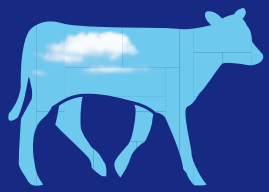
ECOLE NATIONALE VETERINAIRE TOULOUSE

Lung Health

A PRACTICAL GUIDE TO DIAGNOSIS



Bovine respiratory pathology

MSD Animal Health

A Practical Guide to Diagnosis

Preface

The economic losses associated with bovine respiratory disease are great, both for beef and dairy cattle. The administration of medical treatment or appropriate vaccination measures are initially based on identification, as accurately as possible, of the infectious causes, particularly if groups of animals are affected.

Clinical signs have a low predictive value of causal agent when considered on their own. However, a combination of epidemiological, clinical and pathological criteria produces leads to satisfactory diagnosis in a majority of cases. Even if not fully expedited, the post-mortem examination is an essential diagnostic procedure. The outcome of complementary tests depends on the initial orientation of sampling, guided by the clinical and necropsy phases, followed by quality of the samples and their condition at time of analysis.

This guide to diagnosis is intended to be practical in terms of presentation through the use of abundant illustrations. Its aim is to provide the practitioner with an effective tool at each stage of the diagnostic process with the objective of defining a few key principles and, at the same time, challenging a few common assumptions.

This project is the result of a fruitful partnership between
- A team of teachers from the **Ecole Nationale Veterinaire Toulouse (ENVT)**, who have been willing at all times to share their experiences of diagnosis in bovine pathology,
- The **Bovilis® technical team**, whose contribution to the prevention and treatment of bovine respiratory disease have made the Bovilis range a key player in the field of animal health in Europe and throughout the world.

Let us hope that this guide will increase operational knowledge of respiratory pathology, facilitate dialogue between practitioners and diagnosic laboratories and help veterinary surgeons keep abreast of the new diagnostic techniques.

Professor François Schelcher, ENVT

Acknowledgements

This work owes much to the pragmatic and scientific input of **Professor François Schelcher** and has also benefited from the considerable advice of colleagues working in various fields. We would like to thank, in particular:

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- **The technical team** of the Intervet/Schering-Plough Bovine Unit

(Drs Olivier Bidaud, René Fournier, Philippe Houffschmitt and Yves Lagalisse).

Doctor Loïc Oliviero,
Technical Manager, Bovine Vaccines,
Intervet/Schering-Plough,
Co-ordinator Bovilis® Expert

Photo credits

- Paul Cabanié, François Schelcher, Caroline Lacroux ENVT (clinical, autopsy, pathological anatomy, histology)
- LDA 35, Rennes (analysis)
- Ed Van Der Meer, Pathology Dept., Intervet International bv (anatomy and lesions)
- Intervet SA, Angers (various)
- Nora Cesbron, ENVN (various)

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Start with the basics

Caution

Example: acute and chronic refer to the duration of progression and not the severity of the condition

Do not confuse

Example: Do not confuse hypostasis with oedema

Tip

Example: Necrotic lesions typical of *M. haemolytica* make it possible to manage without a bacteriological examination

Never

Example: Pleurisy is never caused by a virus alone

WATCH OUT for pre-conceived ideas

Example: emphysema does not systematically indicate RSV

There are three ways to use this guide

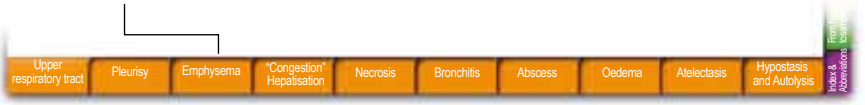
You can either …

- **read it from start to finish** like a novel
- **consult the INDEX** and refer to the relevant sheet indicated
- **go directly to the index tab** that interests you, particularly in the NECROPSY and ANALYSIS sections

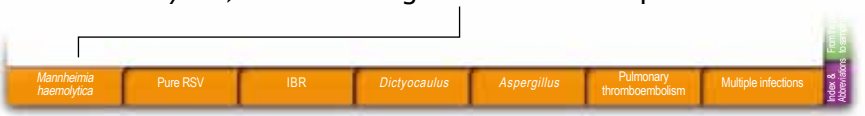
These two sections work in two ways

NECROPSY

1 . You identify a lesion (e.g.: emphysema) and are looking for the cause:



2 . You are considering a possible cause (e.g.: *Mannheimia haemolytica)* and searching for its lesional expression:



ANALYSIS

1 . How to proceed starting from a sample (e.g.: TTA)?

2 . You are looking for a cause (e.g.: bacteria) - which samples should be taken?

Some index tabs are more general

NECROPSY ▸ Practical tips

ANALYSIS ▸ From sampling to pathogen

▸ Secretions, lung: Samples to be taken carefully.

ANATOMY

Macroscopy

Microscopy

EPIDEMIOLOGY/CLINICAL MEDICINE

Disease progression in the herd

Clinical signs

NECROPSY

Practical tips

Basic lesions

Upper respiratory tract – Pleurisy – Emphysema – "Congestion"/ Hepatisation - Necrosis - Bronchitis - Oedema - Atelectasis – Hypostasis and Autolysis

Note:

For pedagogical reasons, lesions resulting from mono-factorial infections are described in the chapter "from pathogen to lesions".
These cases are relatively unusual in practice.
In the index tab **"multiple infections"** the gross pathology more frequently encountered in the field is described.

From pathogen to lesions

Mannheimia haemolytica - RSV - IBR - Dictyocaulus - Aspergillus - Thromboembolism – Multiple infections

Duration of disease progression

ANALYSIS

From sampling to pathogen

Secretions, lung: Sample carefully - Blood: sample carefully - Deep nasal swabbing - TTA (BAL) - Lung - Blood

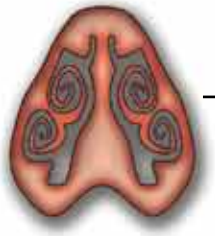
From pathogen to sampling

Bacteria - Bacteria (interpretation and antibiotics resistance test) - RSV - Other viruses - Dictyocaulus

