5.45	12.98	Linfociti attivati:	
Conta corr. WBC (x 1000 /µL):	5.45	12.98		Linfociti atipici:	
Mielociti (µL):	0	0	0	Neutrofili tossici:	
Metamielociti (µL):	0	0	0	Corpi di Doehle:	
Neutrofili banda (µL):	0	0	286	Schiumosità citopl.:	
Neutrofili segmentati (µL):	17622	3555	9314	Vacuolizzazione citopl.:	
Linfociti (µL):	990	1169	3810	Basofilia citopl.:	
Monociti (µL):	1188	186	798	Granuli tossici:	
Eosinofili (µL):	340	104	1164	Neutrofili giganti:	
Basofili (µL):	10	0	106	Macropoliciti:	
Danneggiate (µL):	0	0	0		
Indifferenziate (µL):	0	0	0		
Altre (µL):	0	0	0		
Varie WBC:					
PLT (1000 /µL):	403	176	479	Stima PLT:	ADEG.: <input checked="" type="checkbox"/> INADEG.: <input type="checkbox"/> AUMENT.: <input type="checkbox"/>
MPV (fL):	6.8	8.9	15.0	Varie:	Piastrine attivate: <input type="checkbox"/> Macroplastrine: <input type="checkbox"/>
PCT (%):	0.272	0.21	0.52		Piastrine allungate: <input type="checkbox"/> Inclusi piastrinici: <input type="checkbox"/>
PDW (%):	9.5	51.8	74.5		

Missy, FI, 2 years

Blood works



CPK (IU/L):	155	42-155
AST (IU/L):	45	20-50
ALT (IU/L):	31	15-50
ALP (IU/L):	55	20-110
GGT (IU/L):	2.7	1-11
Colinesterasi (IU/L):		3347-7074
Bilirubina Totale (mg/dL):	0.30	0.15-0.4
Proteine Totali (g/dL):	8.0	5.5-7.5
Albumine (g/dL):	2.9	2.7-3.6
Globuline (g/dL):	5.1	2.6-3.9
Rapporto A/G:	0.57	0.7-1.2
Colesterolo (mg/dL):	208	150-350
Trigliceridi (mg/dL):	57	30-110
AMILASI (IU/L):	659	300-1800
Urea (mg/dL):	48	18-45
Creatinina (mg/dL):	1.32	0.75-1.3
Glucosio (mg/dL):	157	60-100
Calcio (mg/dL):	8.6	8.2-12
Fosforo (mg/dL):	3.9	2.1-6.2
Magnesio (mg/dL):		0.67-0.94
Sodio (mEq/L):	147	143-151
Potassio (mEq/L):	4.1	3.9-5.1
Rapporto Na/K:	36	28.5-37.4
Cloro (mEq/L):	112	109-118
Cloro corretto (mEq/L):	111	109.1-115.9
HC-O-3 (mmol/L):		18.4-24.8
Divario Anionico:		13.1-19.4
Osmol. sier. calc. (mOsm):	290	277-291
Ferro totale (µg/dL):	87	100-200
UIBC (µg/dL):		182-306
TIBC (µg/dL):		318-479
Saturazione (%):		28.2-56.8
Prot. C Reattiva (mg/dL):	1.17	0.01-0.22
Lipasi (dggr) (U/L):		-

Tempo di tromboplastina parziale attivata - aPTT (sec.):	12.8	10.2	22.0
Tempo di protrombina - PT (sec.):	7.8	6.8	8.6
Fibrinogeno (mg/dL):	154	152	284
Prodotti di degradazione della fibrina/fibrinogeno - FDPs (µg/mL):	0.82	< 5	
D-Dimeri della fibrina (µg/mL):	6.42	0.01	0.34
Antitrombina (%):	126	110	167

Abdominal radiographs to check the stomach

Missy, FI, 2 years

Differential diagnoses

Gastric dilatation

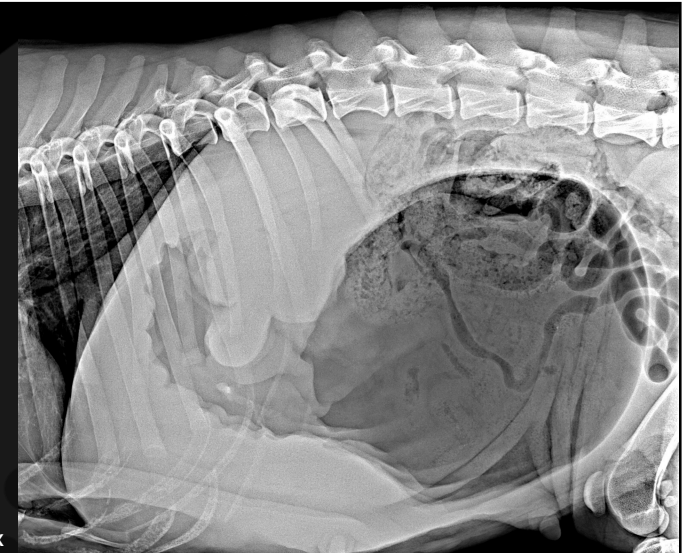
Gastric dilatation and volvulus (GDV)

Plan

- Abdominal RX to differentiate from gastric dilatation and GDV
- Thoracic RX to exclude pulmonary diseases which could cause aerophagia



