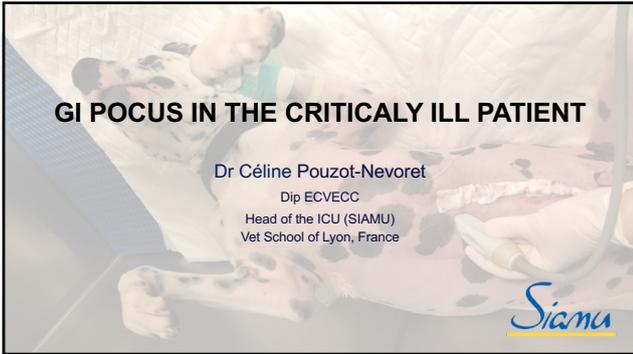


GI POCUS IN THE CRITICALLY ILL PATIENT

Dr Céline Pouzot-Nevoret
Dip ECVECC
Head of the ICU (SIAMU)
Vet School of Lyon, France



Siama

1

Introduction

- Point-of-care ultrasound
- Real time diagnostic modality
- At the patient cage side
- Quick learning curve




2

Rules of POCUS

- Never compromise patient safety
- Always based on your physical examination
- Need to be repeated and adapted
- Not an evaluation of all organs



3

Abdominal POCUS - Technique

Lateral, sternal or standing
(No dorsal recumbency)

No shaving



4

Abdominal POCUS - Technique

5 views

- 1: Sub xyphoid
- 2: Right paralumbar
- 3: Left paralumbar
- 4: Cysto-Colic
- 5: Umbilical



Consider patient positioning and gravitational effects and adjust protocols accordingly

5

Gastro-intestinal POCUS

In the ER

↓

Surgery?

In the ICU

↓

GI motility
Enteral nutrition

6

Snow

- 6 mo MN Husky
- 2 days of anorexia, vomiting
- Hypovolemic shock and abdominal pain
- Palpable tubular structure



7

Snow

- 6 mo MN Husky
- 2 days of anorexia, vomiting
- ...Friday night
- Hypovolemic shock and abdominal pain
- Palpable tubular structure

- Stabilisation
 - Fluids
 - Pain medication
- Blood test
 - PCV 55%, TS 67g/L
 - BG 122mg/dL, Lact 3.5mmol/L
 - pH 7.5, HCO3- 31mmol/L, pCO2 47mmHg, BE +5mmol/L
- Abdominal X-Ray
 - No radio-opac foreign body

8

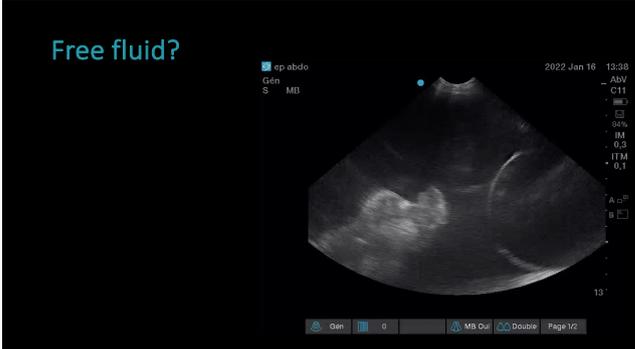
Binary questions for GI emergencies

- Free fluid?
- Free air?
- GI obstruction?



9

Free fluid?



10

Free fluid?



11

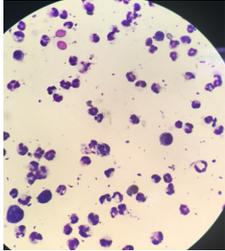
Hyperechoic fluid



12

What will make you decide to go to surgery?

- Exudate
 - Nucleated cells > 7000/ μ L
 - TP > 30 g/L
- Low glucose/high lactate in effusion
- Septic peritonitis
- Increase fluid quantity



13

Binary questions for GI emergencies

- Free fluid?
- Free air?
- GI obstruction?