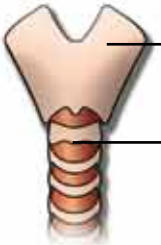
INDEX

Index & abbreviations

The respiratory system

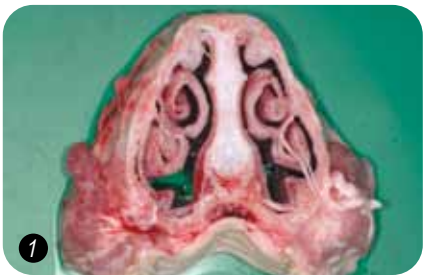


Nasal cavities ●1

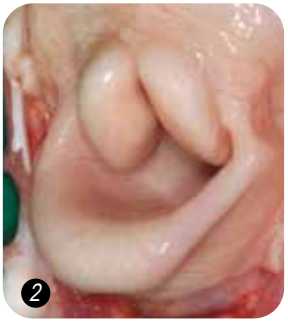


Larynx ●

Trachea



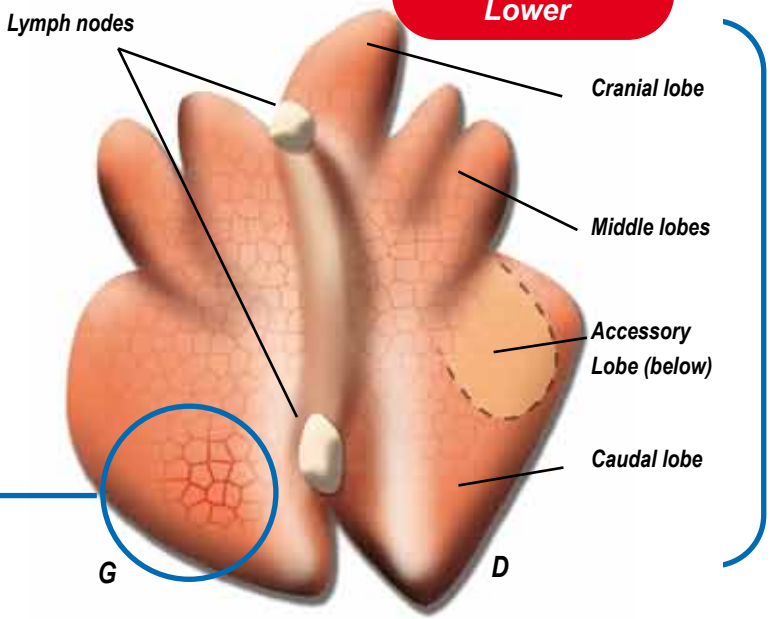
Cross-section



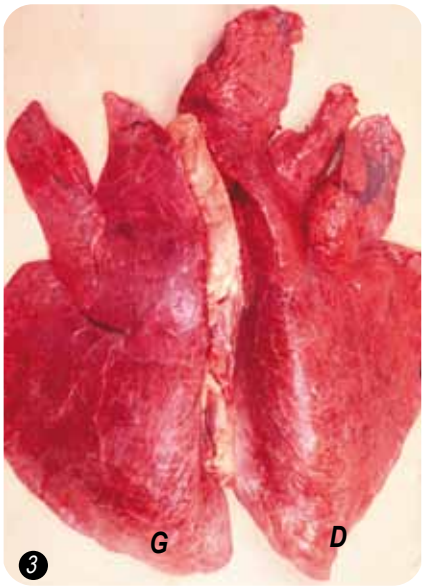
Larynx

Upper

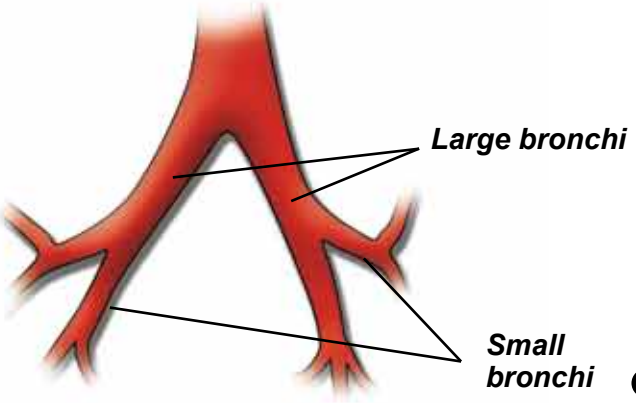
Lower

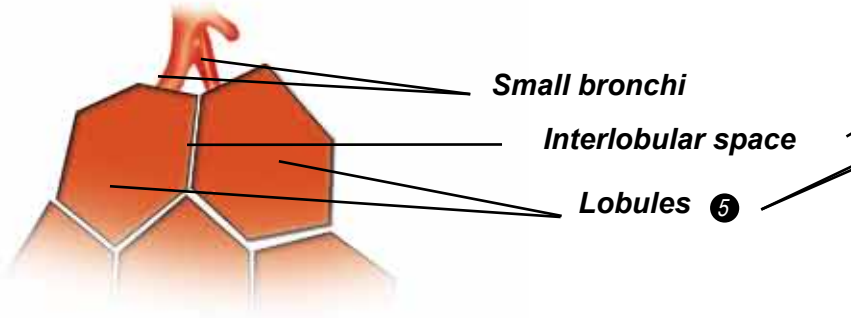


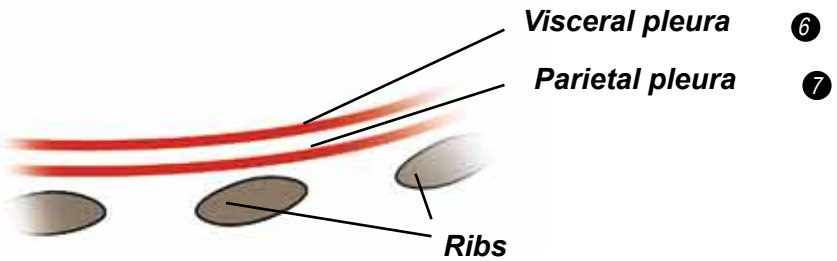
Pulmonary lobes ●

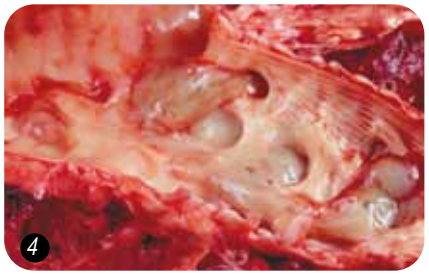


Pulmonary lobes

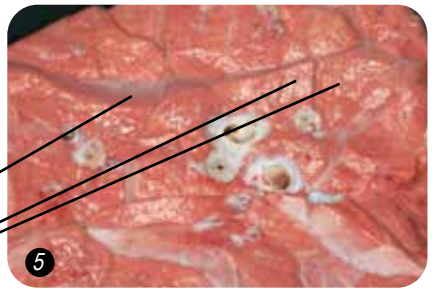




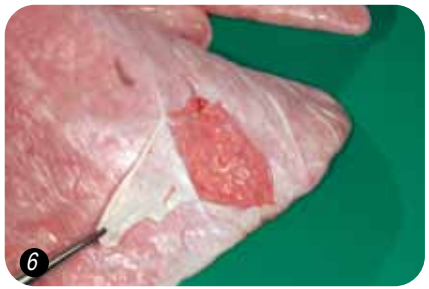




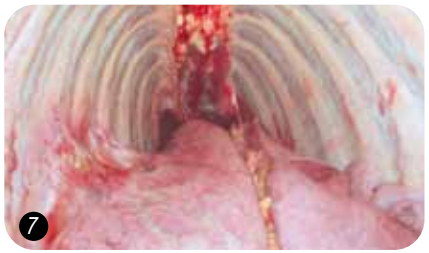
Bronchial ramifications



Section of the lung



Visceral pleura

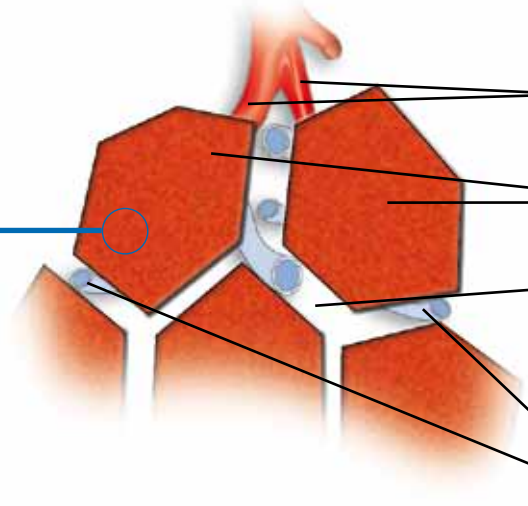


Parietal pleura, made conspicuous in this case by fibrous symphyseal pleurisy

The respiratory system

Macroscopy

(Previous sheet)



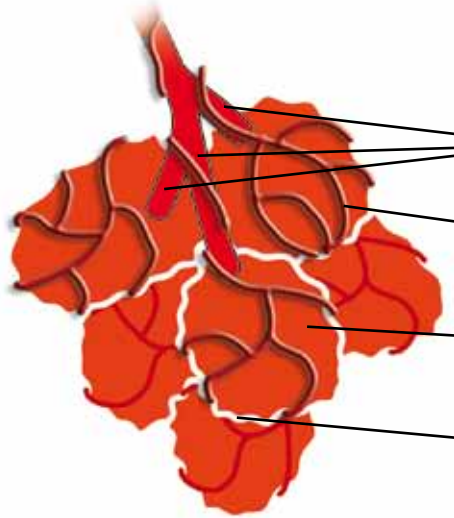
Small bronchi

Lobules

Interlobular area

Lymphatic vessels

Microscopy



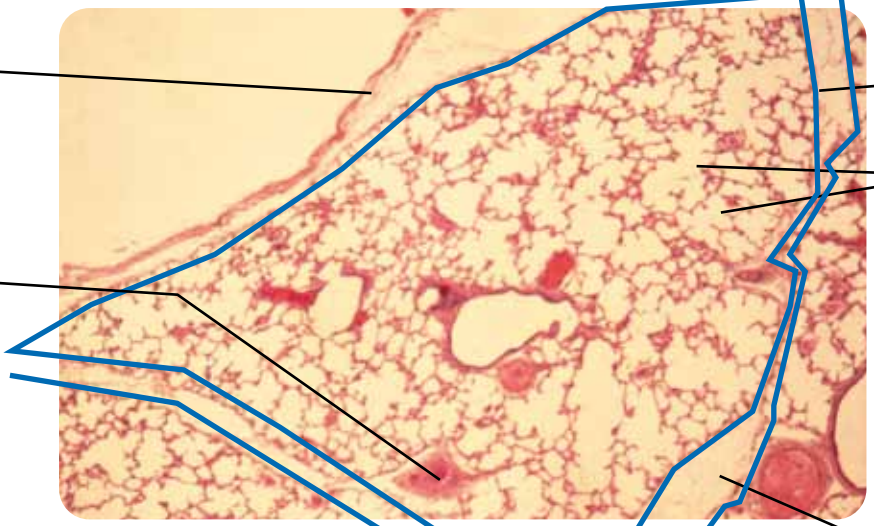
Bronchioles

Capillaries

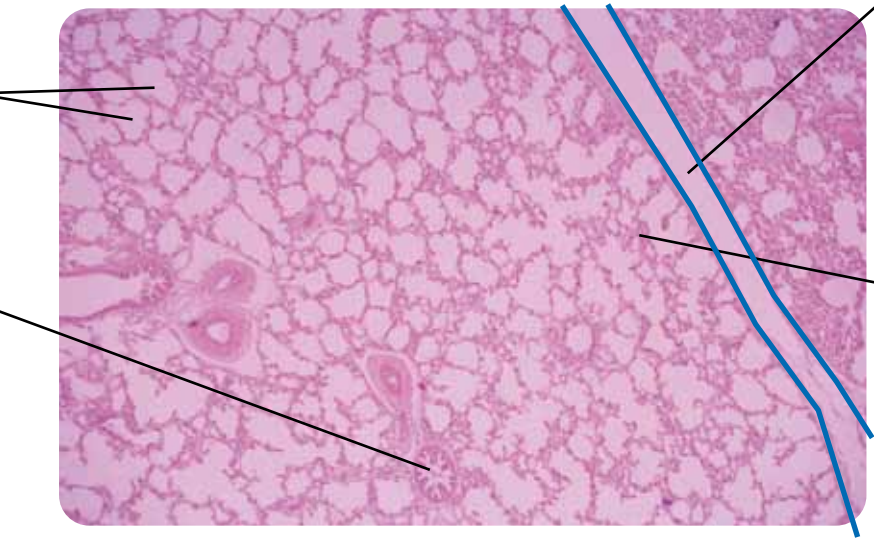
Alveolus

Interstitial or interalveolar space

DO NOT CONFUSE



Histologic section of the lung, magnified x 40



Histologic section of the lung, magnified x 40

Progression in the herd

	Epidemic	Endemic
	"Epidemic outbreak"	"It's coughing all the time"
	In terms of incidence = No. of new cases/unit of time	
Definition:	*... High incidence*	*... Low incidence*

Closed herd

▪ Typically **viral** ▪ Frequently **RSV** ▪ Does not exclude one particular bacterium: ***Mannheimia haemolytica***	▪ Often **bacterial** ▪ Does not exclude viruses in synergy with bacteria
Does not exclude non-infectious factors	**Primary non-infectious factors**

All in - all out fattening unit

Frequent outbreaks	Endemics more rare
Viruses **and** bacteria	**Bacteria**
Infectious **and** non-infectious	Mainly **non-infectious factors**

Continuous fattening

Interpretation difficult

Acute	Sub-acute	Chronic

In terms of duration of progression and not severity !

Progression over **3 days**	Progression over **10 - 15 days**
▪ A purely viral infection is always acute	▪ Suggests bacterial involvement
▪ An acute infection is not necessarily viral (Example: Shipping Fever is an acute infection caused by ***Mannheimia haemolytica***)	▪ **Does not exclude initial viral involvement**
	▪ Sometimes results from successive viral infections in the same animal

IMPORTANT
No strict relationship between acute/chronic or epidemic/endemic and aetiology: an acute or epidemic episode can be bacterial (*Mannheimia haemolytica*)

Recurring problem in the herd

- **In a closed herd:** possible re-appearance of purely viral episodes; with RSV there is the question of chronic carriers (not demonstrated until now)
- **In an open herd:** possible involvement of several pathogens

EPIDEMIOLOGICAL/CLINICAL MEDICINE

Clinical signs

Symptoms

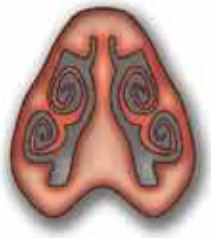
Epistaxis

Discharge

Haemoptysis

Cough = below the larynx

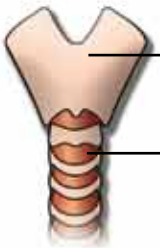
Dyspnea



Nasal cavities

Lesions

Rhinitis



Larynx

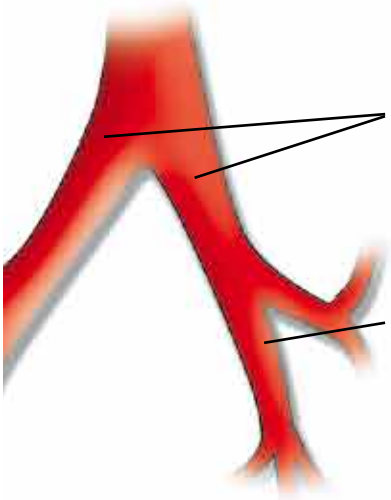
Laryngitis

Trachea

Tracheitis

Upper

Deep



Large bronchi

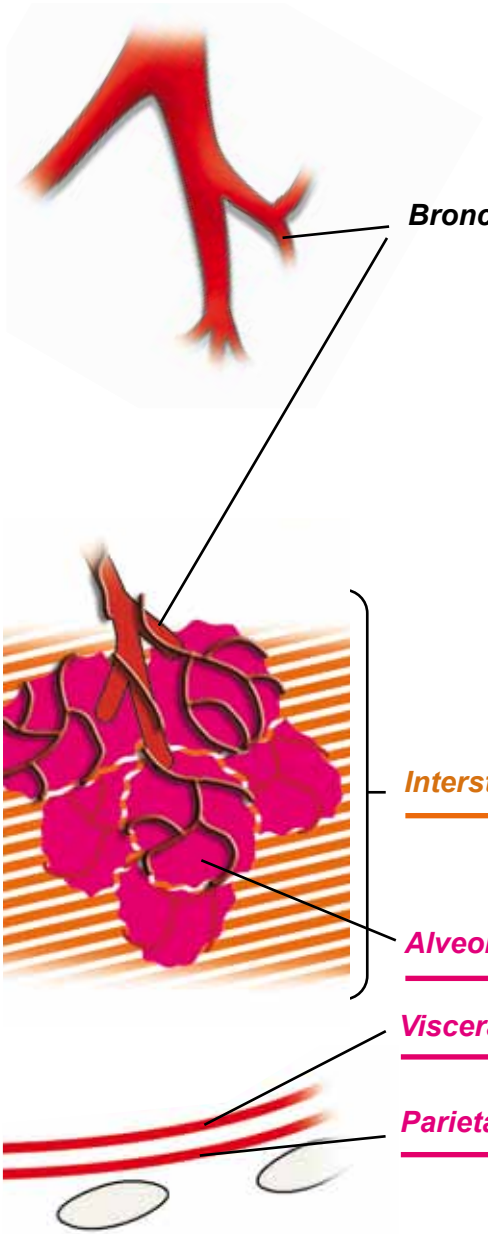
Bronchitis

Small bronchi

Pathogen agents

IBR

Emphysema



Bronchioles — **Bronchiolitis**

Interstitial tissue — **Interstitial pneumonia**

Alveolus — **Alveolar pneumonia**

Visceral pleura

Parietal pleura

Pleurisy

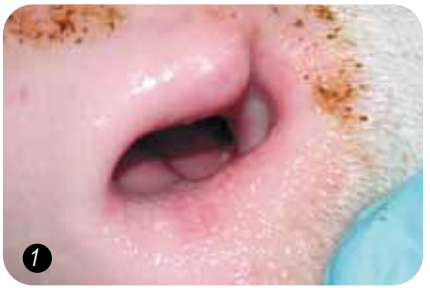
PI3 / RSV ...

