VetAgro Sup
Campus Vétérinaire de Lyon

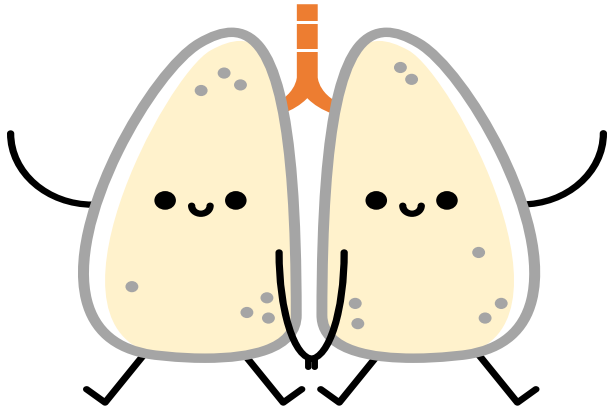
Siamu

Aspiration pneumonia

Céline Pouzot-Nevoret

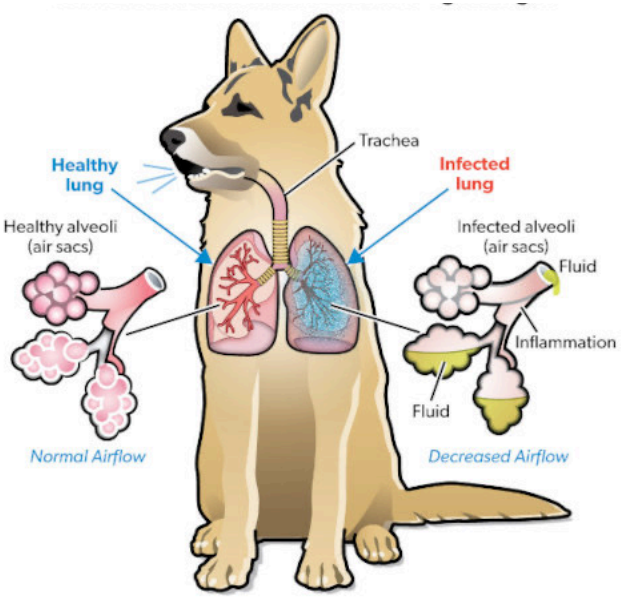
Professor, Dip ECVECC

SIAMU - LYON - FRANCE



Introduction

- Refers to the inhalation of gastric or oropharyngeal contents into the respiratory tract beyond the larynx
- Important cause of morbidity in both emergency and ICU settings
- Dogs > Cats



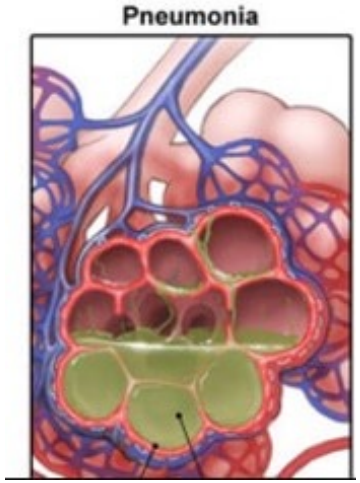
https://www.handicappedpets.com/

Definitions

- Aspiration pneumonitis
  - Injuries caused by inhalation of chemical irritant
  - Mainly gastric content

- Aspiration pneumonia
  - Pulmonary bacterial infection that develops following aspiration

- Clinical presentation can be similar



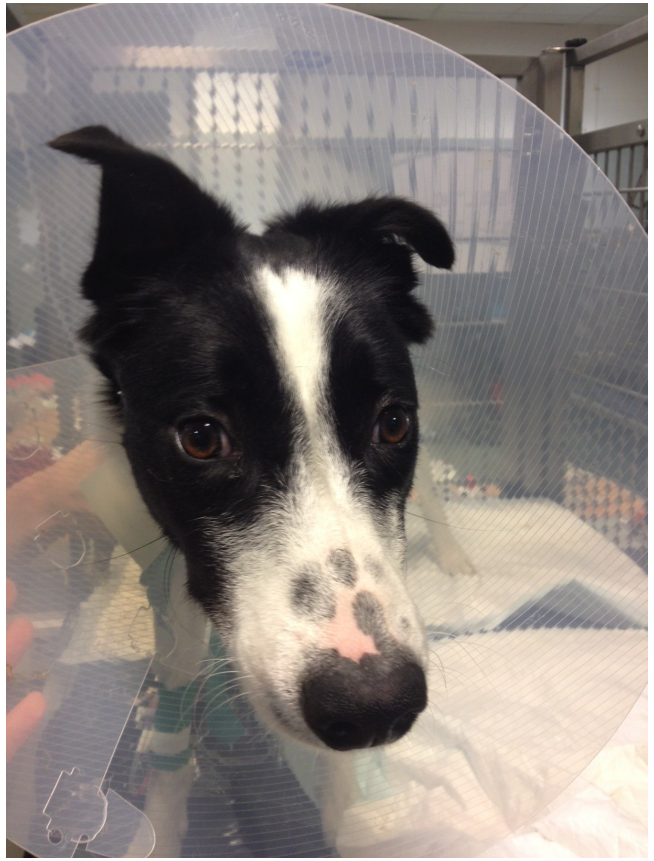
Risks factors

- **Impaired airway protection**
  - Sedation/Anesthesia
  - Altered mentation/Seizures
  - Laryngeal/Pharyngeal dysfunction
  - Mechanical ventilation
- **Impaired esophageal function**
  - Megaesophagus
  - Esophageal foreign body
- **Breed predisposition**
  - Brachycephalic
- **Increased intragastric volumes**
  - Delayed gastric emptying

Kogan 2008, Sherman 2017, Wilson 2016, Levi 2019

Clinical signs

- Associated with the underlying condition
  - Vomiting/regurgitation
  - Neurological signs
  - Upper airway respiratory signs
  - …
- Wide range of respiratory signs