Missy, FI, 2 years



DX

Missy, Fl, 2 years

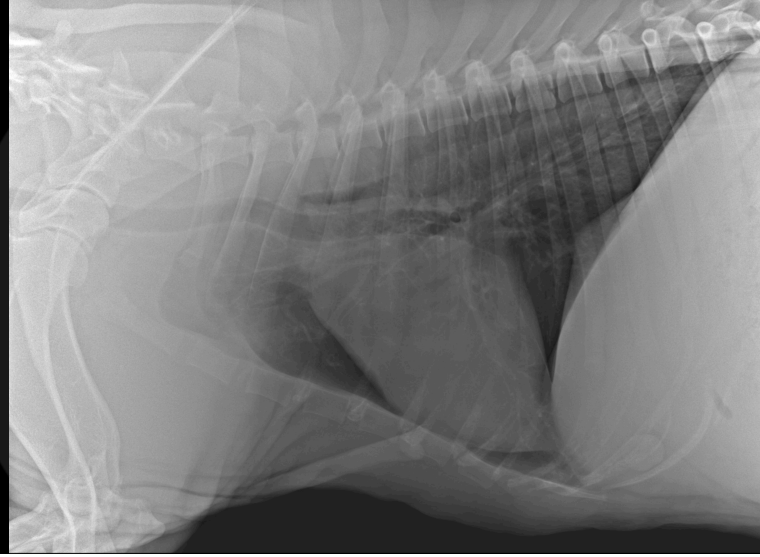


SX

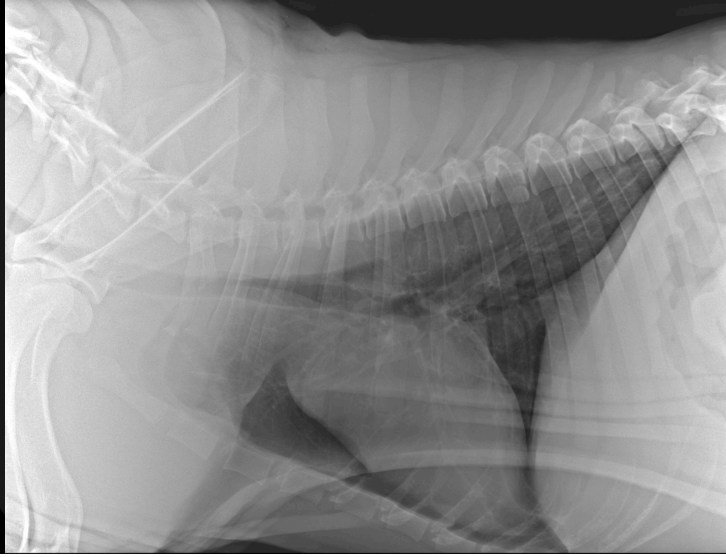
Missy, Fl, 2 years



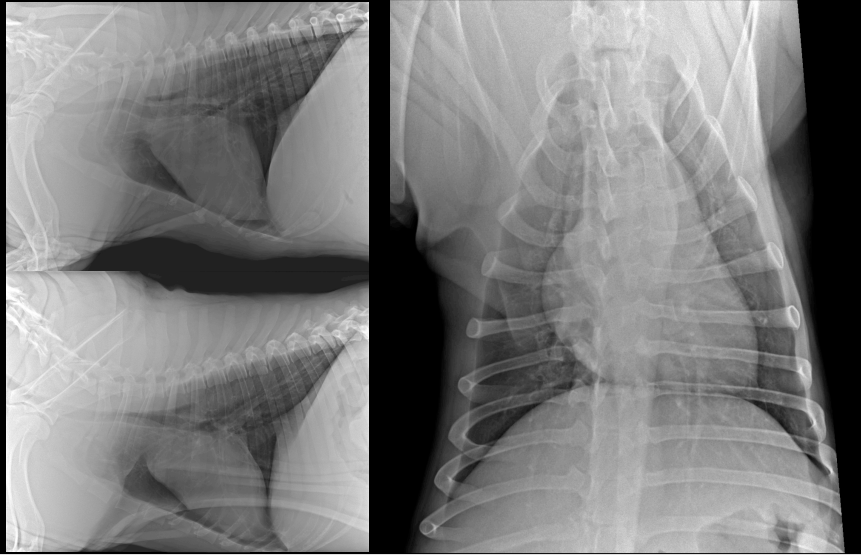
Missy, Fl, 2 years



Missy, Fl, 2 years



Missy, FI, 2 years

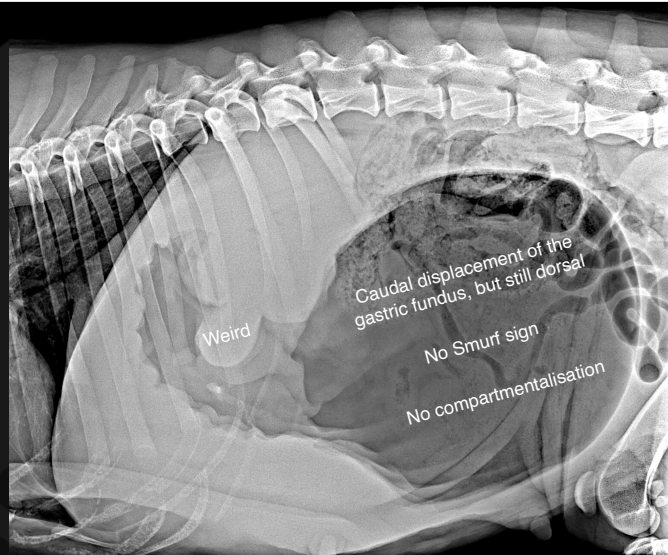


### Your evaluation

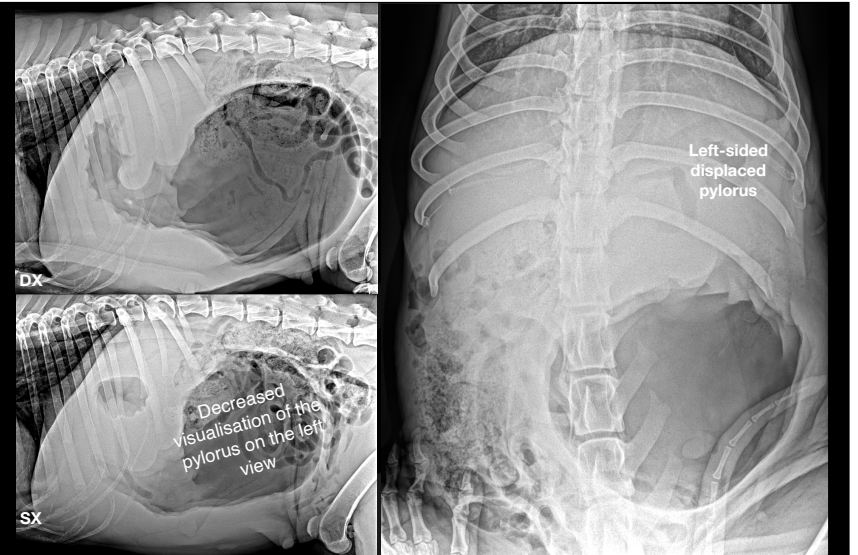
- Is there a gastric torsion?
- Is there a gastric dilatation?
- Is there a pneumonia?