Pasteurella

Clinical signs

- **The appearance of the discharge can first be used to estimate the speed of progression**
  - Serous: rapid progression (1)
  - Mucous: prolonged progression (2)
- **Sometimes the discharge points to a cause**
  - Yellowish: bacteria in the naval cavities (3)
  - Abundant, erosions on external nares + pseudomembranes: (4) (5)
- **Laryngitis can clinically mimic bronchopneumonia, though wheezing sound is specific**
- **Orthopnea* (ARDS) is not specific to RSV**
  (high predictive value however, for calves and young cattle) (6)
  - Acute bovine pulmonary oedema and emphysema (fog fever)
  - Acute bacterial pneumonia
- **If arthritis is present in a group of calves, consider *Mycoplasma bovis*. Possibility of IBP with *Mycoplasma bovis* without arthritis or arthritis without mycoplasma, accidentally associated with IBP**
- **"Intestinal flu" (diarrhoea outbreak affecting adults), occurring in the field, is an enteric syndrome with various causes, frequently including coronavirus.**

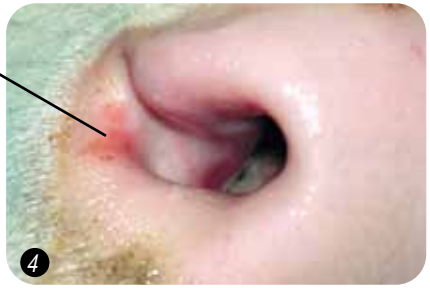
** Characteristic appearance: dyspnoea with extended members and stretched-out neck, which indicates acute respiratory distress syndrome (ARDS)*



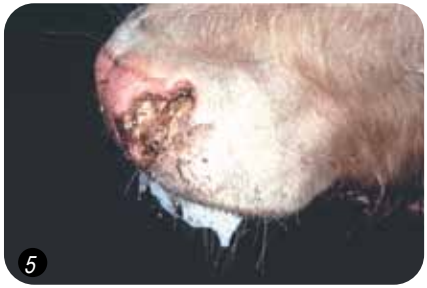
Serous discharge

Mucous discharge

Purulent discharge



Erosion: IBR

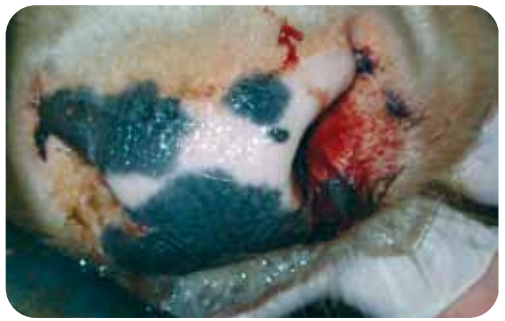


Discharge and pseudomembranes

Orthopnea

Epistaxis

Rare
often **unilateral**
Bleeding from the nostrils

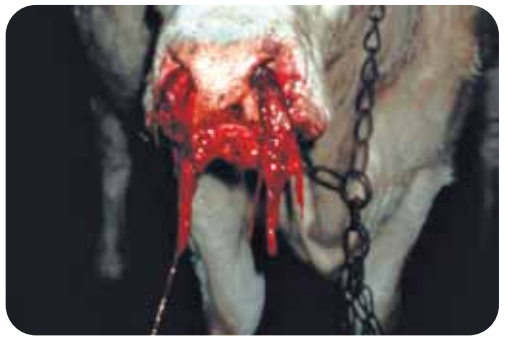

Epistaxis

STOP

DO NOT CONFUSE

Haemoptysis

More frequent
Often **bilateral**
Blood in the mouth and nostrils
Pulmonary origin: thromboembolism *(sheet 22)*


Haemoptysis

NECROPSY

Practical tips

- **Legal aspect** *(EC Regulations No. 1774/2002 and 878/2004, rural code, book 2, articles L. 226-1 et seq., L.231-2, L.236-1, R226-1- R226-4 and R228-15; Code of Conduct, article R.242-33 and 242-83)*

  - **Is it authorised on the farm?**
    Necropsies at the farm are **not permitted legally but are tolerated** by certain knackeries / rendering plants. Consult the latter with regard to the conditions for carcass recovery.
    In the absence of specific regulations or prohibition, respect the rules of good practice, particularly in terms of hygiene and safety. In the event of suspected ND, contact the SVS (State Veterinary Service).

  - **At the abattoir: Is this acceptable?**
    NO, this depends on the rendering plant. Necropsies conducted by an animal health expert are authorised subject to the conditions issued by the DDSV (Regional Veterinary Authority), provided the standards for installation and equipment are respected (Order of 06/08/2005).

  - **At the Regional Analysis Laboratory / National Veterinary College**
    - Ideal for taking useful samples
    - Legal problem with transport (please refer to EC Regulation No. 1774/2002):
      - **In theory:** Vehicle suitable for the transport of substances in categories 1 and 2 and subject to authorisation, **accompanying document completed by the veterinary surgeon**
      - **In practice:** it is possible for the owner to provide transport. Transport can be organised by a small number of Regional Analysis Laboratories or National Veterinary Colleges

- **Complete autopsy necessary**

  - Do not limit the examination to the respiratory system e.g. lesions caused by ruminitis or liver abscess due to thromboembolism (young bulls) *(sheet 22)*
  - Open the larynx, trachea, and bronchi and examine (section) the lymph nodes (tuberculosis etc.)

- **Timescale**
  - Following death
    - Summer: < 12 hours
    - Winter: < 48 hours
  - Sampling for further analysis
    - Within 3 - 5 days after onset of infection *(sheet 26)*

Consider taking photos

- **Ensure that the case being subject to necropsy is representative**
- **What you see is a photograph taken at a given moment: consider the aspect of progression**
- **Less important in case of "chronic" progression**
- **The predictive value of macroscopic lesions for pathogens is only appropriate for a small proportion of acute cases**
- **In the (frequent) absence of unambiguous lesions, the use of (laboratory) analysis is indispensable**

Note:

For educational reasons, lesions caused by monofactorial infections are described in the chapter "from pathogen to lesions". These cases are relatively infrequent in practice.
In the index tab **"multiple infections"** the gross pathologies most frequently encountered in the field are presented *(sheet 23)*

Upper respiratory tract

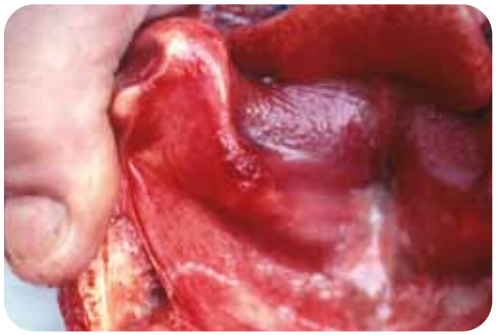
Laryngitis

- Can clinically mimic bronchopneumonia

A minimal lesion can cause marked clinical signs ("croupous[1]" laryngitis)

- Consider IBR *(sheet 19)*

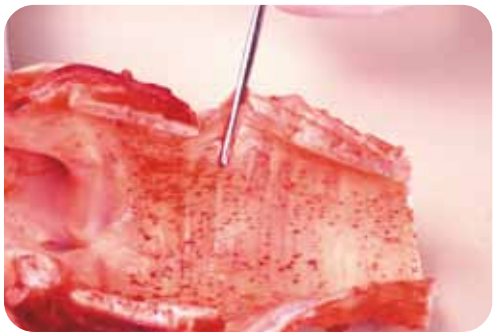
[1]: meaning necrotic laryngitis or diphtheria in the calf.



Laryngitis

Terminal tracheal haemorrhages

- These are petechiae
- These are terminal phase lesions

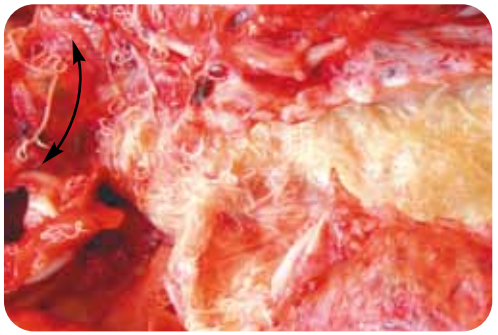


Terminal tracheal haemorrhages

Visual[2] dictyocaulosis

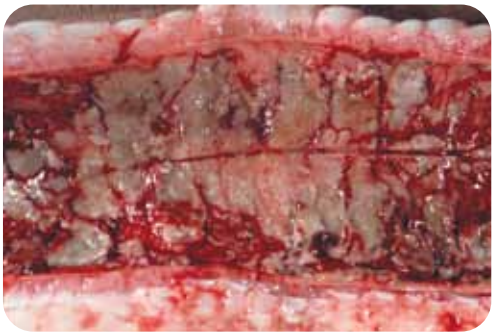
- Parasites present
- Mucus abundant

[2]: Visual adult stage of the parasite



Visual dictyocaulosis

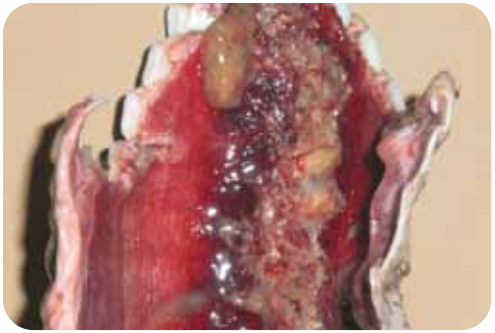
- **Fibrino-necrotic tracheitis: IBR**
  - Fibrinopurulent deposits
  - **Adherent** false membranes
  - Ulcerated mucosa



Fibrino-necrotic tracheitis

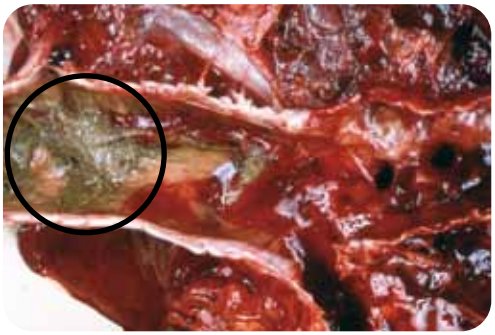
STOP **DO NOT CONFUSE**

- **Drainage of bronchopneumonia**
  - **Non-adherent** mucopurulent exudate
  - Non-ulcerated mucosa



Exudate due to bronchopneumonia

- **Aspiration of regurgitated material (terminal)**
  - "Non-lesion"
  - No inflammatory reaction in the mucosa



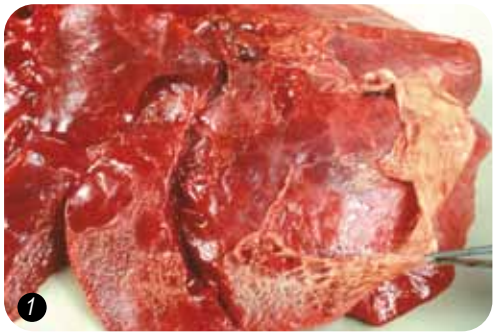
Aspiration of regurgitated material (terminal)

Pleurisy

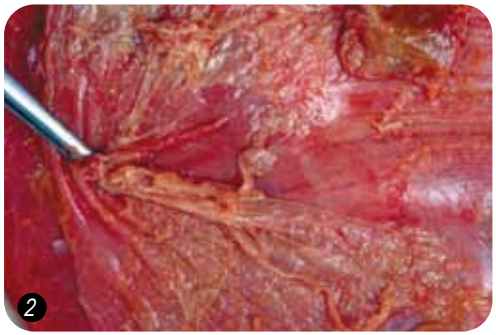
Attenuation of pulmonary sounds.
Sounds "liquid" in case of liquid exudation.
Possible confusion with pericarditis

- **Definition:** Inflammation of the pleura
  - On the lungs: visceral pleurisy (1)
  - On the costal wall surface: parietal pleurisy (4)

Localisation without diagnostic significance



Fibrinous pleurisy

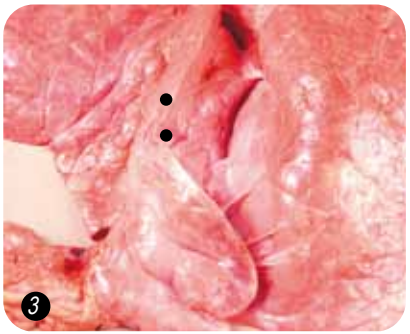


Fibrinous pleurisy

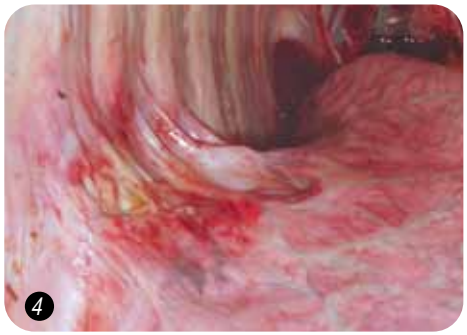
- **Appearance and duration of progression**

▸ Fibrinous: Minimum 24 – 48 h (1)
  - **White yellowish**
  - **Slightly adherent**
  - **Elastic** (2)

▸ Fibrous: 15 days - 3 weeks (3) (4)
  - **White**
  - Very adherent
  - **Non-elastic**