Clinical signs

Clinical signs

Diagnosis approach

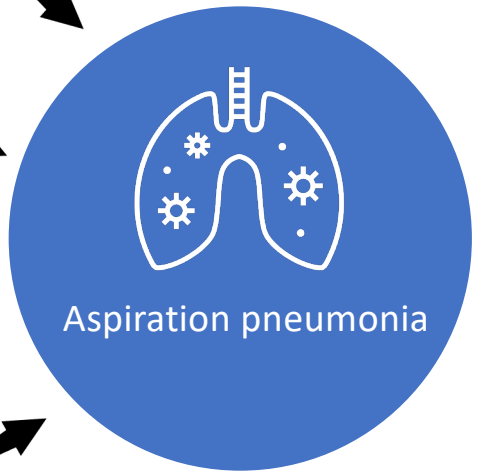
Diagnosis approach

Clinical signs related to the underlying condition

Clinical signs related to respiratory tract

Signalment

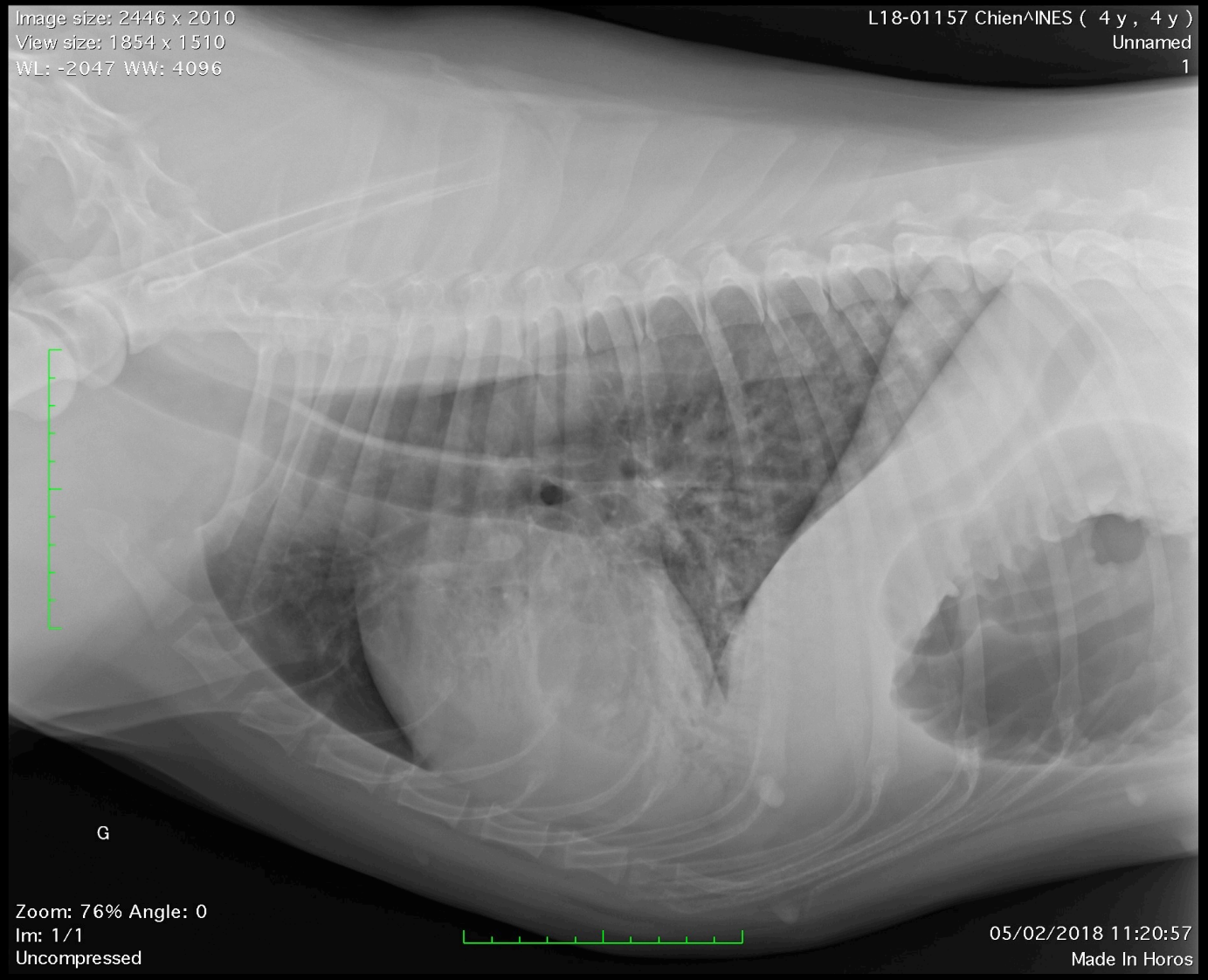
History



Additional tests

Radiographs

Kogan JAVM 2008 , Levy et al. JSAP 2019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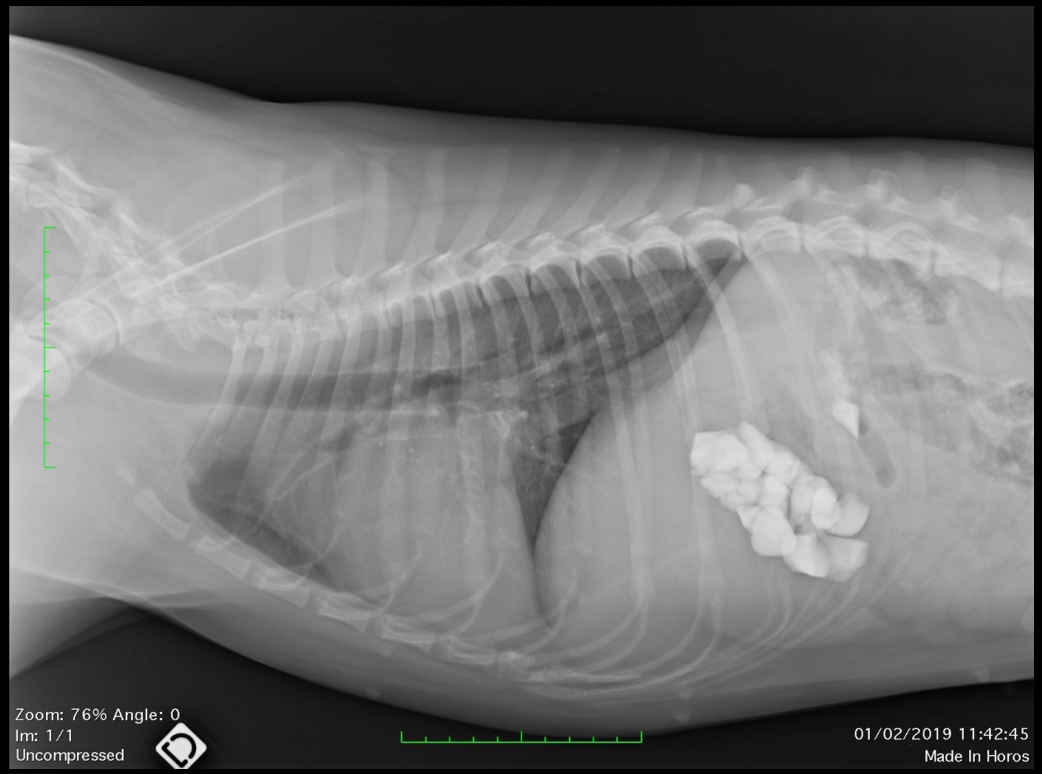
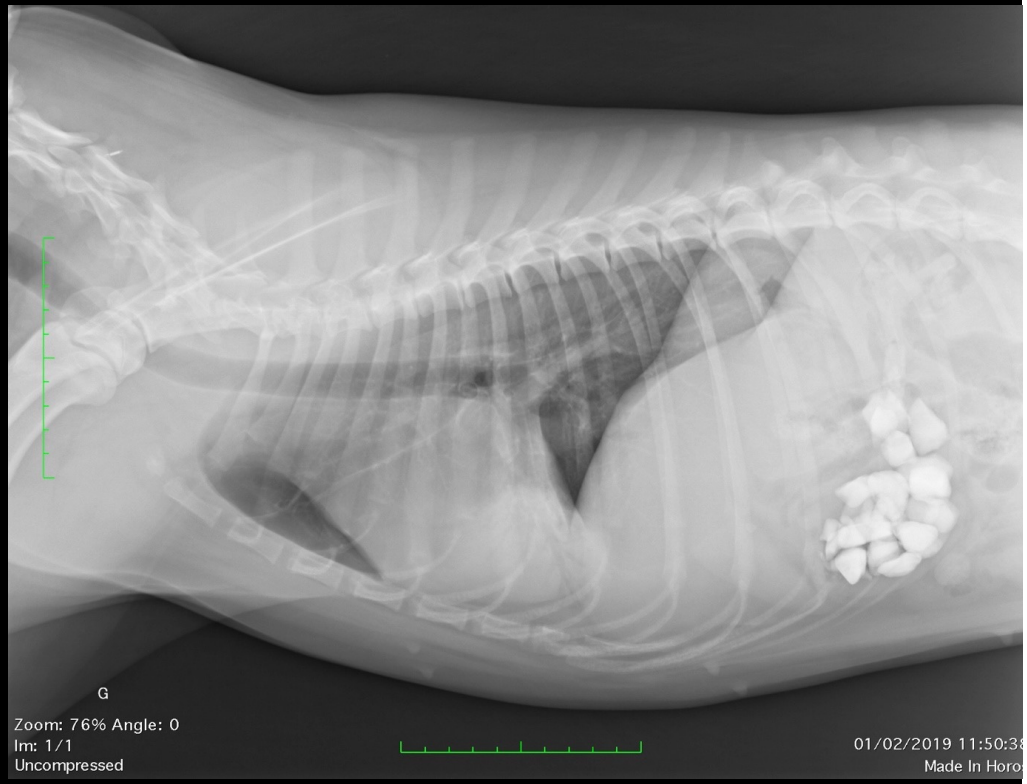
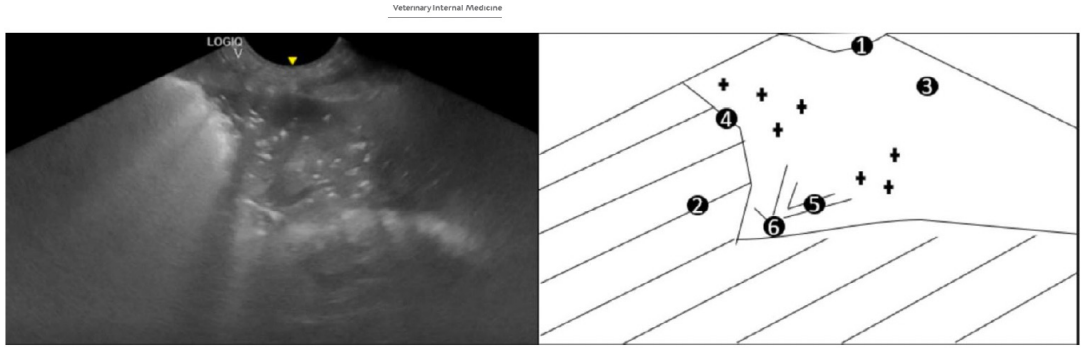




Only in stabilized patient!

POCUS

- B-Lines
- Shred sign
- Air and/or fluid bronchogramme
- Tissu sign



Received: 31 January 2021 | Accepted: 21 January 2022
DOI: 10.1111/jvim.16379
STANDARD ARTICLE