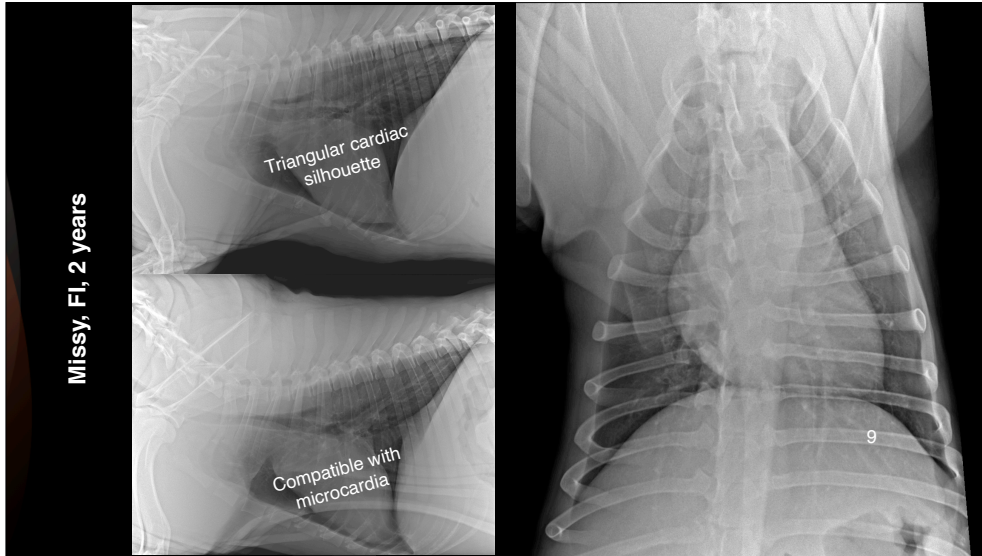


Missy, FI, 2 years



Missy, FI, 2 years





**Missy, Dogue de Bordeaux, FI, 2 years**

**Radiographic diagnoses:**

- Left displacement pylorus, ... Spleen?
- Gastric dilatation, no GVD
- Microcardia

**Next steps:**

- A-Fast to check reasons for pyloric displacement

**Missy, FI, 2 years**

Probe position in a different patient

Pyloric region

8

**Missy, FI, 2 years**

Probe position in a different patient

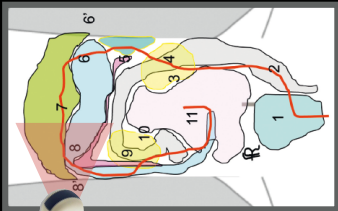
Pyloric region

8



### Missy, FI, 2 years

Probe position in a different patient



Gall bladder

8'



### Missy, Dogue de Bordeaux, FI, 2 years

#### Ultrasonographic diagnoses:

- Severe thickening of the submucosa
- Echoic sediment in the gallbladder

#### Conclusions:

- Suspected gastric oedema + functional gastric stasis
- Conservative management under hospitalisation and recheck



### Missy, Dogue de Bordeaux, FI, 2 years

- Decompressed
- Responded well to medical treatment
- She seemed fine during the night but suddenly, She collapsed in the morning
- Recheck

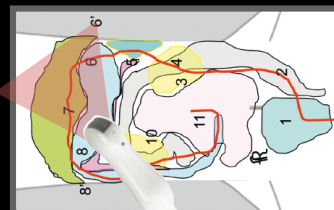


### Missy, FI, 2 years

12 hours later

7-6

Probe position in a different patient



**Missy, FI, 2 years**

12 hours later

Probe position in a different patient

Left side of the liver

7-6

**Missy, FI, 2 years**

Probe position in a different patient

Gastric body

6-7

**Missy, FI, 2 years**

Probe position in a different patient

Splenic body

5

**Missy, FI, 2 years**

12 hours later

Probe position in a different patient

Right side of the liver

7-8

Missy, Dogue de Bordeaux, FI, 2 years

Ultrasonographic diagnoses:

- Gas in the intra-hepatic portal branches
- Gastric pneumatosis
- Splenic thrombosis
- Peritoneal effusion

Conclusions:

- Causes for gastric pneumatosis
- Confirm gas in the portal branches VS hepatic emphysema



Missy, FI, 2 years



Missy, FI, 2 years



Missy, FI, 2 years



## Your evaluation

- Is there gas in the hepatic portal branches?
- Is there gas in the gastric wall?
- What would you do next?



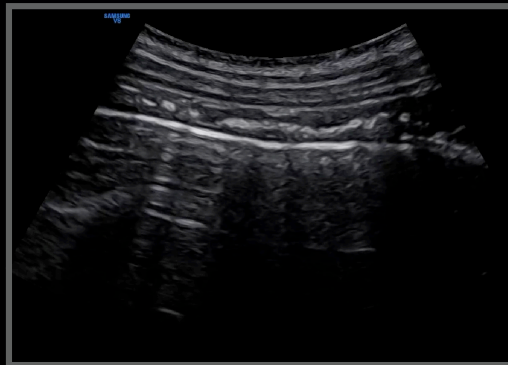
## Gastric pneumatosis

The gastric wall is stretched

The  $> \text{Volume} < \text{Pressure}$

The  $\downarrow P$  make liquid nitrogen precipitate in a gas state

Vacuum Phenomenon



Emerg Radiol  
DOI 10.1007/s10140-016-1401-6



REVIEW ARTICLE

### Vacuum phenomenon

Youichi Yanagawa<sup>1</sup> · Hiromichi Ohsaka<sup>1</sup> · Kei Jitsuiki<sup>1</sup> · Toshihiko Yoshizawa<sup>1</sup> · Ikuto Takeuchi<sup>1</sup> · Kazuhiko Omori<sup>1</sup> · Yasumasa Oode<sup>1</sup> · Kouhei Ishikawa<sup>1</sup>

the mechanism responsible for the formation of the VP [1]. If an enclosed tissue space is allowed to expand as a rebound phenomenon after an external impact, the volume within the enclosed space will increase. In the setting of expanding volume, the pressure within the space will decrease. The solubility of the gas in the enclosed space will decrease as the pressure of the space decreases. Decreased solubility allows a gas to leave a solution. The combination of lower nitrogen solubility and the minimal metabolism of nitrogen by the body mainly accounts for the formation of the VP. Basically, the mechanism underlying the formation of the VP is the same as cavitation induced by rotation of a ship's propeller in water, which depends on two laws of physics: Henry's Law and Boyle's Law.