Associated with surgical condition



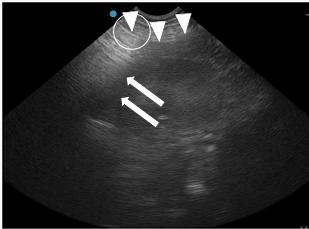
ULTRASONOGRAPHIC FINDINGS IN DOGS AND CATS WITH GASTROINTESTINAL PERFORATION

SIMON R. BOYER, DVM, AUSTIN S. TOWELL, DVM, DANIELLE G. PINSACK, DVM, DVMC

14

Free air

- Steps
 - Remember: air will go up
 - Identify peritoneal lining
 - Look for enhanced peritoneal stripe sign
 - Look for reverberation artefacts
 - Originate at the peritoneal lining
 - Extend distally
 - Obliterates normally visible structures



Journal of Veterinary Internal Medicine
Volume 47, Number 5, October 2015
DOI: 10.1177/0898010115584288
Copyright © 2015 American College of Veterinary Internal Medicine

Veterinary Science

Original Article
Accuracy of sonographic diagnosis of pneumoperitoneum using the enhanced peritoneal stripe sign in healthy dogs
Song Yoon Kim, Ki Tae Park, Song Chan Yoon, Hye Chon Lee*

15



pneumo abdo 2022 Mar 09 07:19

Gén AbV
S MB C11

60%
IM 0,3
ITM 0,1

A 0,0
B

11

Gén 0 MB Out Double Page 1/2

16



pa 2023 Avr 20 06:44

Gén AbV
S MB C11

3%
IM 0,4
ITM 0,2

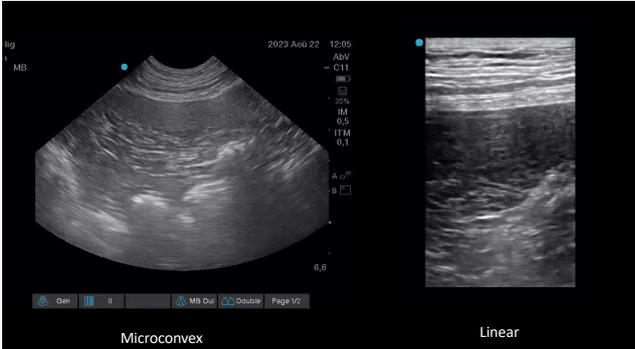
A 0,0
B

5,2

Major pitfall:
Intestinal gas

Gén 0 MB Out Double Page 1/2

17



lig 2023 Août 22 12:05

AbV
C11

3%
IM 0,5
ITM 0,1

A 0,0
B

6,6

Microconvex Linear

Gén 0 MB Out Double Page 1/2

18

Binary questions

- Free fluid?
- Free air?
- GI obstruction?



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GI obstruction

- Indirect findings



20



21

GI obstruction

- Indirect findings
 - Absence of luminal content progression
 - Segmental luminal distension by fluid
 - Non uniform peristalsis
 - Dilated stomach



J Small Anim Pract. 2011 Sep;52(9):486-90. doi: 10.1111/j.1748-6822.2011.01704.x.
 Ultrasonography of small intestinal obstructions: a contemporary approach
 D A A Garcia 1, T R Fries, R S D C Viare, S D Guarnis, A Obden
 Read Full Article | Viewpoint
 Overview of point-of-care ultrasound in diagnosing intestinal obstruction
 Read Full Article | Viewpoint

22



23

GI obstruction

- Indirect findings
 - Absence of luminal content progression
 - Segmental luminal distension by fluid
 - Non uniform peristalsis
 - Dilated stomach

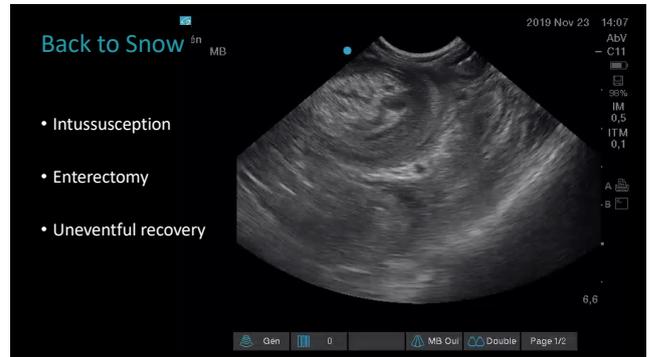
Not always associated with obstruction!