Journal of Veterinary Internal Medicine Open Access ACVIM American College of Veterinary Internal Medicine

Comparison of lung ultrasound, chest radiographs, C-reactive protein, and clinical findings in dogs treated for aspiration pneumonia

Nina Fernandes Rodrigues[1] | Léna Giraud[1] | Géraldine Bolen[1] | Aline Fastrès[1] | Cécile Clercx[1] | Søren Boysen[2] | Frédéric Billen[1] | Kris Gommeren[1]

- Ventral
- Right > Left

A retrospective study on parapneumonic effusion in 130 dogs with a clinical diagnosis of pneumonia

Frontiers 2024

Priscilla Burnotte*, Nicolas Graziano and Kris Gommeren

- Parapneumonic effusion (34%)

POCUS

Received: 31 January 2021 | Accepted: 21 January 2022
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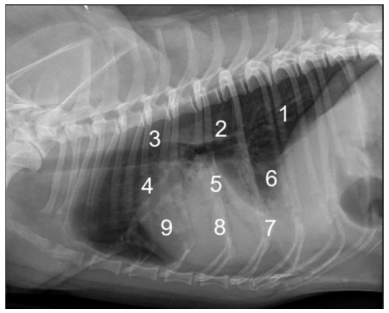
Score 1
1 to 3 B-lines