Received: 17 March 2016 / Accepted: 26 April 2016  
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## Missy, Dogue de Bordeaux, FI, 2 years

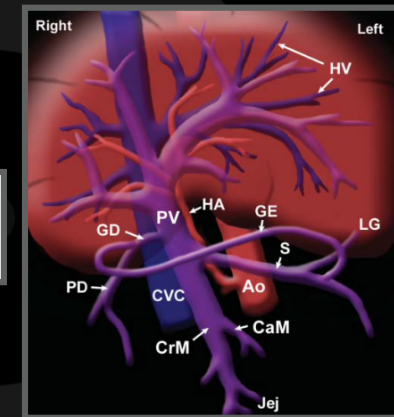
Differential diagnoses of gastric pneumatosis

- Gastric wall necrosis
- Gastric mucosal disruption
- Emphysematous gastritis
- Increased mucosal permeability

Canine and feline **emphysematous gastritis** may be differentiated from gastric emphysema based on clinical and imaging characteristics: Five cases.  
Thierry F, Ferreira MF, Paterson GK, Liuti T, Del-Pozo J.  
Vet Radiol Ultrasound. 2019 Mar;60(2):136-144. doi: 10.1111/vru.12691. Epub 2018 Oct 11.  
PMID: 30311329

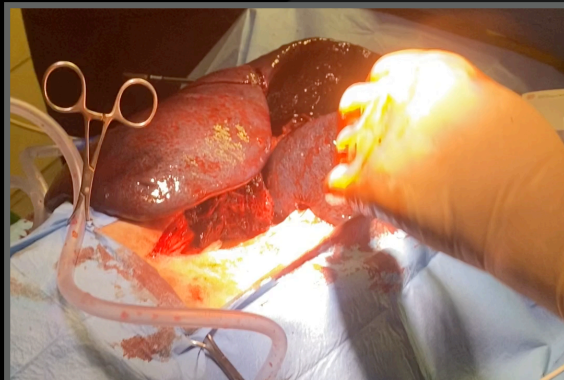
## Missy, Dogue de Bordeaux, FI, 2 years

Ultrasonographic differentiation between **portal venous** and **parenchymal gas** may be important for the prognosis of canine and feline hepatic emphysema: 37 cases.  
Manfredi S, Fabbi M, Bonazzi M, Leonardi F, Miduri F, Parrocchini I, Daga E, Gnudi G, Volta A.  
Vet Radiol Ultrasound. 2019 Nov;60(6):734-744. doi: 10.1111/vru.12797. Epub 2019 Aug 16.  
PMID: 31418988



Portal vascular system. *Atlas of Small Animal Ultrasonography* 2nd ed., D. Penninck, M.A. d'Anjou. 2015 Wiley.

## Missy, FI, 2 years



### Primary splenic torsion in dogs: 102 cases (1992-2014).

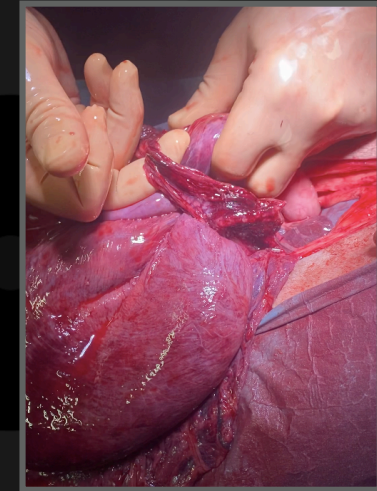
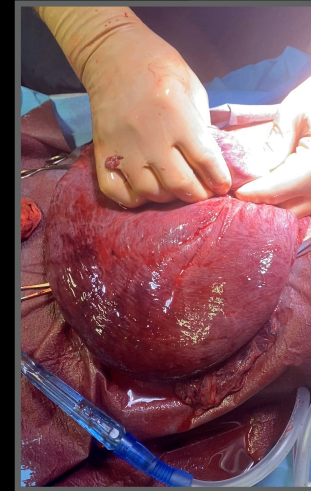
DeGroot W, Giuffrida MA, Rubin J, Runge JJ, Zide A, Mayhew PD, Culp WT, Mankin KT, Amsellem PM, Petrukovich B, Ringwood PB, Case JB, Singh A.

J Am Vet Med Assoc. 2016 Mar 15;248(6):661-8. doi: 10.2460/javma.248.6.661.

PMID: 26953920 [Free article.](#)

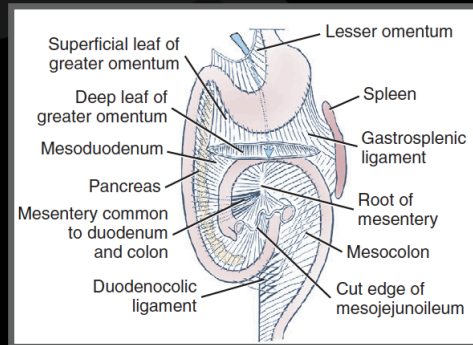


## Missy, FI, 2 years



## Missy, Dogue de Bordeaux, FI, 2 years

- Splenic torsion
- Rupture of the gastrosplenic ligament
- Pyloric entrapment

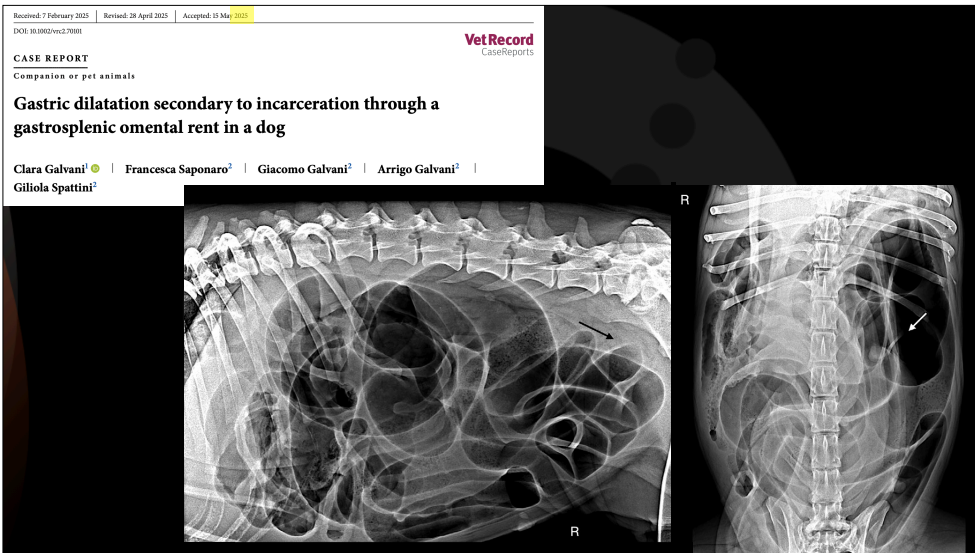


Plan of visceral and connecting peritoneum, ventral aspect.  
Miller's Anatomy of the Dog, 4th ed., H. Evans, A. de Lahunta,  
2013 WB Saunders.