J Small Anim Pract. 2011 Sep;52(9):486-90. doi: 10.1111/j.1748-6822.2011.01704.x.
 Ultrasonography of small intestinal obstructions: a contemporary approach
 D A A Garcia 1, T R Fries, R S D C Viare, S D Guarnis, A Obden
 Read Full Article | Viewpoint
 Overview of point-of-care ultrasound in diagnosing intestinal obstruction
 Read Full Article | Viewpoint

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- Intussusception
- Enterectomy
- Uneventful recovery

The next day...

- Hemodynamically stable
- Still anorexic
- No borborygmi
- Nauseous and abdominal pain



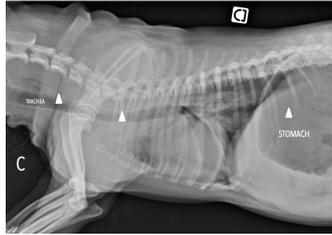
NGT placement

GI motility

27

NG tube placement

- Control good position with Xray
- Move unstable patient
- Discontinue therapy
- Time/person consuming
- Radiation - Cost



28



29

NG tube placement

- In human medicine
 - Se 93% to 100%, Sp 97 to 100%
 - POCUS faster than X-Ray
- Training
- In vet patients?



30

NG tube placement

Verifying the placement and length of feeding tubes in canine and feline neonates

Fig. 2 a Ultrasonography sagittal scanhead position. b Ultrasonography transverse scanhead position. c Ultrasound image of the feeding tube entering the gastric cardia (CARDIA US) by ultrasonography. Arrow: tip of the tube entering the cardia. d Tip of the tube deforming the gastric wall in an empty stomach (MAX US) by ultrasonography. Arrow: deformed gastric wall. e Tip of the tube deforming the gastric wall in a full stomach (MAX US) by ultrasonography. Arrow: deformed gastric wall.

31

NG tube placement – dogs

- 52 hospitalized dogs
- 6/52 in the respiratory tract

Point-of-care method	Thoracic radiography		Sensitivity (%) (95% CI)	Specificity (%) (95% CI)	Accuracy (%) (95% CI)
	Correct position (N=45)	Incorrect position (N=6)			
Auscultation	Correct position	38	84.4 (70.5–93.5)	50.0 (11.8–88.2)	80.4 (66.9–90.2)
	Incorrect position	7			
Ultrasound	Correct position	43	95.6 (84.9–99.5)	83.3 (53.9–99.6)	94.1 (83.8–98.8)
	Incorrect position	2			
Capnography	Correct position	41	91.1 (78.8–97.5)	33.3 (4.3–77.7)	84.3 (71.4–93.0)
	Incorrect position	4			
Aspiration and pH	Correct position	10	22.2 (11.2–37.1)	100 (54.1–100)	31.4 (19.1–45.9)
	Incorrect position	35			

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NG tube placement – cats

- 25 hospitalized cats, 12 NO and 13 NG tubes
- Esophagus and stomach views

ESOPHAGUS		Agreement	CI 95%
Longitudinal plane vs Radiography of the esophagus	Longitudinal plane	100%	(86–100)
	Transverse plane	96%	(88–100)
	Bubble contrast	92%	(81–100)

STOMACH		Cohen's kappa	CI 95%
Stomach plane vs Radiography of the stomach	Stomach plane	0.76	(0.49–1)
	Bubble contrast	0.26	(–0.1–0.64)

CI, confidence interval.

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In practice

Picture Dr Nectoux

Sternal or right lateral recumbency

Linear probe
Transverse view of the esophagus

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In practice

Picture Dr Nectoux

Sternal or right lateral recumbency

Linear probe
Longitudinal view of the esophagus

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In practice

Picture Dr Nectoux

Insufflation 15mL air

Sternal or right lateral recumbency

Microconvex probe
Subxiphoid view - Stomach

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POCUS for NG tube placement

- Advantages
 - No need to move unstable patient
 - No need to discontinue therapy
 - No Radiation
 - Fast to perform
- Esophagus and stomach
- Limitations



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Snow

- NG tube in place
- Gastric residual volume: 150 ml

GI motility?