Score 2
> 3 B-lines

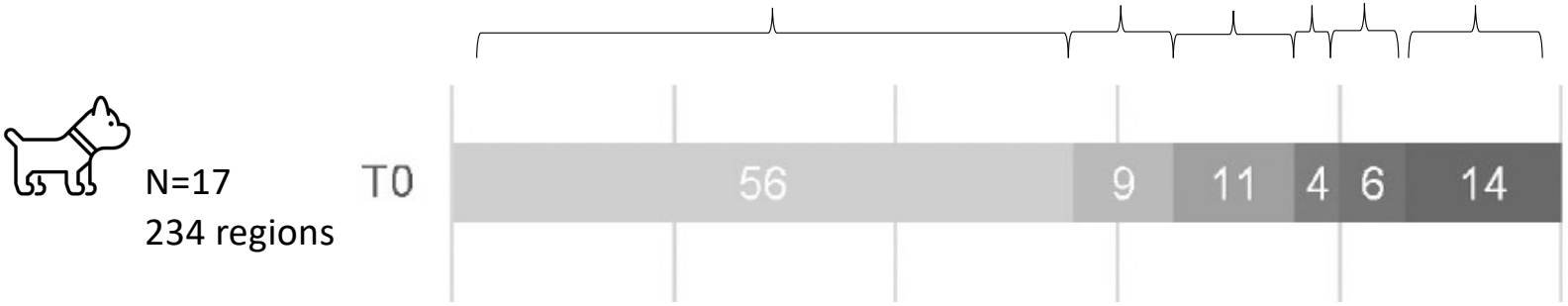
Score 3
Coalescent B-lines

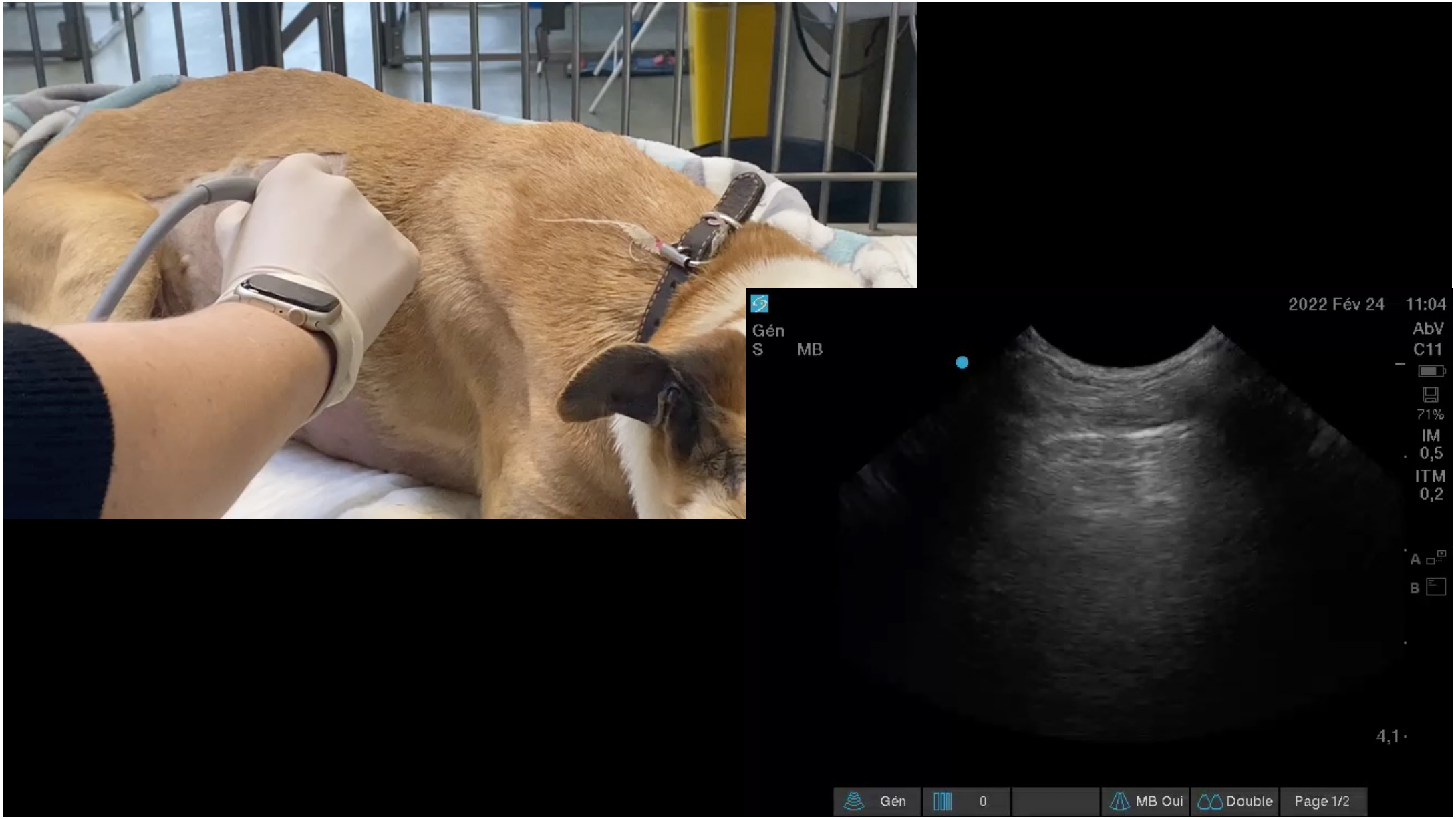
Score 4
Shred



Score 5
Shred + Air and/or fluid bronchogram

Score 6
Tissue sign

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