## Missy, Dogue de Bordeaux, FI, 2 years

### Conclusions:

- Splenectomy and omental repair
- She recovered after surgery



## Olivia, Dogue de Bordeaux, FI, 6 years

- Today She was brought out several time
- Watery diarrhoea
- Vomiting white foam
- Bloating abdomen
- Sent for suspected pancreatitis



Olivia, FI, 6 years



RBC (milioni / $\mu$ L) :	6.27	5.70	8.56	Acantociti:		Elliptociti:	
HGB (g/dL) :	16.4	14.1	21.2	Anisocitosi:	+	Ipcromia:	
HCT (%) :	46.6	39.0	59.2	Agglutinazione:		Macroцити:	
MCV (fL) :	74.3	63.1	72.6	Codociti:		Microцити:	
MCH (pg) :	26.2	21.8	25.4	Cheratociti:		Parassiti eritrocitari:	
MCHC (g/dL) :	35.2	33.3	36.8	Cnizociti:		Policromasia:	
CHCM (g/dL) :		34.3	37.8	Corpi di Heinz:		Punteggature basofile:	
MCHC/CHCM :		0.94	1.01	Corpi di Howell-Jolly:		Rouleaux:	
CH (pg) :		22.0	26.0	Cristalli di Hb:		Schistociti:	
CHDW (pg) :		2.72	3.34	Dacriociti:		Selenociti:	
RDW (%) :	12.5	11.6	14.7	Drepanociti:		Sferociti:	
HDW (g/dL) :		1.63	2.22	Eccentricociti:		Stomatociti:	
NRBC/100 WBC :	0	0	0	Echinociti:	++	Torociti:	
<b>Varie RBC:</b>							
WBC (x 1000 / $\mu$ L) :	9.6	5.45	12.98	Linfociti attivati:			
Conta corr. WBC (x 1000 / $\mu$ L) :		5.45	12.98	Linfociti atipici:			
Mielociti (/ $\mu$ L) :	0	0	0	Neutrofilii tossici:			
Metamielociti (/ $\mu$ L) :	0	0	0	Corpi di Doehle:			
Neutrofilii banda (/ $\mu$ L) :	0	0	286	Schiumosità citopl.:			
Neutrofilii segmentati (/ $\mu$ L) :	8832	3555	9314	Vacuolizzazione citopl.:			
Linfociti (/ $\mu$ L) :	384	1169	3810	Basofilia citopl.:			
Monociti (/ $\mu$ L) :	192	186	798	Granulii tossici:			
Eosinofili (/ $\mu$ L) :	192	104	1164	Neutrofilii giganti:			
Basofili (/ $\mu$ L) :	0	0	106	Macropoliciti:			
Danneggiate (/ $\mu$ L) :	0	0	0				
Indifferenziate (/ $\mu$ L) :	0	0	0				
Altre (/ $\mu$ L) :	0	0	0				
<b>Varie WBC:</b>							
PLT (1000 / $\mu$ L) :	217	176	479	Stima PLT:	ADEG.: <input checked="" type="checkbox"/> INADEG.: <input type="checkbox"/> AUMENT.: <input type="checkbox"/>		
MPV (fL) :	8.5	8.9	15.0	Varie:	Plastrine attivate: <input checked="" type="checkbox"/> Macroplastrine: <input type="checkbox"/>		
PCT (%) :	0.185	0.21	0.52		Plastrine allungate: <input type="checkbox"/> Inclusi piastrinici: <input type="checkbox"/>		
PDW (%) :	11.5	51.8	74.5				

Olivia, FI, 6 years

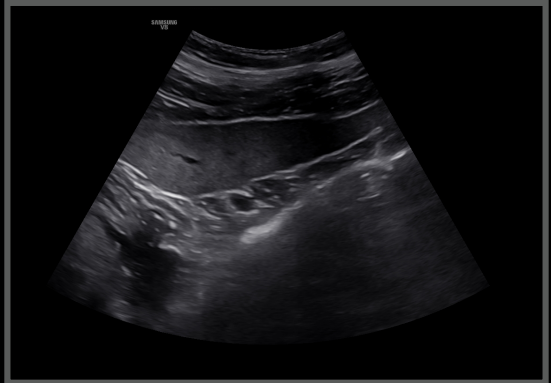
FiO2 (%) :				Billirubina Totale (mg/dL) :	0.21	0.15-0.4
pH:	7.342	7.36	7.49	Proteine Totali (g/dL) :	6.5	5.5-7.5
pCO2 (mmHg) :	42.3	35.0	45.0	Albumine (g/dL) :	3.1	2.7-3.6
pO2 (mmHg) :	48.3	35.1	64.3	Prof. C Reattiva (mg/dL) :	0.60	0.01-0.22
Na+ (mmol/L) :	146.8	135	145	Tempo di tromboplastina parziale attivata - aPTT (sec.) :	13.1	10.2
K+ (mmol/L) :	3.86	3.65	4.7	Tempo di protrombina - PT (sec.) :	9.0	6.8
Ca++ (mmol/L) :	1.32	1.25	1.5	Fibrinogeno (mg/dL) :	161	152
Cl- (mmol/L) :	111.8	110	118	Prodotti di degradazione della fibrina/fibrinogeno - FDPa (pg/mL) :	0.88	<5
Lat (mmol/L) :	0.7	0.5	2.5	D-Dimeri della fibrina (pg/mL) :	0.54	0.01
Hct (%) :	46.0	36	51	Antitrombina (%) :	128	110
HCO3- (mmol/L) :	23.1	17.5	26.4	Note:		
TCO2 (mmol/L) :	24.4	17.5	20			
BEf (mmol/L) :	-2.0	-3	+3			
BEec (mmol/L) :	-2.8	-6.6	+2.7			
SBC (mmol/L) :	22.3					
eO2c (%) :	81.0					
Ca++ (pH 7.4) (mmol/L) :						
Gap Anionico (mmol/L) :	15.7	12	20			
A-aDO2 (mmHg) :	46.2					
Ri:	1.0					
pAO2 (mmHg) :						
paO2 / pAO2:						
pO2 / FIO2:	231.1					
THb (g/dL) :						
O2Hb (%) :						
COHb (%) :						
MetHb (%) :						
RHb (%) :						
eO2m (%) :						
O2ct (Vol%O2) :	17.3					
O2cap (Vol%O2) :	21.1					
Bun (mg/dl) :	15.0	22	35			
Crea (mg/dl) :	1.0	1.0	2.0			
Glu (mg/dl) :	82.0	77	129			
MG++ (mmol/L) :	0.7	0.30	0.60			