Fibrous pleurisy



Fibrous pleurisy

Origin

Without associated pulmonary lesions
1 case/10

With associated pulmonary lesions
9 case/10

Haematogenous

Always **bilateral**
Calves +++
Often other serous membranes affected as well

Septicaemia
Polyserositis

Direct contact

Usually **unilateral**
Adults +++
Sometimes + pericarditis

5

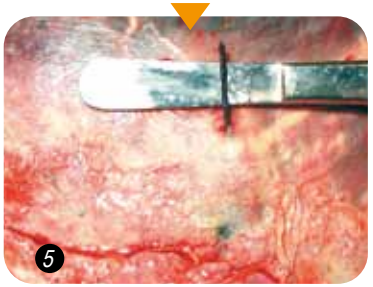
Foreign body

Aerosol

Unilateral or bilateral

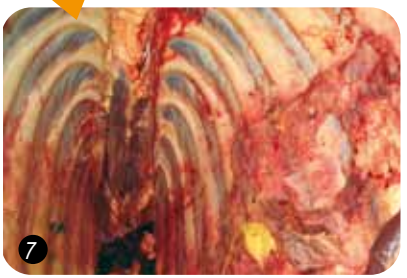
6 7

Bacteria
M. haemolytica



Foreign body

Visceral pleurisy



Parietal pleurisy

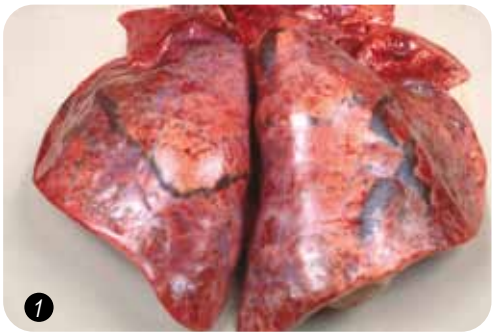
IMPORTANT
Acute progression + pleurisy:
Consider *M. haemolytica*

Pleurisy is
NEVER
caused by a virus alone

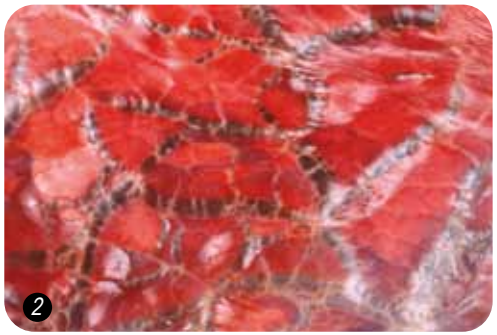
Emphysema

Crepitations
"Brief" noises

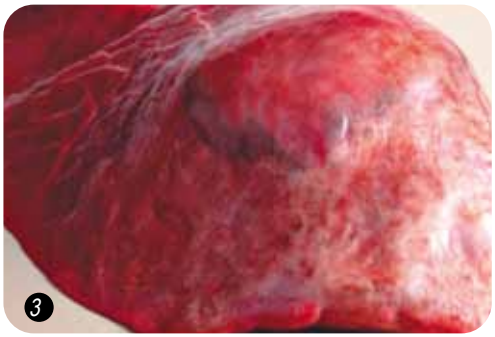
- **Mechanism:** alveolar distension due to air caused by a bronchial obstruction (whatever its cause) and likely to spread in the following areas:
  - **Lobular**
  - **Inter-lobular = swollen appearance** ❶ ❷ ❸
  - **Sub-pleural = bubbles on the surface** ❹ ❺
  - **Subcutaneous**



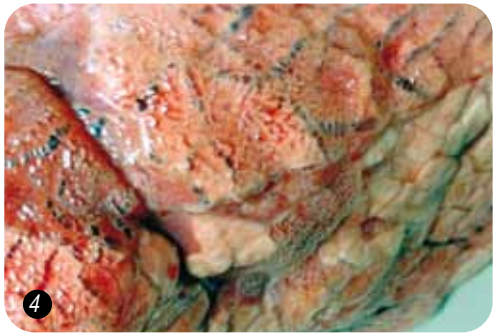
General appearance



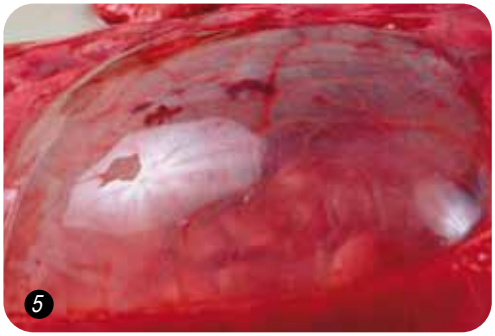
Interlobular



Interlobular dissecting



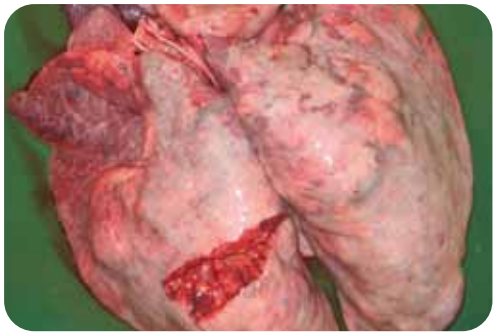
Sub-pleural



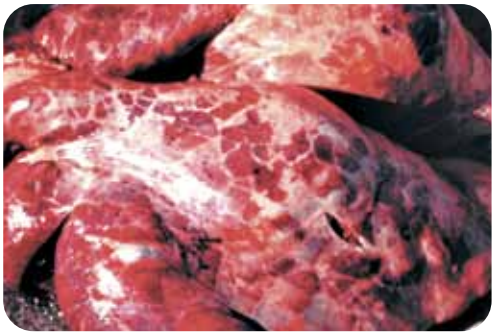
Sub-pleural

Does not indicate the cause*.

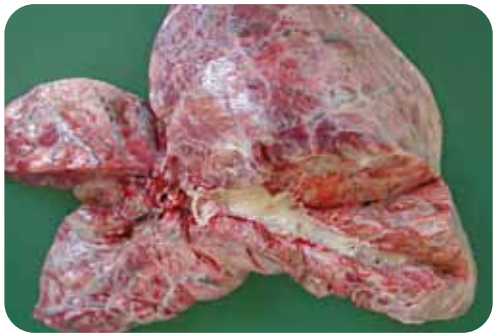
3 examples of emphysematous lungs - What is the cause?



Answer: RSV



Answer: IBR



Answer: DICTYOCAULOSIS

* Most cases of bovine bronchopneumonia are “obstructive” and therefore promote emphysema.
Emphysema alone: poor predictive value for the pathogen.

Look for lesions associated with emphysema:

- **Section of the bronchi**
  - **Mucus and parasites: Dictyocaulosis** *(sheet 20)*
  - **Tracheitis: IBR** *(sheet 19)*
  - **Bronchial mucopus: RSV** *(sheet 18)*
- **Section of the lungs**
  - **Typical necrosis: *Mannheimia haemolytica*** *(sheet 17)*

Terminal emphysema

Often without associated pulmonary lesion
Associated with terminal frothy oedema *(sheet 17)*

Acute bovine pulmonary oedema and emphysema (fog fever)

Consider this possibility during the autumn grazing period

* In the chronological sense

"Congestion"/Hepatisation

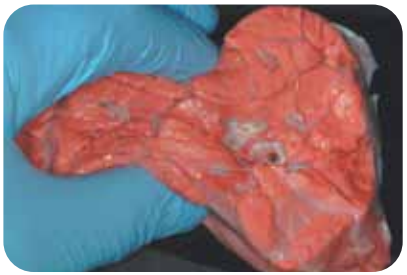
Definition

- **Please note: In the field,** the terms **congestion, hepatisation or consolidation / induration** are used interchangeably and incorrectly when the lungs are "red"
- The red colour indicates "congestion" while "hepatisation" or consolidation / induration indicate increased consistency

"No increase in consistency = No pneumonia"

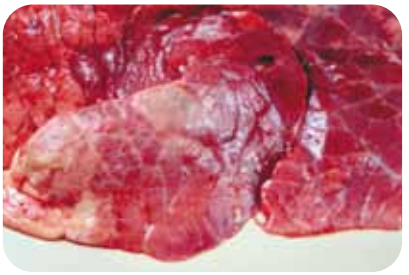
The 3 levels of consistency

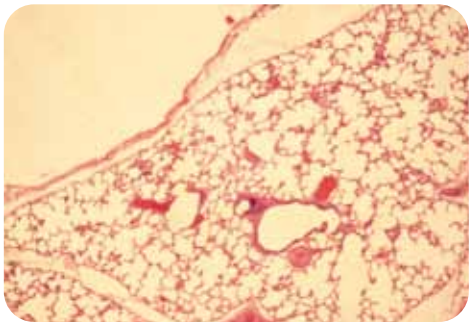
Normal consistency **"lip"**



Moderate induration **"nose"**

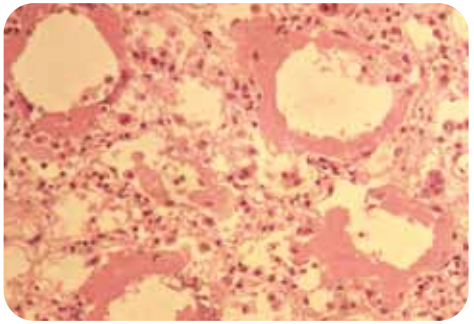
Severe induration / true hepatisation **"forehead"**





Histological section of the healthy lung

Healthy lung



Interstitial" pneumonia

9 cases/10 or 1 cases/10

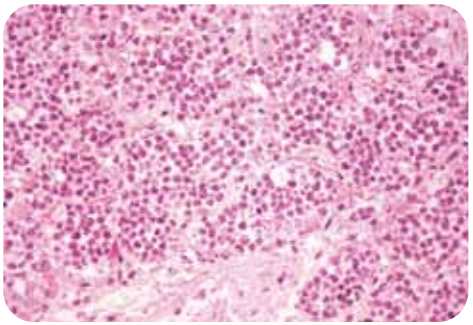
Interstitial pneumonia

Virus

Per-acute if RSV

Interstitial oedema

Salmonella



"Alveolar" pneumonia. Macrophages and polynuclear neutrophils invade the alveoli

Alveolar pneumonia

Bacteria

(does not exclude an initial virus)

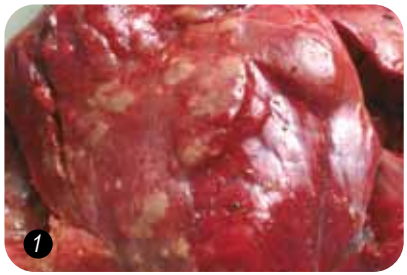
Necrosis

Definition: Death of tissues in the living animal

Either specifically due to *M. haemolytica*: FREQUENT

Can be seen on the surface ❶ or more frequently in the section ❷

- 1 - 2 cm diameter, irregular contours
- +/- grey, with characteristic whitish edge
- On one or more lobes, especially cranial
- In the indurated areas
- Microscopic interpretation:
  - Degeneration of neutrophils (action of the leucotoxins) ❸
  - "Oat grain" cells in the periphery (Oat cells) ❹



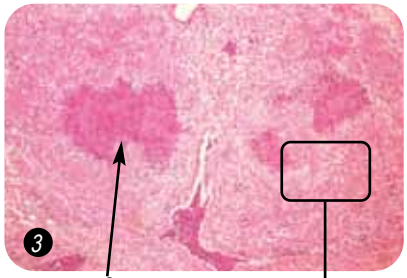
On the surface

In the section

This lesion specific to *M. haemolytica* is not, however, systematic *(sheet 17)*

Or aspergillosis: RARE

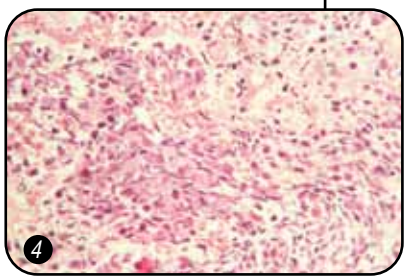
- Can be seen on the surface ❺ ❻
- 2 - 3 mm in diameter
- Blackish edge possible ❼
- Multiple foci: all in the lobes, including the caudal lobes