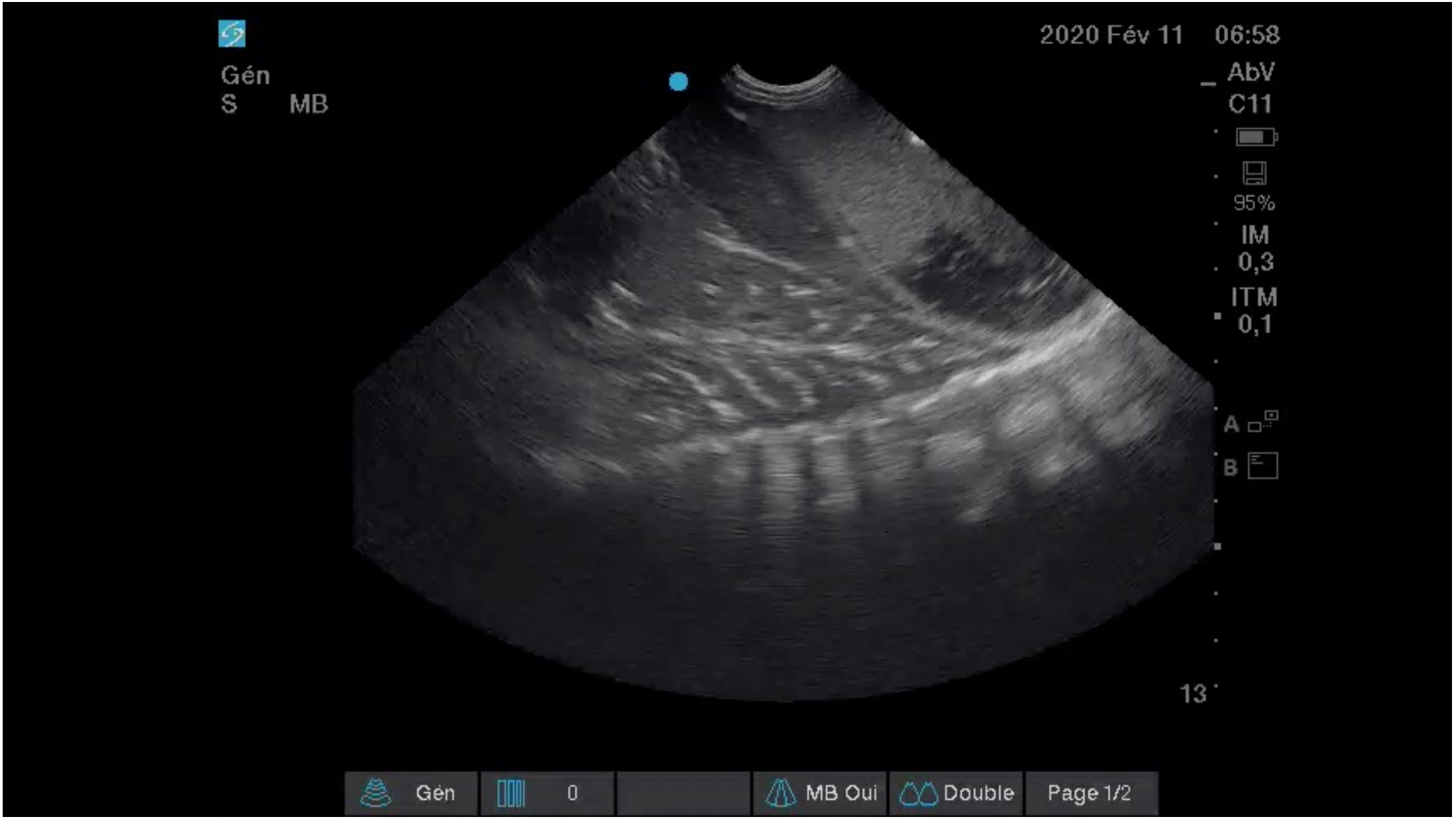
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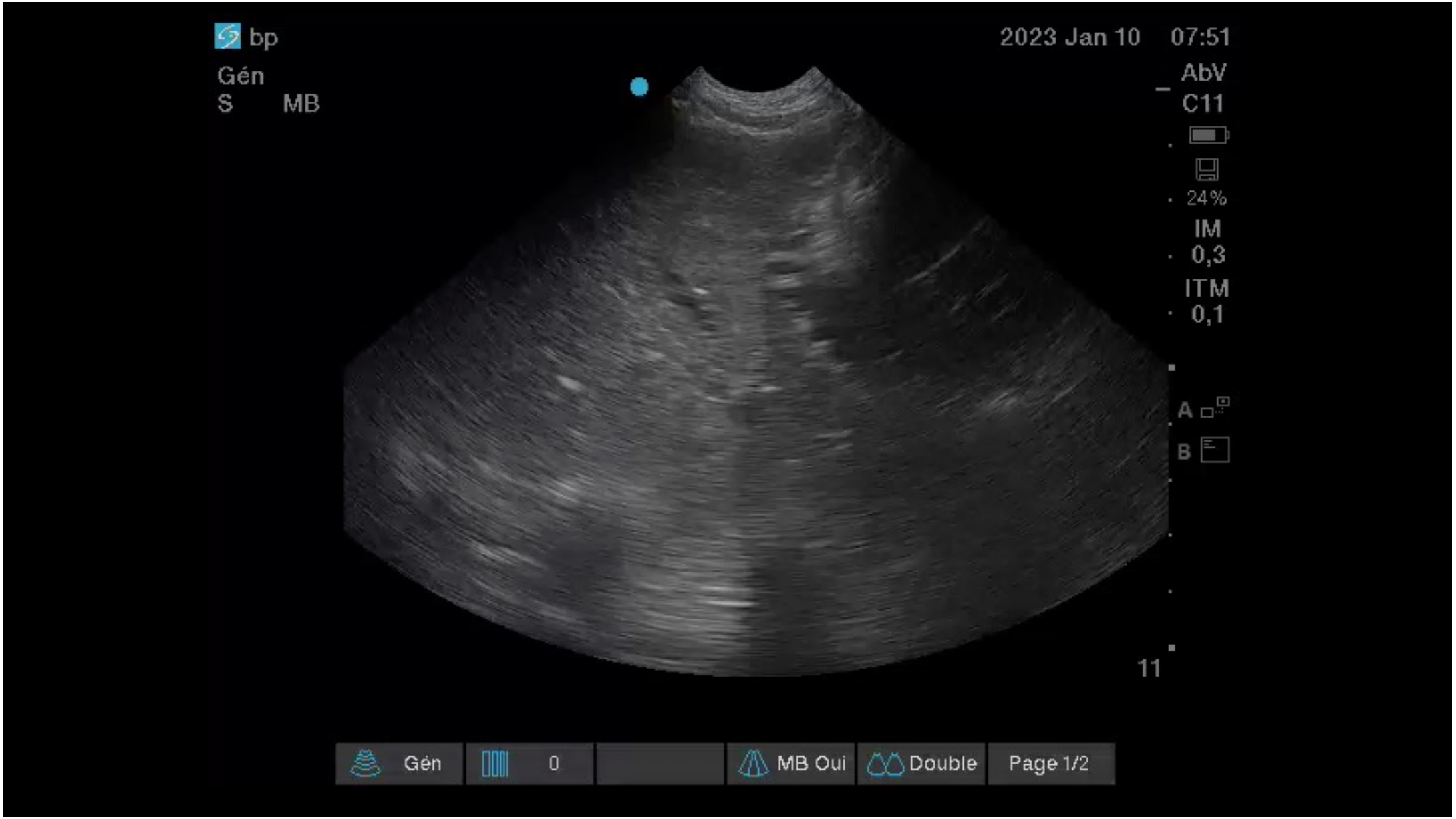
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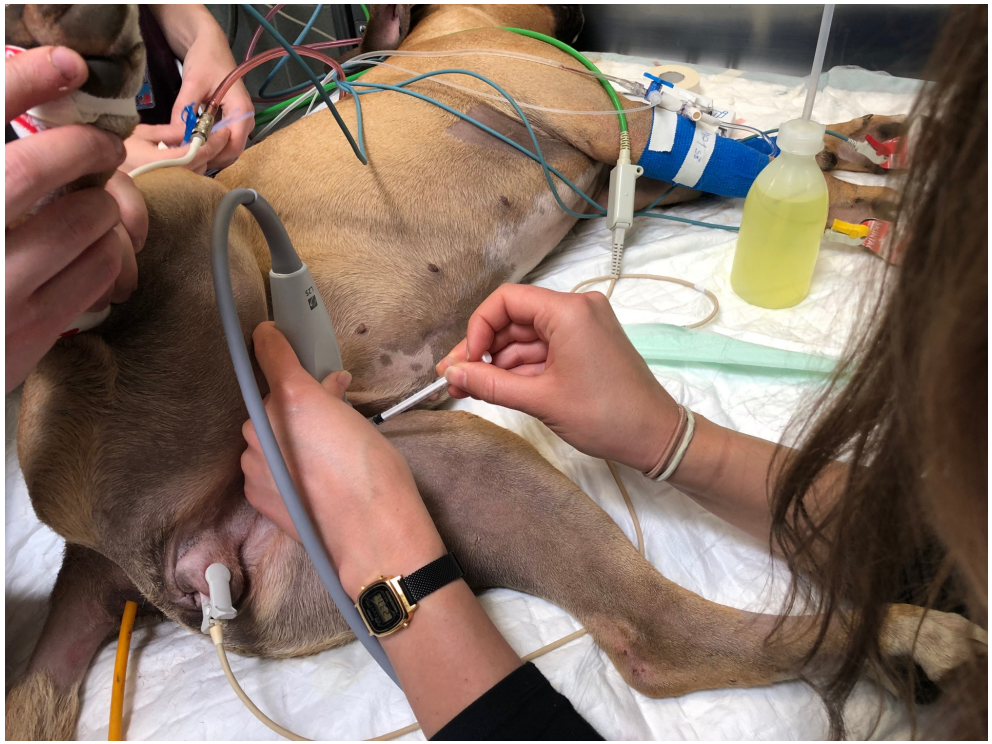
Blood tests