Ultrasound to investigate for abdominal pain

Olivia, FI, 6 yrs

Probe position in a different patient

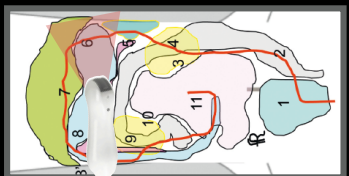
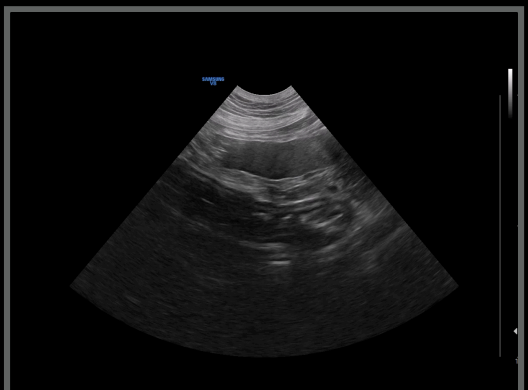
8-6-5



Olivia, FI, 6 yrs

Probe position in a different patient

6

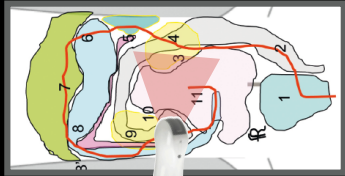
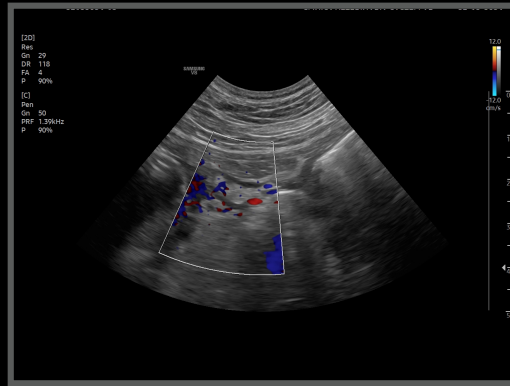


Olivia, FI, 6 yrs



Probe position in a different patient

3-11

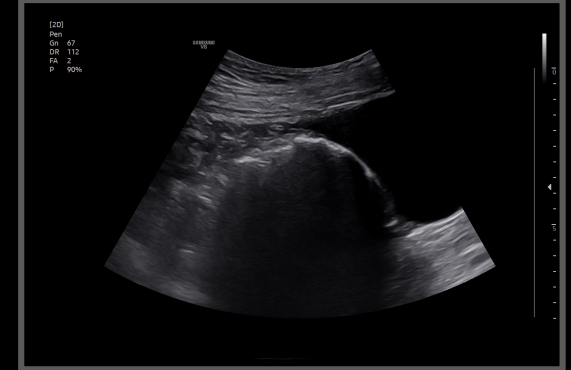


Olivia, FI, 6 yrs



Probe position in a different patient

4-1

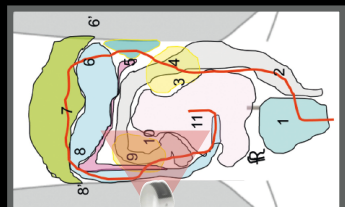


Olivia, FI, 6 yrs



Probe position in a different patient

10-11



Olivia, Dogue de Bordeaux, FI, 6 years

Ultrasonographic diagnoses:

- Write your ultrasonographic report
- What is your most likely differential diagnosis?
- What would you do next?



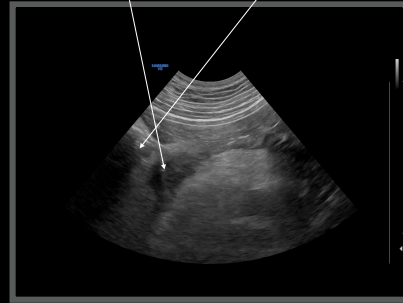
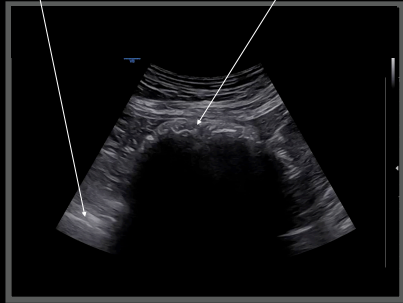
Olivia, Dogue de Bordeaux, FI, 6 years

Scattering artifact

Thickened colonic wall

Scattering artifact  
+ free fluid

Colon



Olivia, FI, 6 years



Olivia, FI, 6 years



Olivia, FI, 6 years



Olivia, Dogue de Bordeaux, FI, 6 years

Radiographic diagnoses:

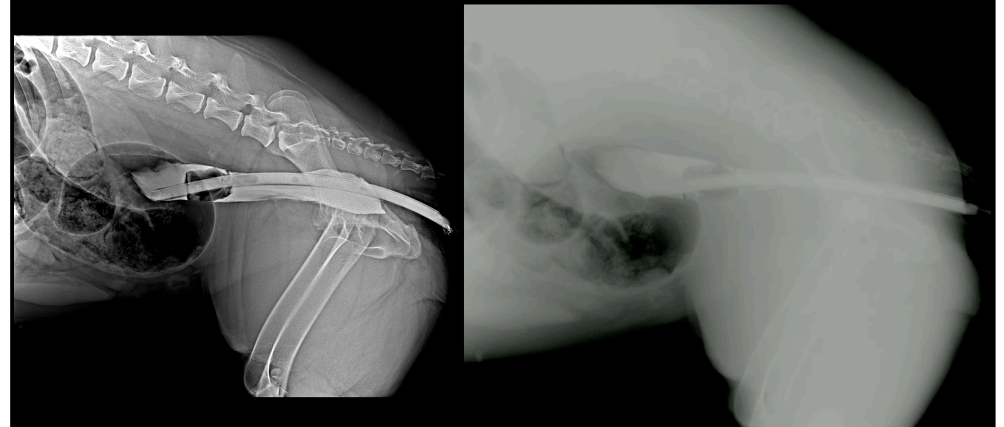
- Write your radiographic report
- What is your most likely differential diagnosis?
- What would you do next?