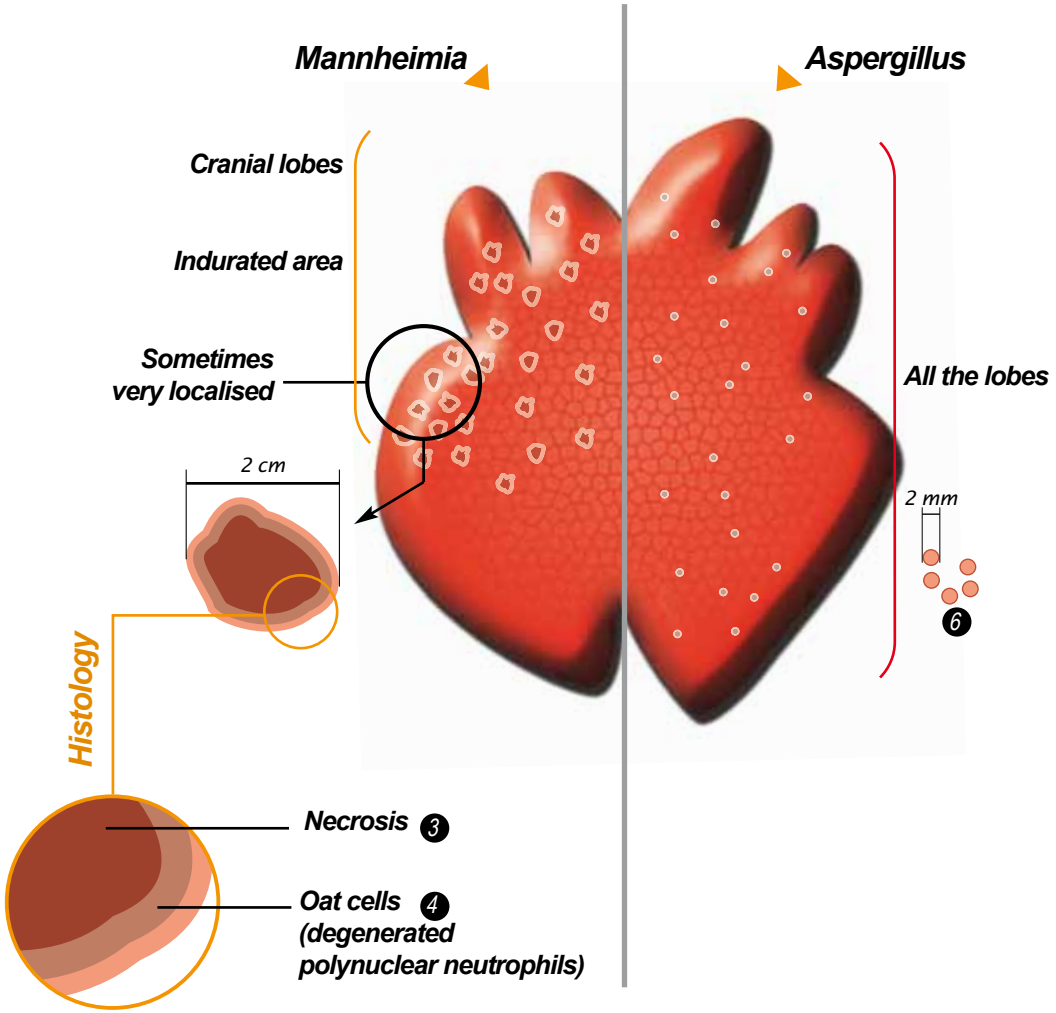
Necrotic focus

Or necrotic-purulent focus: SPORADIC ❽

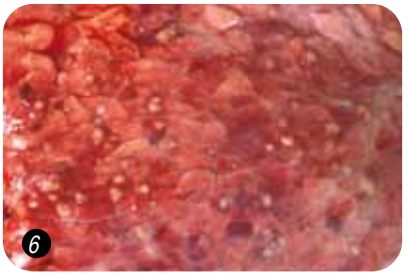
- Several centimetres
- Often old
  - Progression of bronchopneumonia due to bacteria other than *M. haemolytica: A. pyogenes, E. coli, Pseudomonas*, necrobacillosis etc.
  - Aspiration Pneumonia
  - Foreign body



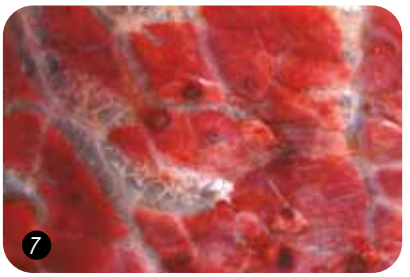
"Oat cells"



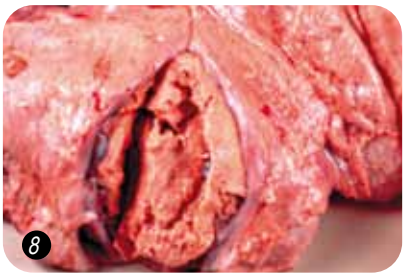
Aspergillosis



Aspergillosis



Blackish edge



Necrotic-purulent focus

STOP

In practice, these 3 types of necrosis cannot be confused.

Bronchitis

Definition: macroscopic (bronchitis) and microscopic (bronchiolitis) lesions.

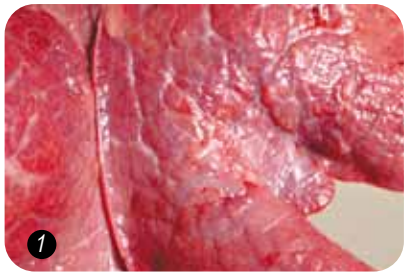
Following the **section** and when **the affected** lobes are subjected to pressure: pus or muco-pus flows.

- **Or purulent bronchitis** 1 2

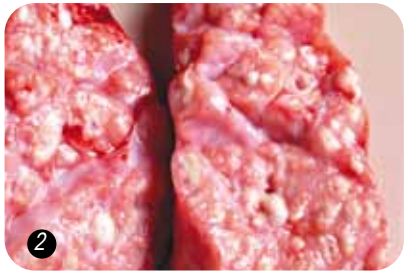
STOP **DO NOT CONFUSE** **with an abscess** *(sheet 13)*

- **Chronic progression**
  1- Purulent bronchitis
  2- Bronchial abscess: bronchial wall clearly visible 3
  3- Bronchiectasis: bronchial dilation with purulent content = chronic lesion 4

Often associated with true chronic hepatisation (alveolar pneumonia, *sheet 10*)

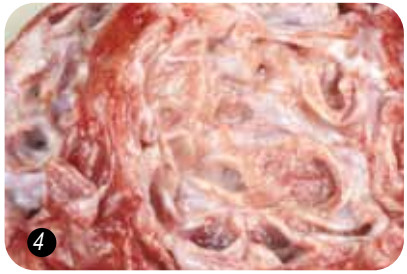


Purulent bronchitis



Purulent bronchitis (section)

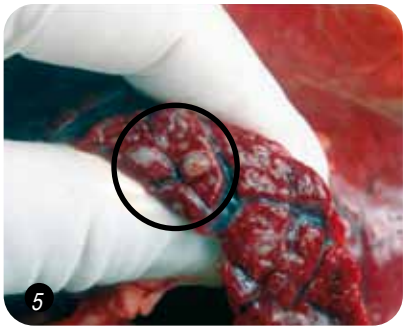
Bronchial abscess



Bronchiectasis

Or mucopurulent bronchitis 5

- **Secretions**
  - less thick
  - less opaque
  - rather white
- **Acute to sub-acute progression**



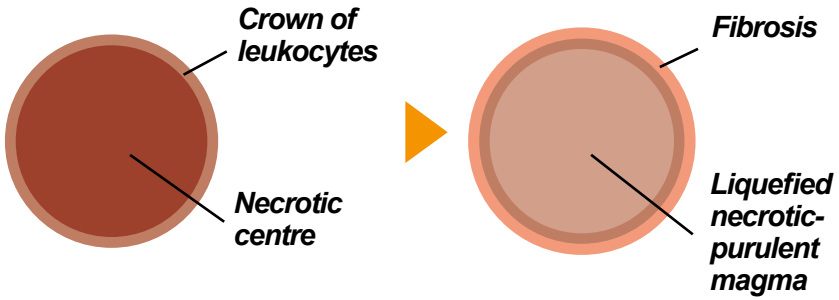
Mucopurulent bronchitis

Often associated with moderate induration (acute interstitial pneumonia, *sheet 10*), suggestive of RSV (*sheet 18*)

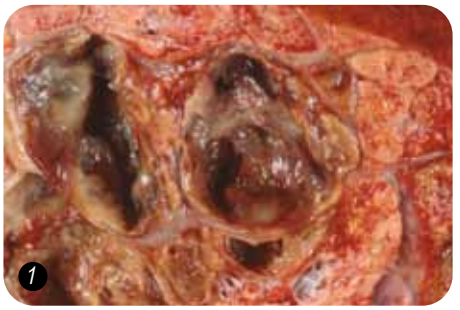
Abscess

Definition: in practice, 3 different lesions are classified as abscesses

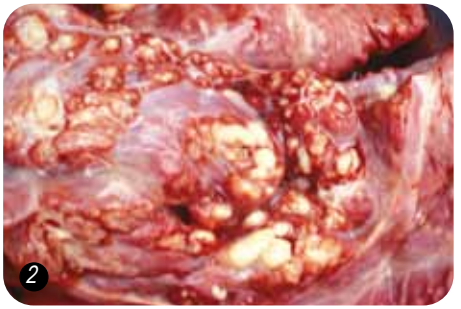
- **Sequestrum:** lesion resulting from the progression of necrotic foci (this progression does not occur frequently) (*sheet 11*)
  e.g.: *Mannheimia haemolytica* ❶



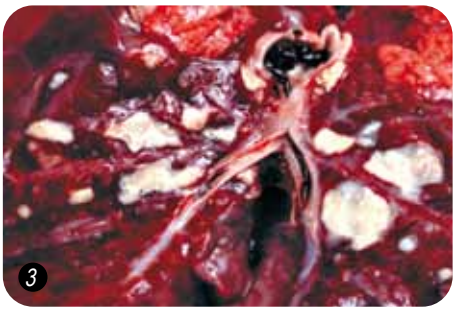
- **Purulent bronchitis** ❷ ❸
  Chronic progression (over 8 - 10 days) of bronchitis, *sheet 12*)



Sequestrum (Mannheimia haemolytica)



Purulent bronchitis



Purulent bronchitis

“True” abscess ❹ ❺

Definition: purulent lesion delimited by a shell

IMPORTANT

An abscess signifies

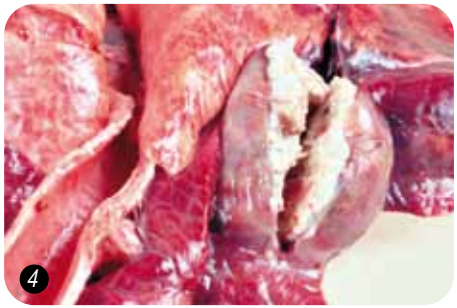
- chronic progression (more than 15 days)
- bacteria are always present

Certain bacteria are particularly pyogenic

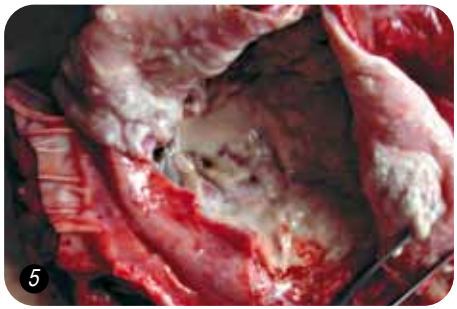
- *Arcanobacterium pyogenes*
- Streptococci

IMPORTANT

A purely viral infection does not produce an abscess



Abscess



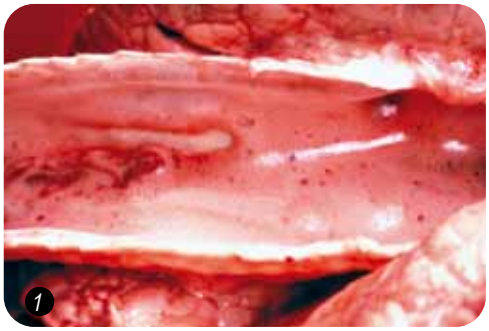
Abscess

Oedema

Creptins
"Crackles"

Distinguish clearly between …

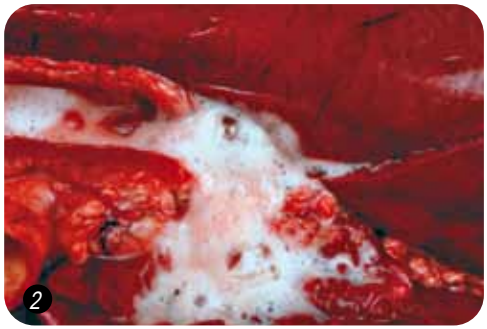
- **Either terminal frothy oedema (tracheo-bronchial)** ❶ ❷
  - **Common terminal lesion** ⚠
  - **Is only** seen a few hours after death: early autopsy
  - **Small bubbles** = frothy



Terminal frothy oedema

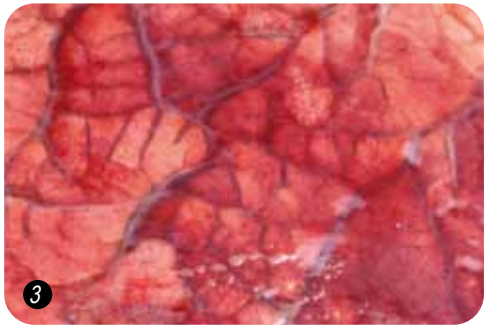
⚠ **Not of diagnostic significance**

Often associated with terminal emphysema, (*sheet 9*)