- CBC/biochemistry nonspecific
  - Leukocytosis/penia
  - Left shift
  - Hypoalbuminemia
  - Interesting for associated disease
- Arterial blood gas
- Specific biomarkers



Arterial blood gas

- Hypoxemia
  - V/Q mismatch
  - Intrapulmonary shunting
  - Impaired diffusion

- No major impact on $PaCO_2$

- **Low PaO_2**
- **Increased A-a Gradient**
- **Some case: limited oxygen responsiveness**

Study Group	pH	$PaCO_2$ mm Hg	PaO_2 mm Hg	HCO_3 mm/L	TCO_2 mm/L	Base Excess mm/L	Hgb Sat %	A-a Gradient
Normal 46	7.393 SD* = 0.038	29.937 SD = 3.862	77.154 SD= 6.841	17.628 SD = 2.173	18.443 SD = 2.253	-5.037 SD = 2.382	92.650 SD = 1.637	9.949 SD = 2.382
Pneumonia 62	7.394 SD = 0.083	28.769 SD = 7.422	61.389 SD = 12.211 **P<0.001**	17.487 SD = 6.389	18.558 SD = 8.485	-6.631 SD =. 4.354 **P=0.013**	86.239 SD = 7.452 **P<0.001**	26.802 SD = 16.280 **P<0.001**

Wingfield, JVECC 1997

Biomarkers

Received: 7 October 2021 | Accepted: 4 May 2022
DOI: 10.1111/jvim.16448
STANDARD ARTICLE
Journal of Veterinary Internal Medicine Open Access ACVIM American College of Veterinary Internal Medicine

Serial evaluation of thoracic radiographs and acute phase proteins in dogs with pneumonia

Julie Menard[1] | Ian Porter[2] | Assaf Lerer[2] | Sarah Robbins[2] | Philippa J. Johnson[2] | Robert Goggs[2]

n=19
Prospective

- C-Reactive protein (CRP)
- Serum amyloid A (SAA)
- Haptoglobin

- Significantly increased at admission
- Positively correlated with presence of radiographic abnormalities

CRP

- [CRP] > 100 mg/L
  - 100% specific for bacterial BP (Viitanen 2014)
- [CRP] Aspiration pneumonia (118 mg/L) > [CRP] infectious Bordetella bronchopneumonia (20 mg/L) (Canonne 2000)
- CRP > 9.5 mg/L identified dogs with abnormal thoracic radiographs (*Se 77%, Spe 81% and accuracy 79%*) (Menard 2022)

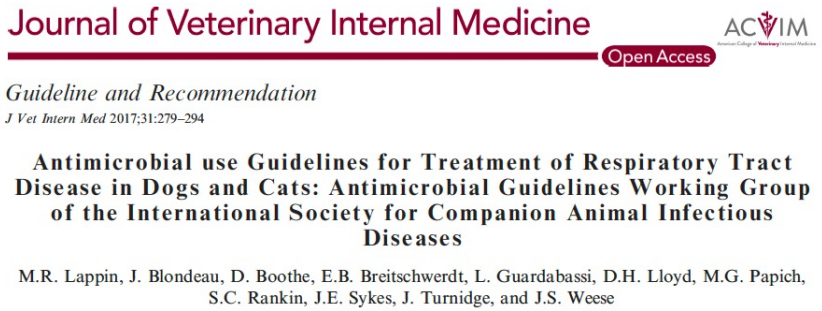
Viitanen et al. JVIM 2013, Canonne et al. JVIM 2000, Fernandes Rodrigues et al. JVIM 2022

Cytology and bacteriology

- BAL, transtracheal lavage, **Lungs FNA**
  - Escherichia coli, Pasteurella spp., Mycoplasma spp., Staphylococcus spp., Pseudomonas aeruginosa, Klebsiella spp. and Bordetella bronchiseptica.

- Often with multiple agents (at least 2)

- Not first line examination



Lappin et al. JVIM 2017

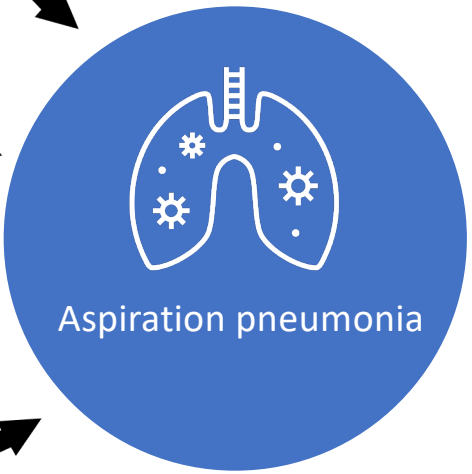
Diagnosis approach

Clinical signs related to the underlying condition

Clinical signs related to respiratory tract

Signalment

History



Additional tests

- POCUS
- Thoracic X Ray if stable
- ABG
- CRP
- BAL if not responsive to treatment

Treatment

Prevention

Initial stabilisation

Antibiotherapy

Respiratory nursing care

Prevention

- Management of underlying factors
- Nursing care
- Gastrokinetics?
- Intubation

Initial stabilization

- Airway management
  - Ensure airway patency
  - Aspiration of gastric content
- Oxygen therapy – Oxygen escalation if needed
  - Objective: SpO2 > 95%
- Fluid therapy if needed

Antibiotics

- **Acutely affected and no signs of sepsis**
  - ß lactamines: Amoxicillin - Clavulanic acid
    - 20-30 mg/kg PO, IV, IM q6-8h
  - Or 1st generation cephalosporine
    - Cephalexine 25 mg/kg PO q12h

- **Acutely affected and signs of sepsis**
  - Add quinolone
  - IV only

All the time?

Successful management of aspiration pneumopathy without antimicrobial agents: 14 dogs (2014-2021)

S. Cook[1], T. Greensmith and K. Humm

- Retrospective study
- 14 dogs, 9/14 with respiratory signs
- Respiratory signs resolved in 12 to 36 hours
- Limitations

- Radiographic changes alone can not be used to determine requirement for antimicrobial

How long?