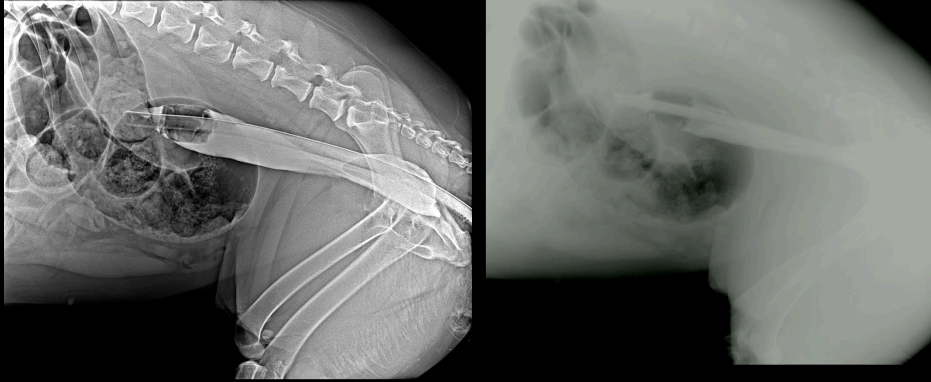
Olivia, FI, 6 years



Positive contrast enema



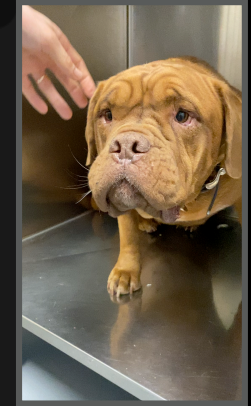
### Positive contrast enema



### Olivia, Dogue de Bordeaux, FI, 6 years

#### Radiographic positive contrast enema conclusions:

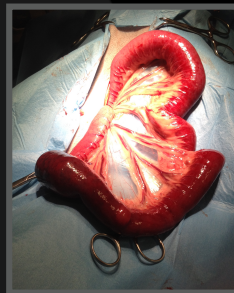
- Descending colon abrupt occlusion
- Cecum and colon displacement
- Confirmed suspicion of a colonic torsion



### Olivia, Dogue de Bordeaux, FI, 6 years

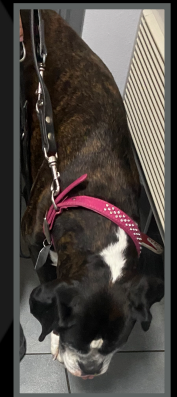
#### Follow up

- Surgery confirmed colonic torsion
- After resolving the torsion, the colon was fine
- Sent to the referring veterinarian the following day



### Fiamma, Boxer, FS, 6 years

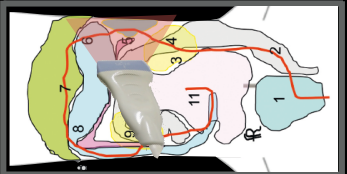
- Lethargic and anorexic since yesterday
- Six months ago amputated left front limb for osteosarcoma
- Three weeks before negative radiographic and ultrasonographic staging





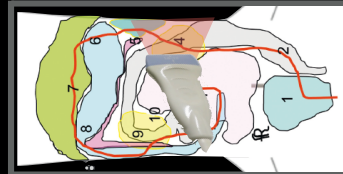
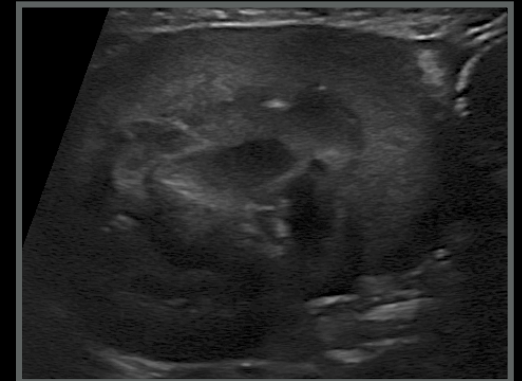
Fiamma, FS, 6 years

6



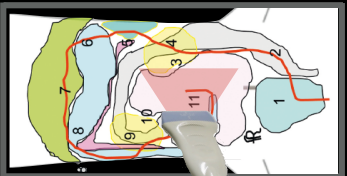
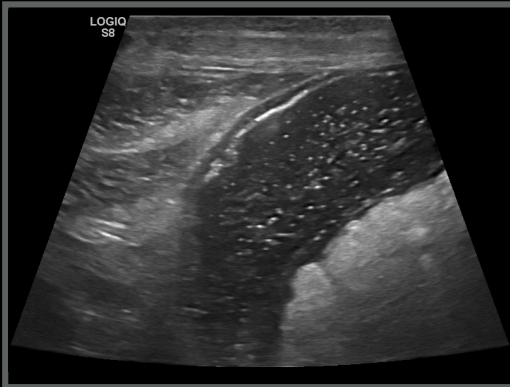
Fiamma, FS, 6 years

4



Fiamma, FS, 6 years

11



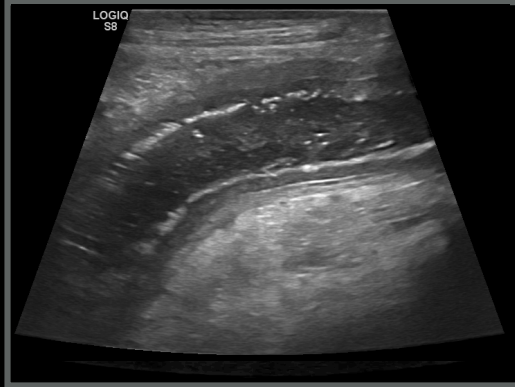
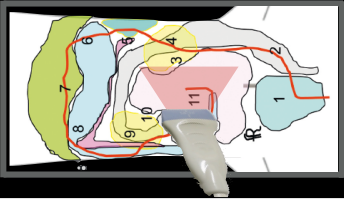
Fiamma, FS, 6 years

11



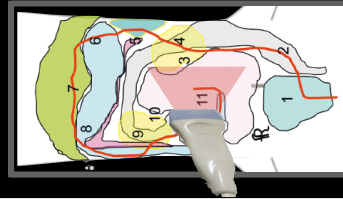
Fiamma, FS, 6 years

11



Fiamma, FS, 6 years

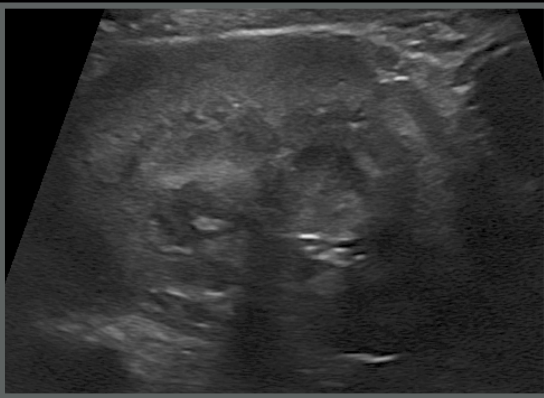
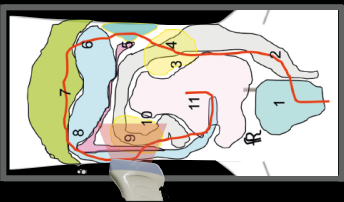
11