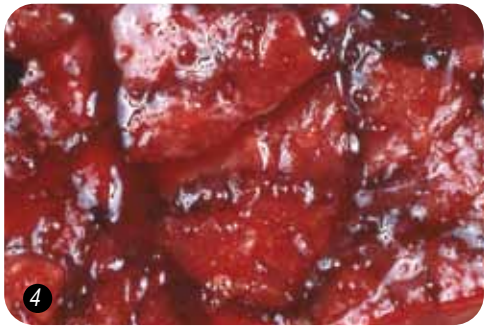


Terminal frothy oedema

- **Or, interstitial or perilobular oedema** ❸ ❹
  - Lung not deflated
  - Flows when dissected
  - Interlobular spaces vitreous and distended
  - Can even be observed several hours after death
  - Origins:
    - Cardiogenic
    - Pulmonary inflammation of:
      - infectious origin
      - non-infectious origin ▸ toxic: fog fever emphysema
        ▸ (acute farmer's lung)



Perilobular oedema



Perilobular oedema

DO NOT CONFUSE

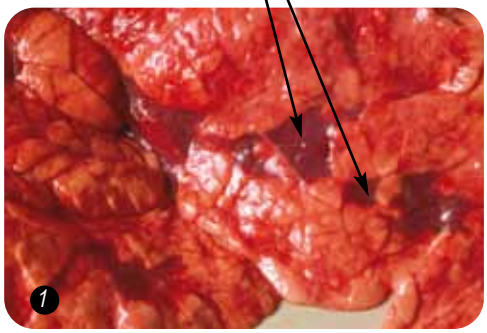
**Oedema in the strict sense is a lesion.
In the field, the term is sometimes used falsely when referring to acute respiratory distress syndrome or the terminal phase of progression that is likely to be acute.**

Atelectasis

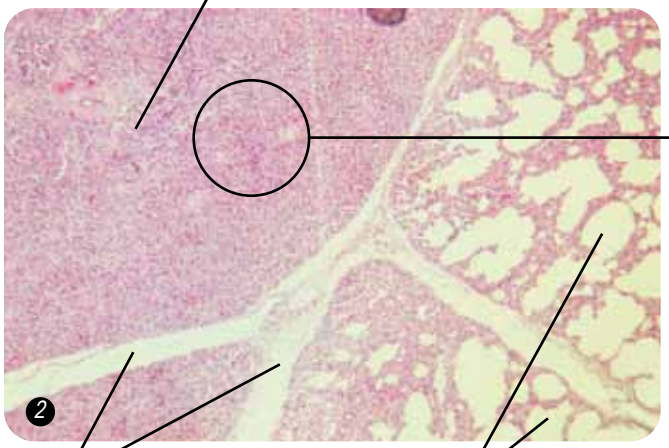
Definition: Alveolar and therefore lobular collapse due to the absence of airflow

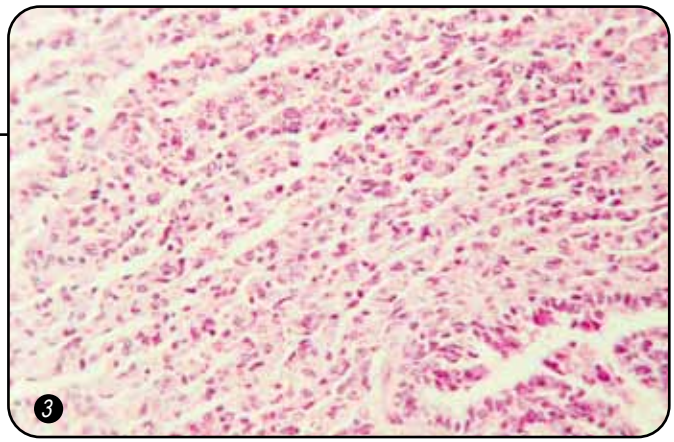
- Macroscopy: red tissue, slightly indurated, **with clear lobular contours,** depressed, associated with a bronchial lesion ❶
- Microscopy: cellular "strata" ❷ ❸

● **Expression:** depression of one or more lobules in relation to the adjacent emphysematous lobules



Atelectasis foci



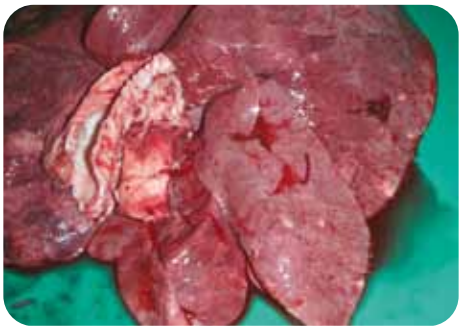


Cellular "strata"

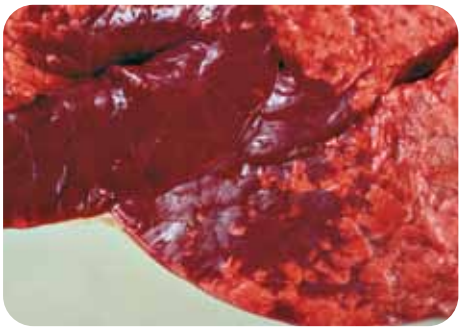
It is not a specific lesion:
several possible causes

DO NOT CONFUSE

In the field, a red and moderately indurated area
(interstitial pneumonia, *sheet 10)*
is often thought to be atelectasis, a less common lesion.



Interstitial pneumonia



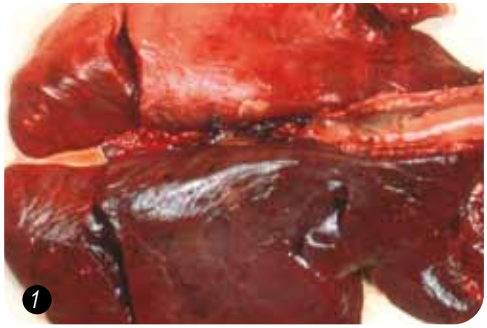
Atelectasis, clear lobular contours

With newborn calves (up to a few days old),
it is possible to observe "physiological" foetal atelectasis

Hypostasis and Autolysis

Hypostasis

- Accumulation of blood in slanting position, occurring *post mortem*
- Cranial if the cadaver has been hung for several hours (rare in practice, sometimes at the abattoir)
- Unilateral if lateral recumbency ❶
- **No increase in consistency**
- "flows" when cut ❷
- Sometimes more visible in section (the pleura may mask the pathological aspect)



Right unilateral hypostasis

- **Do not take samples at this location**
- **Hypostatic pneumonia is rare (lesion *ante mortem* following prolonged recubency).**

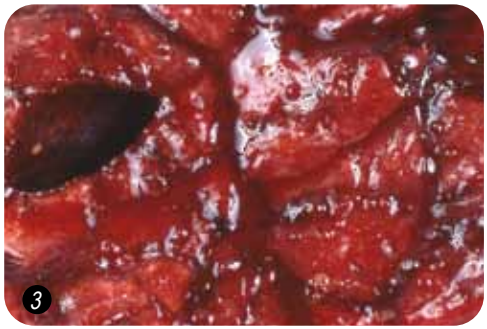
- **Hypostasis: unilateral, +/- associated with autolysis** ❷


❷

STOP

DO NOT CONFUSE

- **Oedema: often bilateral, dilation of the interlobular septa, appears shiny and moist when cut** ❸


❸

Autolysis and putrefaction

Compared to other organs, such as the kidneys and liver: the lung is not the preferred location for the phenomena of autolysis and putrefaction

Mannheimia haemolytica

Always

- **Marked lobar hepatisation** (alveolar pneumonia, *sheet 10*) ❶

Often

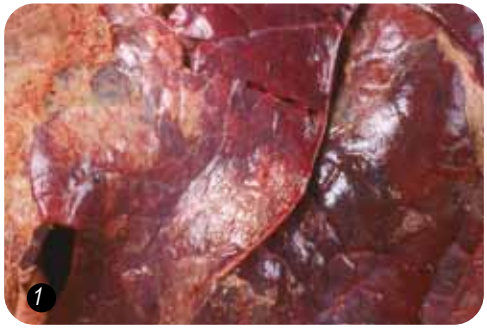
- **Pleurisy** *(sheet 8)* ❷
- **Typical necrosis** *(sheet 11)* ❸ ❹

Other pictures

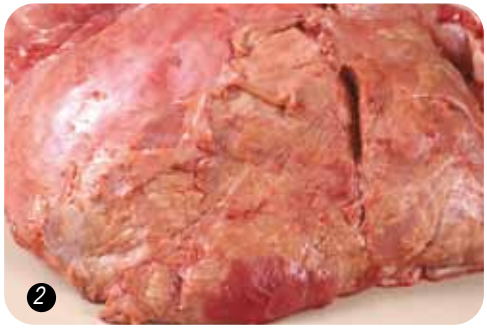
- Hepatisation
  - without necrosis
  - or without pleurisy
- Hepatisation + emphysema (caudal lobes)
- Hepatisation + non-adherent bronchial exudate from drainage
- "Cavitation" following the elimination of necrotic elements (sometimes classified as an abscess, *sheet 13*) ❺

The typical necrotic character of these lesions means that you do not have to carry out bacteriology

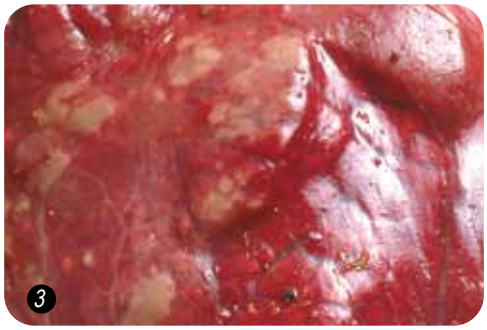
Typical picture



"Hepatisation"



Fibrinous pleurisy

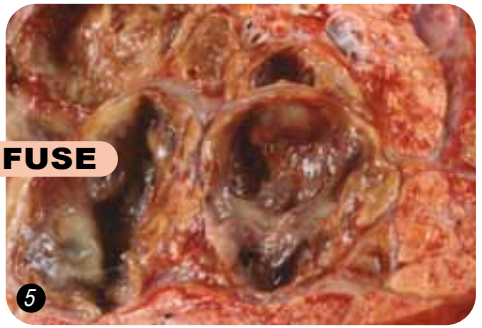


Necrosis seen on the surface

Necrosis seen in cross-section

DO NOT CONFUSE

with true abscesses



"Cavernous" sequestra

NEVER

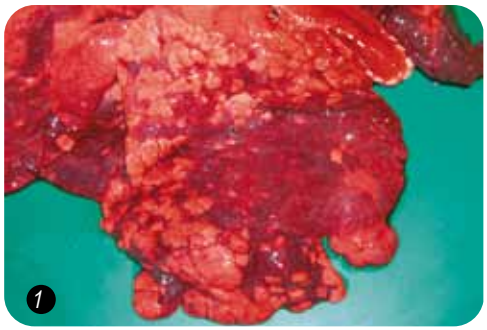
any moderate consolidation (indicating interstitial pneumonia, *sheet 10* **)**

These lesions do not exclude a primary viral infection

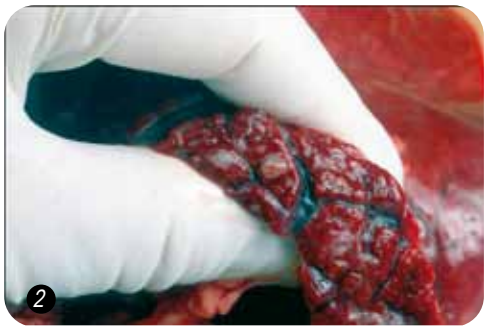
Single RSV infection

- **Always**
  - **Interstitial pneumonia** *(sheet 10)*
    - Cranial lobes (1)
  - **Mucopurulent bronchitis** *(sheet 12)* (2)
- **Often**
  - **Emphysema**
    - Interlobular or subpleural
    - Caudal lobes (3)
- **Other pictures**
  - **Interstitial pneumonia and mucopurulent bronchitis without emphysema** (4)

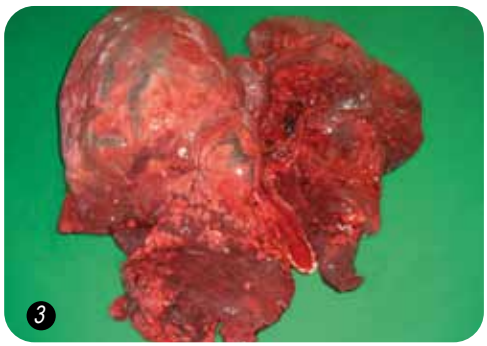
Typical picture



Interstitial pneumonia of the cranial lobes



Mucopurulent bronchitis



Interstitial pneumonia of the cranial lobes and emphysema of the caudal lobes

NEVER

- **pleurisy**
- **true hepatisation** (alveolar pneumonia) (if only RSV)

IMPORTANT

Possibility of RSV without emphysema
Remember: emphysema does not necessarily mean RSV *(sheet 9)*