- Historically
  - 4-6 weeks
  - 2 weeks after normalisation of thoracic X-Rays

- Time of normalization of APPs shorter than radiographic resolution (Menard 2022, Fernandez Rodriguez 2022)

How long?

Journal of Veterinary Internal Medicine
Open Access
ACVIM
Standard Article
J Vet Intern Med 2017;31:124–133

The Utility of Acute-Phase Proteins in the Assessment of Treatment Response in Dogs With Bacterial Pneumonia

S.J. Viitanen, A.K. Lappalainen, M.B. Christensen, S. Sankari, and M.M. Rajamäki

- Prospective longitudinal observational study
- 19 Dogs diagnosed with bronchopneumonia
- Measurement of CRP, SAA and Haptoglobuline

- **Conventional treatment**
  - 3-6 weeks or 2 weeks beyond resolution of alveolar density on TXR
- **CRP guided**
  - discontinued 5–7 days after serum CRP returned to normal (<25 mg/L)

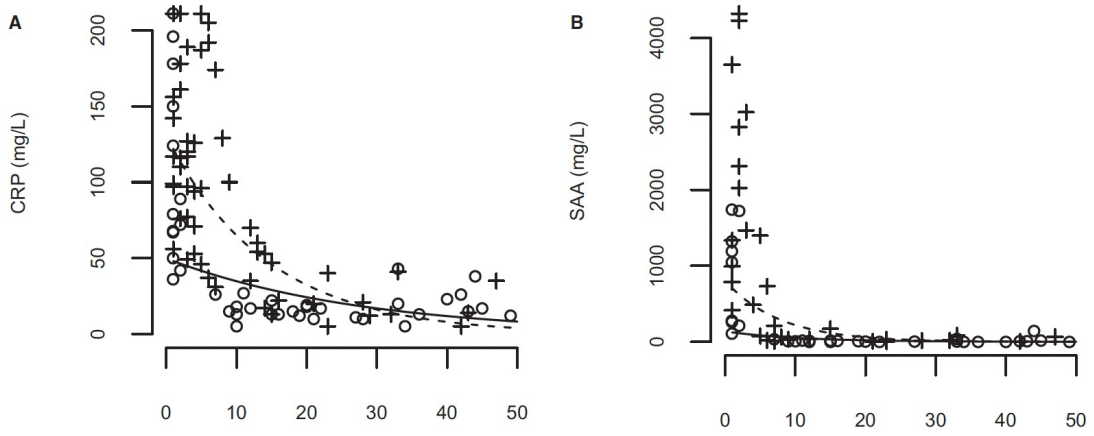
How long?

Journal of Veterinary Internal Medicine
Open Access
ACVIM
Standard Article
J Vet Intern Med 2017;31:124–133

The Utility of Acute-Phase Proteins in the Assessment of Treatment Response in Dogs With Bacterial Pneumonia

S.J. Viitanen, A.K. Lappalainen, M.B. Christensen, S. Sankari, and M.M. Rajamäki

- CRP and SAA rapidly decrease after treatment initiation
  - Useful marker of treatment response
- Treatment guided by CRP significantly < conventional treatment
  - 21 days vs 35 days
- No relapse
- No randomisation



How long?

animals

MDPI

Article

Comparison of Short- versus Long-Course Antimicrobial Therapy of Uncomplicated Bacterial Pneumonia in Dogs: A Double-Blinded, Placebo-Controlled Pilot Study

2021

Aida I. Vientós-Plotts [1], Isabelle Masseau [2] and Carol R. Reinero [1,*]

- Randomized, double-blinded, placebo-controlled
- 8 dogs randomized for 10 vs 21 days of Ab
- Resolution of clinical signs in all dogs regardless Ab therapy duration

How long?

Received: 13 October 2021 | Accepted: 2 March 2022
DOI: 10.1111/jvim.16405
STANDARD ARTICLE
Journal of Veterinary Internal Medicine Open Access ACVIM American College of Veterinary Internal Medicine

Antimicrobial discontinuation in dogs with acute aspiration pneumonia based on clinical improvement and normalization of C-reactive protein concentration

Nina Fernandes Rodrigues | Léna Giraud | Géraldine Bolen | Aline Fastrès | Cécile Clercx | Kris Gommeren | Frédéric Billen

- Prospective observational study
- 17 dogs (14 with AP)
- Discontinuation of Ab based on clinical improvement and CRP normalization

- Stop treatment after 1 week (70%) or 3 weeks (30%)
- No short-term relapse
- Long-term relapses occurred in 3 dogs (17%) after 1, 1.5, and 3 months

How long?

JAVMA AVMA

Clinical course and radiographic resolution of pneumonia in dogs treated with a shorter versus longer course of antimicrobials: a randomized, double-masked, placebo-controlled study

Erica L. Reineke, VMD, DACVECC*; Megan E. McClosky, DVM, DACVIM; Katie D. Mauro, DVM, DACVECC; Adam Schlax, VMD, DACVR; Kathryn M. McGonigle, DVM, DACVIM; Heather Scavello, CVT; Stephen D. Cole, VMD, DACVM; Laurel E. Redding, VMD, PhD, DACVPM

2025

- 30 dogs with radiographic diagnosis of pneumonia
- 2 vs 4 weeks treatment
- No difference

So, How long?

- 7-14 days
- Especially when dogs show significant clinical improvement or resolution at the end of the treatment period
- Guided by APPs (CRP)

Respiratory nursing care

Pulmonary rehab

Aerosol therapy

Pulmonary rehab : Some simple methods

- Walk
- Clean the upper airways
- Sternal position (McMilan 2009)
- Change recumbency (Ten Cate 2024)
- Specially in severe hypoxemia

- Improve expectoration

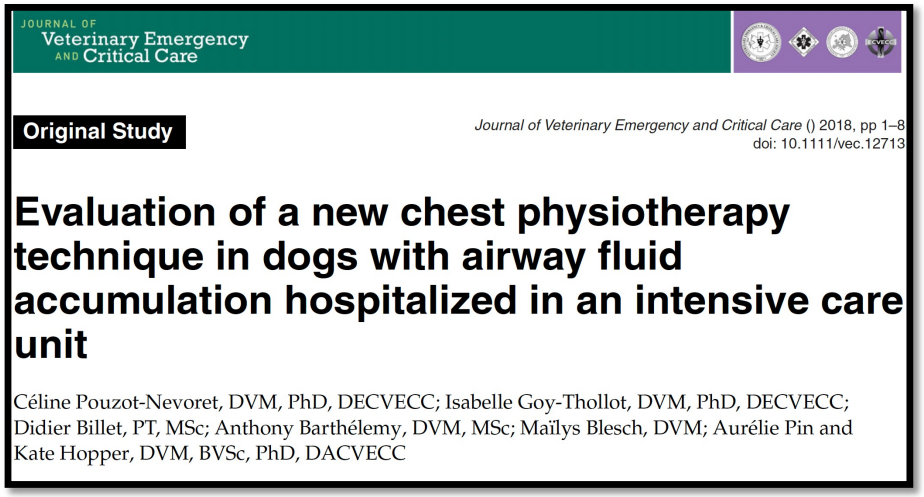
Chest physiotherapy

Objective

Increase expectoration with external measures

Pouzot-Nevoret, JVIM 2020

Prolonged slow expiration + Assisted cough



JOURNAL OF Veterinary Emergency AND Critical Care

Original Study

Journal of Veterinary Emergency and Critical Care () 2018, pp 1–8
doi: 10.1111/vec.12713