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GI dysmotility disorders

- Frequent during hospitalisation
- Several risk factors
 - Stress
 - Pain
 - Drugs
 - Recumbency
 - Abdominal surgery
- Complications
 - Aspiration pneumonia?
 - Pain
 - Enteral feeding intolerance

Review | J Vet Emerg Crit Care (San Antonio). 2016 Mar-Apr;26(2):234-53. doi: 10.1111/vec.12449. Epub 2016 Jan 28.

Gastrointestinal dysmotility disorders in critically ill dogs and cats
 KimM Whitehead¹, Yonaira Cortes¹, Laura Elmans²

39

Gastric POCUS - Human

- Estimation of gastric volume and motility
 - Before anaesthesia
 - In pregnant women
 - For evaluation of prokinetics efficacy
 - To be continued...

Association Between Gastric Antral Cross-sectional Area and Postoperative Nausea and Vomiting in Patients Undergoing Laparoscopic Cholecystectomy. Wang K, He J, He Z, Guo Z, Li J, Guo W. J Coll Physicians Surg Pak. 2023 Mar;33(3):249-253. doi: 10.29271/jcpssp.2023.03.249. PMID: 36945151

Their Clin Risk Manag. 2023 Aug;13:685-698. doi: 10.2471/TCM.642685. eCollection 2023. Epub 2023 May 2.

Ultrasongraphic Assessment of Gastric Volume in Fasted Patients Undergoing Gastrointestinal Endoscopy Under Sedation
 Hong-Bong¹, Hoon-Che², Myung-Gun³, Chikang-Wang⁴, Hui-Zou⁵, Binan-Wang⁶, Chikang-Wang⁷, Sook-Hee⁸

J Indian Assoc Pediatr Surg. 2023 May;48(5):227-232. doi: 10.4755/iasps.2023.28.5.20230502.

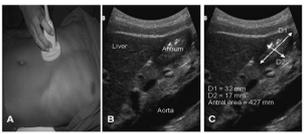
Assessment of Gastric Residual Volume with Ultrasound in Children at Fasting and after Oral Intake of Carbohydrate-Rich Fluid in the Preoperative Period
 Katarin Kurnia Gory¹, Aeri Sigitari², Purwati Dwi³, Vira Lita⁴, Raghunandan Prasad⁵, Sanyal Dinesh⁶, Sankar Chandra Pant⁷, Anuja La⁸

Ultrasonic evaluation of metoclopramide's effect on gastric motility in emergency trauma patients. Shi H, He J, Guo Z, Li J, Guo W, Li XZ, Huang QW. Front Physiol. 2023 May;10:14999736. doi: 10.3389/fphys.2023.999736. eCollection 2023. PMID: 37234409 Free PMC article.

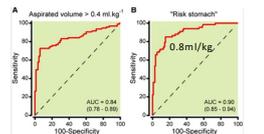
40

Gastric POCUS

Clinical Assessment of the Ultrasonographic Measurement of Antral Area for Estimating Preoperative Gastric Content and Volume
 Bouvet L et al. 2011 Anesthesiology



Antral CSA = ((CC × AP) × π) / 4, with π value = 3.14.



Does ultrasonographic assessment of gastric antrum correlate with gastric residual volume in critically ill patients? A prospective observational study. Gauthier Toubin¹, Hubert Kauf², Laurent Vermeire³. 2021 J Clin Mon and Comp. doi: 10.1007/s00135-021-00221-2

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Gastric POCUS

Gastric UltraSound
 www.gastricultrasound.org

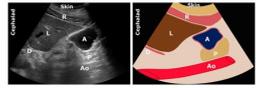
1. SCANNING TECHNIQUE



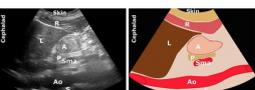
4.1 EMPTY STOMACH



4.4 CLEAR FLUID



4.3 SOLID LATE STAGE



A: anterior, Ao: aorta, D: diaphragm, L: liver, P: pancreas, R: rectus abdominis muscle, S: spleen, St: superior mesenteric artery.