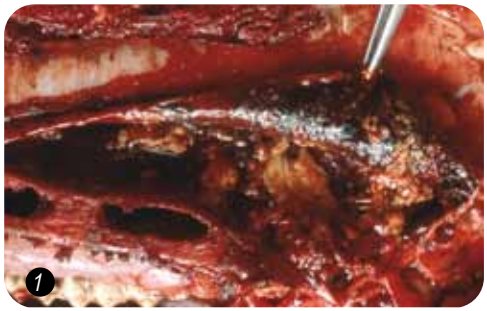
NECROPSY From pathogen to lesions

IBR

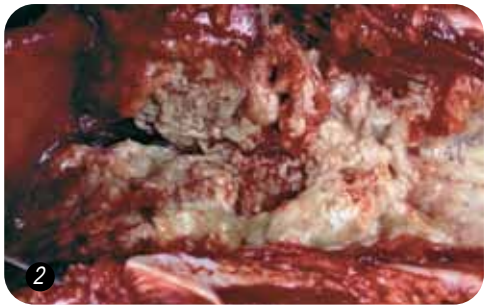
"snoring" sound

Typical picture

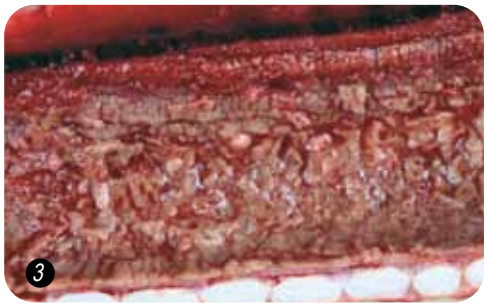
- **Typical picture**
  - **Fibrino-necrotic rhino-tracheo bronchitis**
    Highly suggestive lesions 1 2 3
  - **Yellowish coating adhering to the mucosa** 3
- **Other pictures**
  - **Emphysema frequent** 4
  - **Bronchopneumonia**
  - **Sometimes limited to laryngeal lesions** 5


1

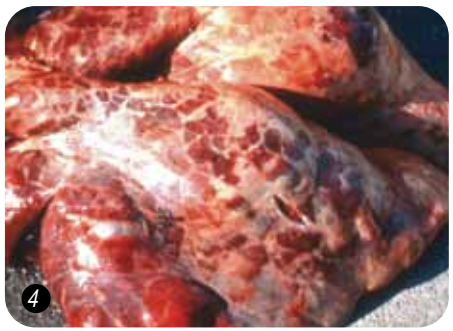
Hemorrhagic and fibrino-necrotic rhinitis


2

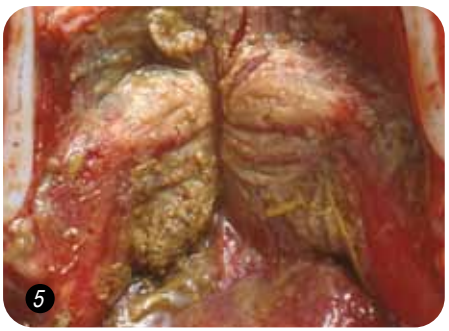
Necrotic-purulent laryngitis


3

Necrotic-purulent tracheitis


4

Severe emphysema

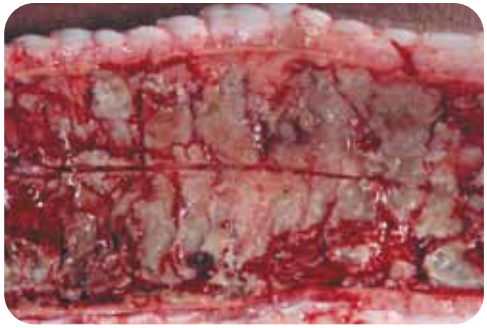

5

Fibrino-necrotic laryngitis

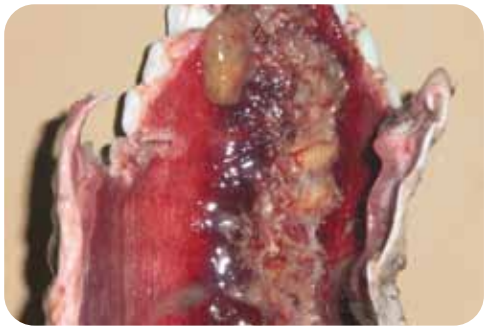
- **<u>Adherent</u> coating (yellowish) = IBR**

DO NOT CONFUSE

- **<u>Non-adherent</u> muco-purulent exudate from draining of bronchopneumonia**



Adherent fibrino-necrotic coating



Non-adherent muco-purulent exudate

Dictyocaulus

Bronchial wheezing

Always

- **Tracheo-bronchitis**
- **Abundant traceal mucus** ❶
- **Presence of parasites** (5 - 6 cm), ❷
  (up to 36 hours after death)

Often

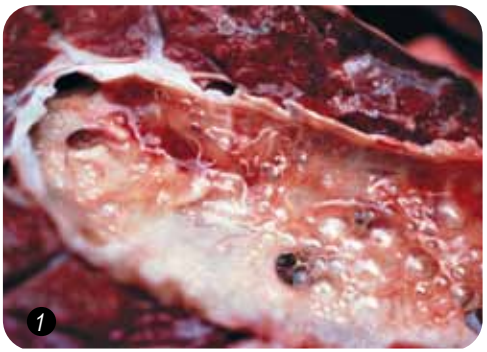
- **Numerous parasites** ❷
- **Emphysema** ❸

Other pictures

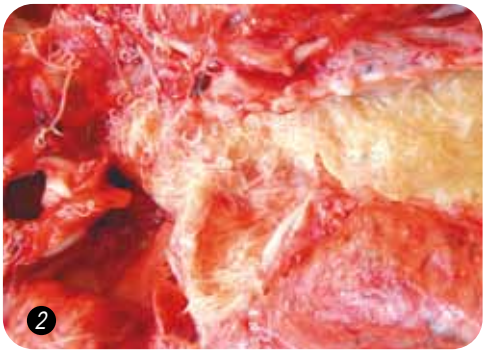
- **Few parasites**
  - Onset of infestation
  - Chronic carrier
  - First infestation, prepatent phase: mass emergence of larvae
  - Reinfestation and allergy
- **Complications**

NEVER
pleurisy (if only dictyocaulosis)

Typical picture

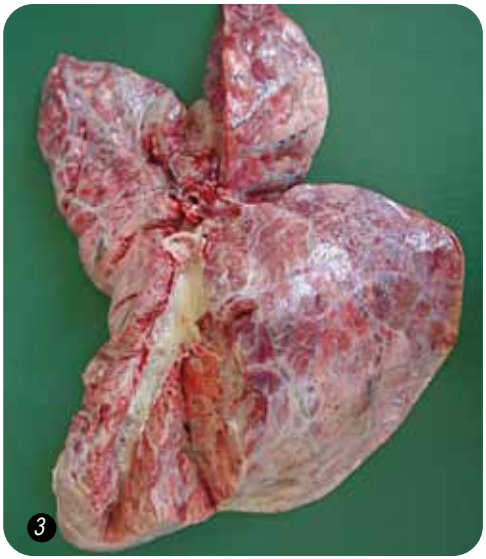


Abundant tracheal mucus



Numerous parasites

- **In the case of emphysema, do not forget to open the bronchi** *(sheet 9)* ❸
- **Verminous bronchitis can manifest itself during a housing period**



Emphysema due to dictyocaulus

Aspergillus

Typical picture

- **Multiple necrotic foci** *(sheet 11)*
  - of several millimetres in diameter
  - without increased consistency in of the lung ❶

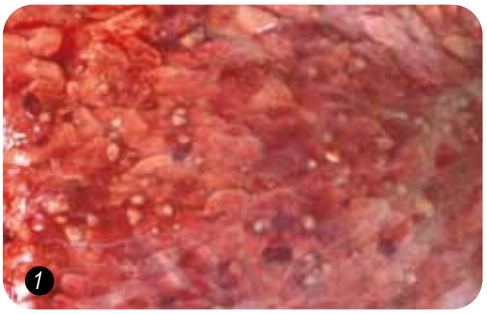
Other pictures

- **Association with bronchopneumonia**
  - Increased consistency ❷
- **Visceral pleurisy**
  - Slight

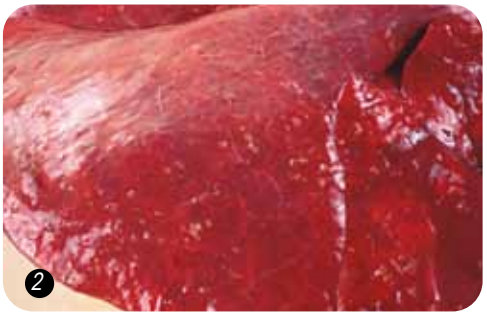
Aspergillosis is most frequently a sporadic disease, sometimes anademic[1], often secondary to immuno-depression

[1]: non-infectious but contamination of several animals from the same origin, such as mouldy straw (spread by a straw shredder, for example)

Typical picture



❶ *Necrotic foci*



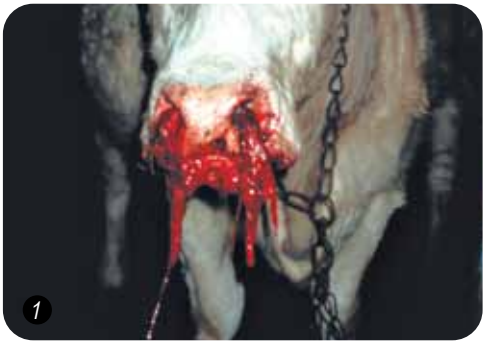
❷ *Bronchopneumonia + aspergillosis*

❸ *Close-up view: blackish edge*

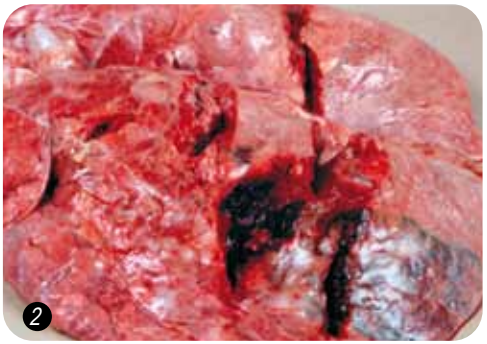
Pulmonary thromboembolism

- **Upper respiratory system** (symptoms)
  - Heamoptysis, often bilateral *(sheet 5)* ❶
  - Sometimes without haemoptysis

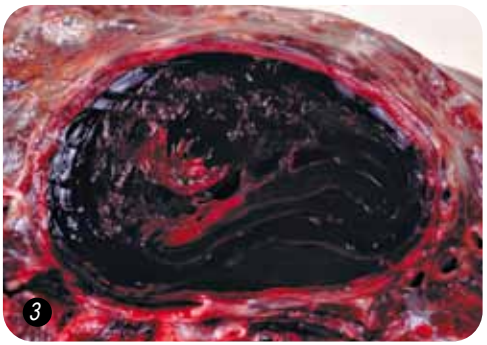
- **Pulmonary lesions** ❷ ❸
  - Embolism and pulmonary haemorrhages
  - Progression to abscessation



Haemoptysis



Pulmonary haemorrhage



Pulmonary thrombosis lesion

Other lesions
(complete autopsy required, *sheet 6)*

Young bulls

- **Thrombosis of the CVC (caudal vena cava)**
- **Hepatic abscess**
- **Ruminitis** ❺

Dairy cow

- **Thrombosis of the CVC with hepatic abscess** ❻ **caused by:**
  - foreign body
  - ruminitis
- **Mastitis**
- **Jugular phlebitis**

Ruminitis

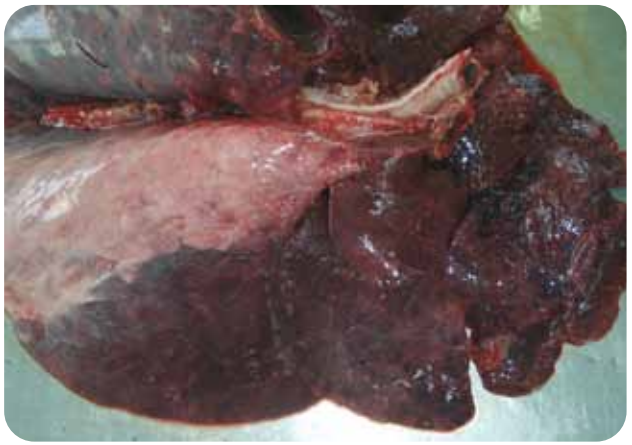
Thrombosis of the CVC

Lesions caused by ruminitis or acidosis are often no longer detectable at necropsy, when thromboembolism is observed.