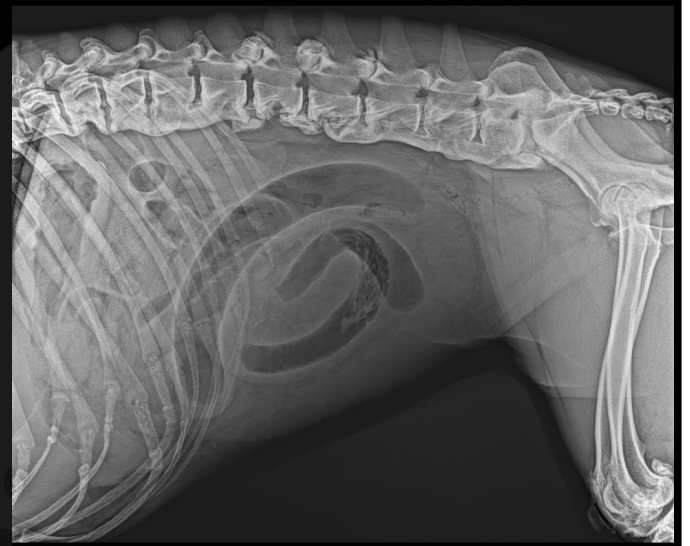
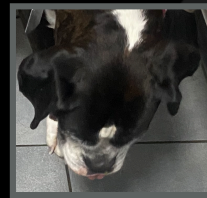
Fiamma, FS, 6 years

9

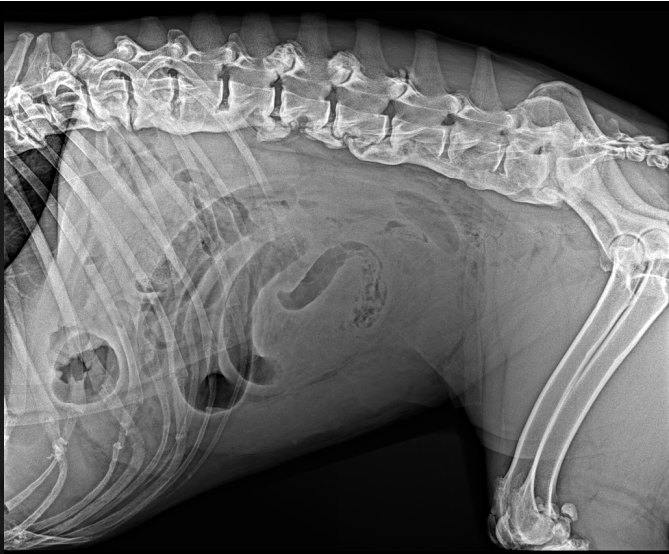
Probe position in a different patient



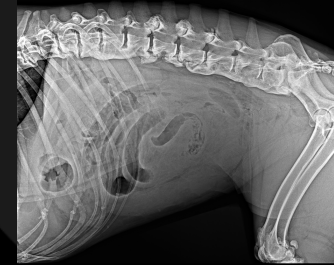
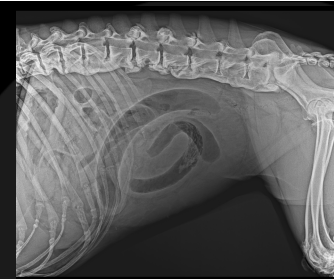
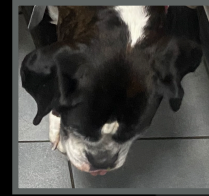
Fiamma, FS, 6 years



Fiamma, FS, 6 years



Fiamma, FS, 6 years



Fiamma, Boxer, FS, 6 years

Radiographic diagnoses:

- Whirlpool sign
- Sentinel loops



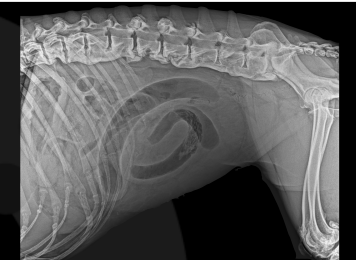
Mesenteric torsion

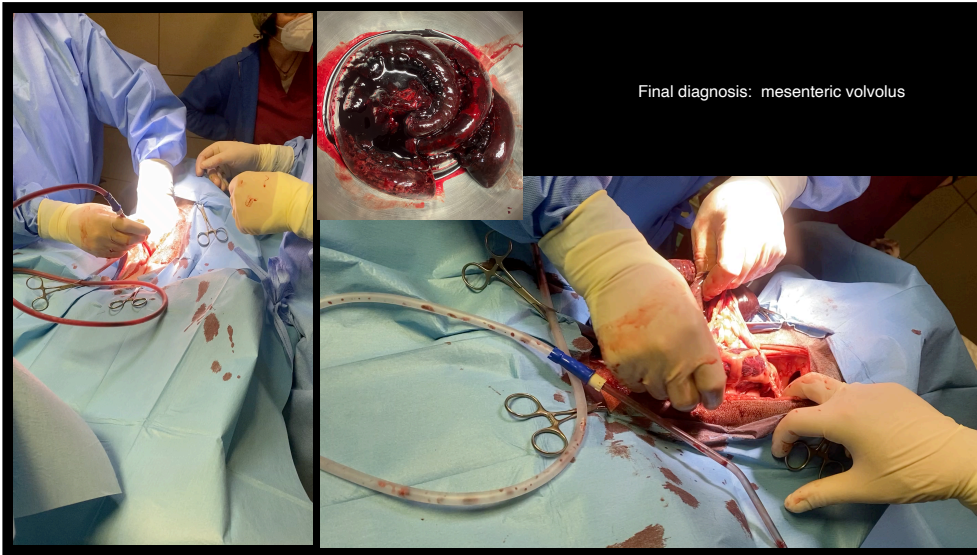
- Whirl sign
- Two populations. of loops
- Lack of peristalsis-necrosis
- Some empty loops

IMAGING DIAGNOSIS—USE OF MULTIPHASIC CONTRAST-ENHANCED COMPUTED TOMOGRAPHY FOR DIAGNOSIS OF MESENTERIC VOLVULUS IN A DOG

KATHLEEN ELLA CHOW, ANDREW WILLIAM STENT, MARIORIE MILNE


*Vet Radiol Ultrasound*, Vol. 55, No. 1, 2014, pp 74–78.





### Conclusions

- Especially in large dogs radiology should be included
- Ultrasound could not be sufficient to define the most likely differential diagnosis



# Thank you



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