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Gastric volume assessment

Height (cm)	20	30	40	50	60	70	80
1	31	18	5	0	0	0	0
2	45	32	20	7	0	0	0
3	60	47	34	21	9	0	0
4	74	62	49	36	23	10	0
5	89	76	63	51	38	25	12
6	103	91	78	65	52	40	27
7	118	105	93	80	67	54	41
8	133	120	107	94	82	69	56
9	147	135	122	109	96	83	71
10	162	149	136	123	111	96	86
11	177	164	151	138	125	113	100
12	192	178	165	153	140	127	114
13	206	193	180	167	155	142	129
14	220	207	194	182	169	156	143
15	235	222	209	200	184	171	158
16	249	236	224	211	196	185	173
17	264	251	239	226	213	200	187
18	278	266	255	240	227	214	202
19	293	282	268	255	242	229	217
20	307	295	282	269	256	244	231
21	315	302	297	284	271	253	246
22	327	314	311	298	285	275	260
23	332	319	316	303	290	280	275
24	346	335	330	317	305	295	289
25	361	348	345	343	330	317	304
26	375	362	369	357	344	331	318
27	400	397	385	372	359	346	333
28	414	411	398	386	373	360	347
29	429	427	414	401	388	375	363

Gastric UltraSound
A Point-of-care tool for aspiration risk assessment

ANTRAL GRADING SYSTEM (GRADES 0 - 2)

GRADE	ANTRAL PRESENTATION	VOLUME IMPLICATIONS	ASPIRATION RISK
0	Empty in both supine and RLO position	Minimal	Low risk
1	Empty in supine, clear fluid visible in the RLO	< 1.5 mL/kg, compatible with baseline gastric secretions	Low risk
2	Clear fluid visible in both positions	> 1.5 mL/kg, likely in excess of baseline gastric secretions	High risk



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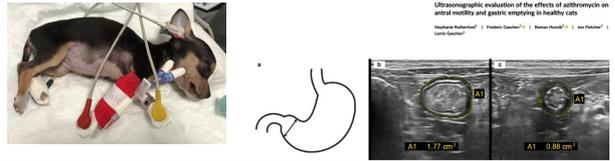
Gastric POCUS in vet patients?

Prospective study
The effect of fasting on gastrointestinal motility in healthy dogs as assessed by sonography

Journal of Veterinary Internal Medicine
Validation of Ultrasonography for Assessment of Gastric Emptying Time in Healthy Cats by Radionuclide Scintigraphy

Journal of Veterinary Internal Medicine
Ultrasonographic assessment of the effect of metoclopramide, erythromycin, and cerenone on solid-phase gastric emptying in healthy cats

Journal of Veterinary Internal Medicine
Ultrasonographic evaluation of the effects of asthromycin on antral motility and gastric emptying in healthy cats



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Direct evaluation of contraction

4-5 contractions/min

Subxiphoid

Prospective study
The effect of fasting on gastrointestinal motility in healthy dogs as assessed by sonography



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Gastric ultrasound

Prospective study
October 2021 - December 2023

Inclusion criteria
Dogs with nasogastric tube confirmed by radiographs

Admission & NG → *Before aspiration → *After aspiration GRV → *After alimentation

Point-of-care ultrasound of gastric antrum to estimate gastric content and volume in critically ill dogs



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Results

- Excellent inter/intra-observer reliability
- Validation of a mathematical model
 - Gastric volume = 22 x log (antral area, cm²) + 2.29 x body weight (kg) - 1

To BE CONTINUED...

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49



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Clinical utility *Why do we care?*

- Guide your prokinetic treatment
- Assess feeding tolerance
- GRV evaluation without NG tube placement
- Gastric lavage in intoxication
- Gastric emptying before ultrasonography



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Take home message

- GI POCUS useful both in emergency and ICU settings
- Can be used for
 - Diagnosis of free fluid, free air, GI motricity/obstruction
 - Feeding tube placement verification
 - Evaluation of GRV and GI motricity
- Based on your physical examination
- Limitations

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Thank you for your attention

- Special thank you to
 - Dr Alexandra Nectoux
 - Dr Soren Boysen



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