Evaluation of a new chest physiotherapy technique in dogs with airway fluid accumulation hospitalized in an intensive care unit

Céline Pouzot-Nevoret, DVM, PhD, DECVECC; Isabelle Goy-Thollot, DVM, PhD, DECVECC; Didier Billet, PT, MSc; Anthony Barthélemy, DVM, MSc; Maïlys Blesch, DVM; Aurélie Pin and Kate Hopper, DVM, BVSc, PhD, DACVECC

Retrospective
30 dogs with PSE (133 sessions)
71 control dogs

Well tolerated
Easily adaptable
No difference in survival

Prolonged slow expiration + Assisted cough

STANDARD ARTICLE

Journal of Veterinary Internal Medicine ACVIM Open Access American College of Veterinary Internal Medicine

Effectiveness of chest physiotherapy using passive slow expiratory techniques in dogs with airway fluid accumulation: A pilot randomized controlled trial

Céline Pouzot-Nevoret[1,2] | Mathieu Magnin[2] | Anthony Barthélemy[1,2] | Isabelle Goy-Thollot[1,2] | Maxime Cambournac[1,2] | Alexandra Nectoux[1,2] | Bernard Allaouchiche[2,3]

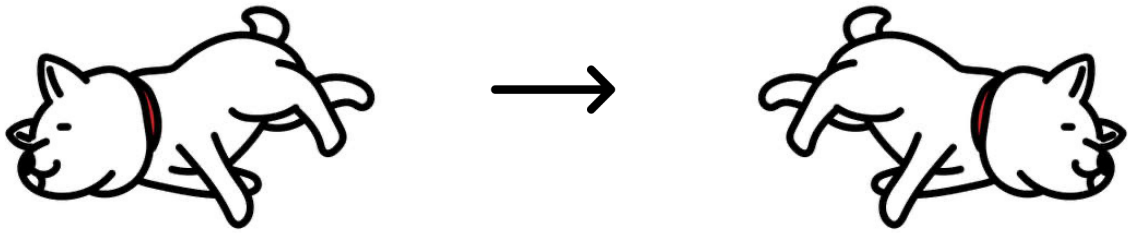
Prospective
15 dogs with CP
16 dogs without CP

- ✓ Increased mean O_2free days
- ✓ Significant P/F increase in the first 48h
- ✓ Mortality rate : 13% CP, 44% control

In practice

3-5 PSE + AC, 10 times over 2-3 min

3-5 PSE+AC, 10 times over 2-3 min



4-6 times a day

Aerosoltherapy

- Direct deposition of medication in the airways

- Deposition depends on
  - Inspiratory flow rate
  - Tidal volume
  - Patient characteristics
  - Size of particles
    - Deposition in the small airways: particles < 5 µm

Nebulizeurs

Jet

Mesh

Ultrasonic

Interface

Drugs

- **Saline**
  - Used for drug transport
  - Can be mixed with other drugs
  - Humidification of the airways

- **Hypertonic**
  - Improve clearance
  - Decrease wall oedema

Avoid mixing drugs

- **Antibiotic**
  - Gentamicin
  - Therapeutic concentration in BAL
  - No systemic effect
    - Even at 10 min, twice a day for 7 days

AJVR AVMA

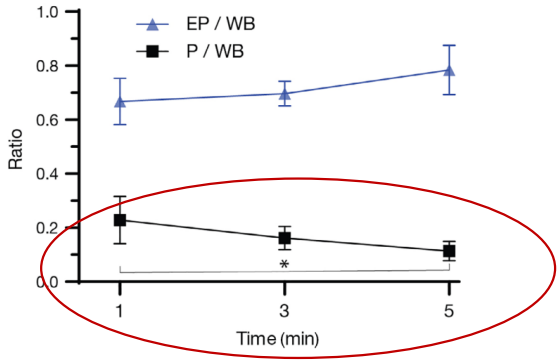
Three-minute nebulization of gentamicin in healthy dogs results in therapeutic concentrations in bronchoalveolar lavage fluid while remaining below the toxic range values in blood

Aurélie Lyssens, DVM[1*]; Tom Biénès, DVM, DECVIM[1]; Aline Fastrès, DVM, PhD[3]; Hélène Machiels, DVM[1]; Camille Moreau, DVM[1]; Alexandru-Cosmin Tutunaru, DVM, PhD, DECVAA[1]; Marine Deville, PhD[2]; Corinne Charlier, PhD[2]; Cécile Clercx, DVM, PhD, DECVIM[1]; Frédéric Billen, DVM, PhD, DECVIM[1]

2024

Duration of nebulization

- Increased duration of Neb. increases deposition in the lungs
- But not pulmonary/whole body deposition



Carranza Valencia JVIM 2021

- 3 min nebulization achieve pulmonary therapeutic concentrations

Lyssens AJVR 2024

Protocol

- Saline
- Hypertonic
- Gentamicin

Twice a day each, in alternance
5 min session

- Away from feeding
- Followed by physiotherapy

No consensus …

Prognosis

- Survival rate 70-80%

- Median hospitalization time 3-6 days

- Long term prognosis depends on the ability to resolve the inciting or
- associated cause

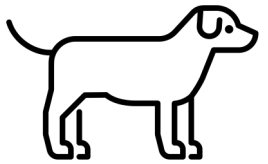
And the cat?

Clinical and radiographic findings in cats with aspiration pneumonia: retrospective evaluation of 28 cases

N. Levy[1], E. Ballegeer and A. Koenigshof

JSAP 2019

- Risk factors
  - Vomiting
  - Anesthesia
  - Upper respiratory disease
  - Esophageal/neuro/laryngeal diseases
- Clinical signs
  - Increased RR
  - Hyper/hypothermia
  - Cough
  - …
- Thoracic X-Rays
  - Right middle lung lobe
  - Left cranial lung lobe
- Survival rate 89%
- Hospitalization time: 3 days



Conclusion

- Aspiration pneumonia is a frequent cause of respiratory distress both in emergency and ICU setting
- First line treatment
  - Oxygen
  - Fluid
  - IV antibiotics
- Additional treatment with chest physiotherapy and nebulization
- New use of specific biomarkers to guide treatment response