Multiple infections

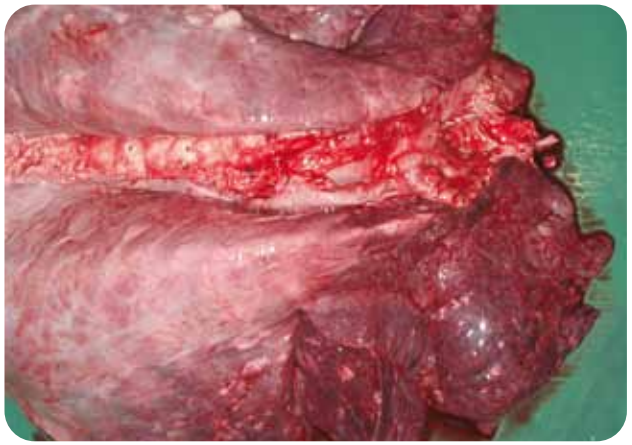
- In practice, most infectious bronchopneumonias (whether enzootic IBP or not) are consecutive to simultaneous or, more frequently, **sequential** mixed infections.

- They have in common:
  - **a preferentially cranioventral localisation**
  - **the absence of any lesions of a specific nature**



Necropsy report

- **Gross pathological diagnosis:**
  heavily extended cranioventral bronchopneumonia, acute/sub-acute character.
- **Description of the lesion and aetiological orientation:**
  Cranial and middle lobe, as well as anterior third of the right caudal lobe, with severe suffering from severe **induration** and **congestion**, without increase in volume. The degree of induration points primarily to **alveolar rather than interstitial pneumonia**. However, the gross characteristics identified exclusively during macroscopic examination do not suggest a specific bacterial or viral infection and indicate instead the intervention of **several pathogens**.

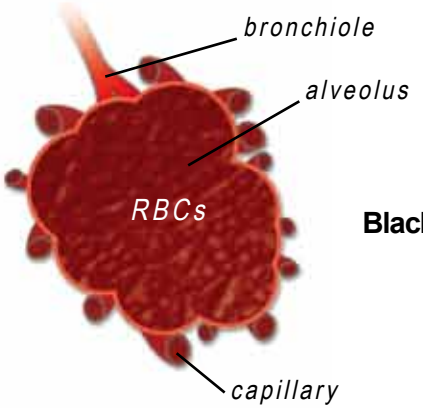
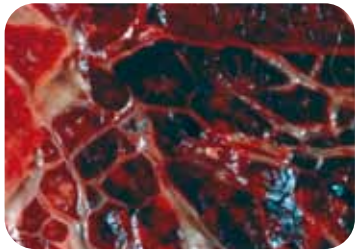
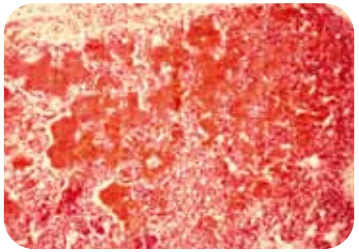


Necropsy report

- **Comment:** Bovine lung: moderately extended cranioventral bronchopneumonia of sub-acute character.
- **Description of the lesion and aetiological orientation:** Cranial, middle and apical third of caudal lobes show moderate **induration** and **congestion**, with a slight increase in volume. In the absence of complementary examinations, the purely macroscopic characteristics lead one to suspect **viral pneumonia without being able to exclude the intervention of bacteria**.

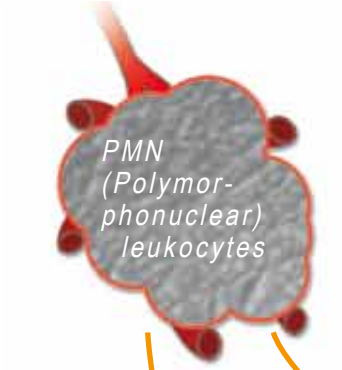
In this case, laboratory examination (See **ANALYSES**)
is indispensable in order to identify the pathogens.

Duration of progression

Time	True hepatisation (alveolar pneumonia, *sheet 10*)	Macroscopy	Microscopy
24h	 **Black hemorrhagic**		
48h	 **Red**		

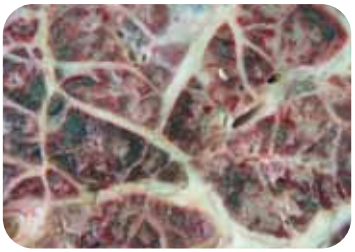
3 days

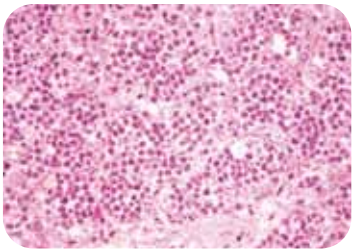
15 days - 3 wks.



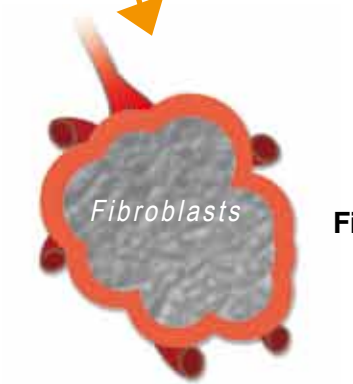
Grey

- Diffuse

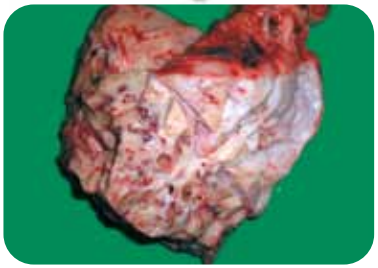




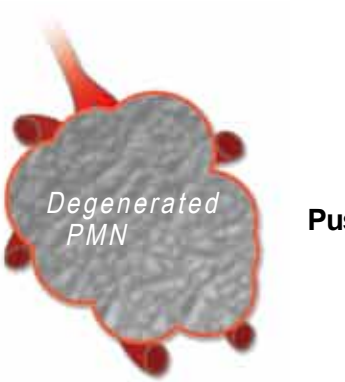
- White spots



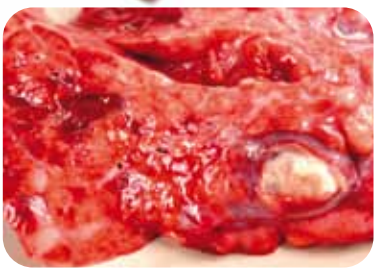
Fibrous



Fibrous pneumonia



Pus



Fibrous pneumonia + abscess

Duration of evolution

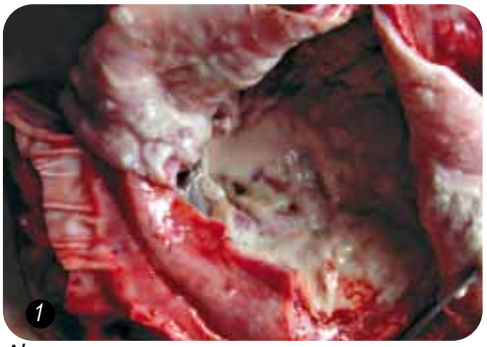
Duration of progression

Other criteria

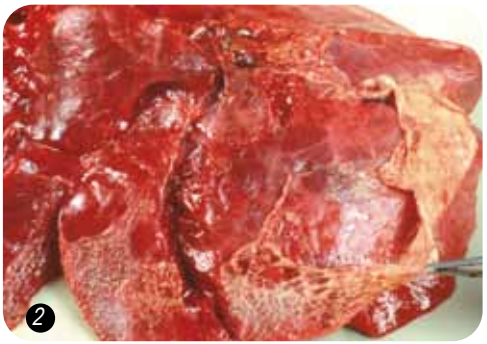
- **True abscess:** more than 3 weeks ❶
  (sheet 13)

- **Pleurisy** *(sheet 8)*
  - Fibrinous: after 24 - 48 h ❷

  - Fibrous: more than 3 weeks ❸



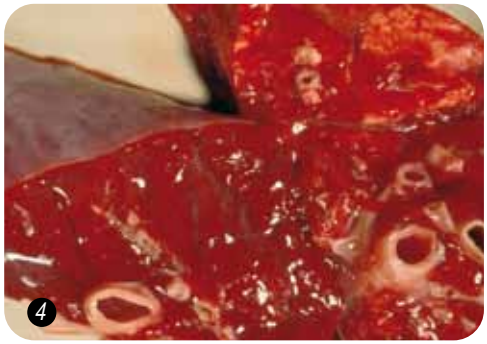
Abscess



Fibrinous pleurisy

Fibrous pleurisy

- **Bronchiectasis** *(sheet 12)*
  - Bronchial dilation with or without purulent content: more than 3 weeks ❹


❹

Bronchiectasis

- **Microscopy provides more precise information** than macroscopy
- **Margin of uncertainty:**
  - greater if the evolution is chronic
  - for an acute phenomenon, it is counted in days

- The result of the progression by means of histology clearly depends on the **location where samples are taken**
- If the pneumonia is heterogeneous, the stage of the lesion is **valid for one lobule only**: Look at the oldest lesion, to date the onset of the process

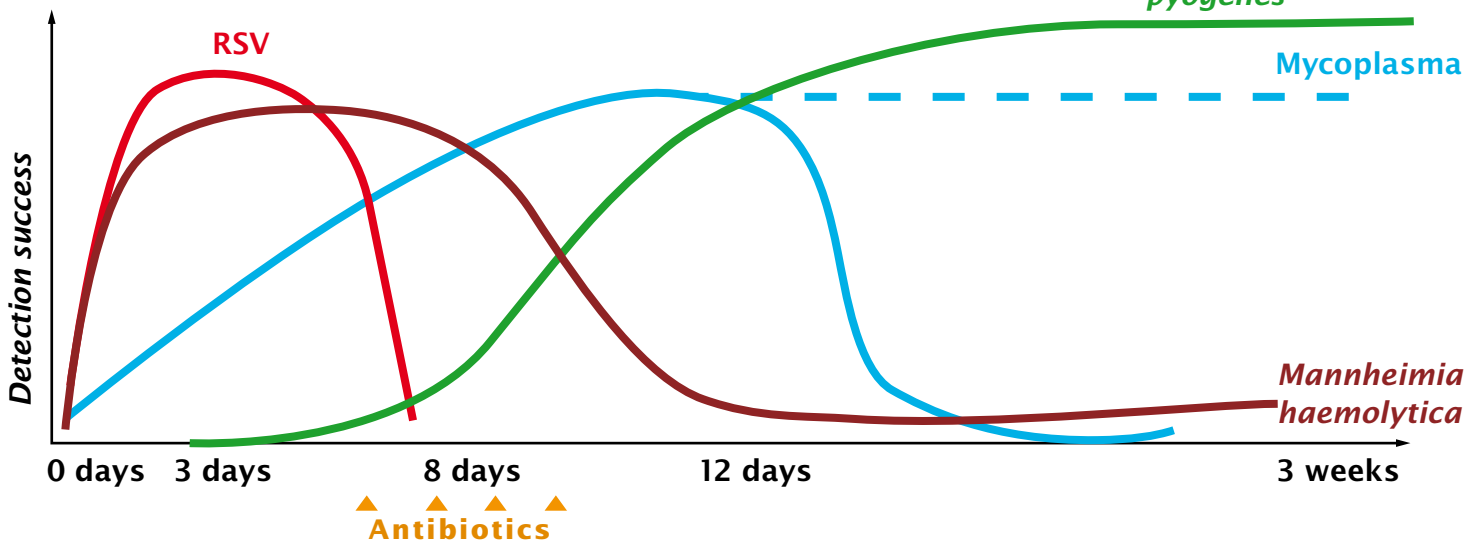
Lesions at different stages in the same lung.

ANALYSES

From sampling to pathogen

Secretions, lungs: sample carefully

When to take samples ?



Ideally

< 5 days

- hyperthermia
- before treatment if looking for bacteria

> 5 days

- For *Mycoplasma bovis* or BVD (IPI)

⚠ Do not head straight for the sick animal, **better to examine its neighbours in incubation.**

What to sample ?

Deep Nasal Swab	TTA/BAL Trans-tracheal Aspiration / Bronchio-alveolar Lavage	Lung
Virus +++ Bacteria +	Virus +/- (BAL>>TTA) Bacteria +++	Virus +++ Bacteria +++

- **Focus on DNS for RSV***
- Focus on TTA or BAL for bacteria*
- Avoid sampling from the posterior pulmonary lobes

* depending upon the working conditions, transportation, and techniques for analysis *(sheets 29 and 30)*

- Sample 10% of animals (with a minimum of 3)
- Taking samples at the analysis laboratory limits the risk of contamination: transport the carcass *(sheet 6)* or a half-lung

Secretions, lungs: sample carefully (continued)

Transportation

Timing (sampling – analysis)

- Ideal < 12 h (TTA +++)
- Limit < 24 H
- Caution: for the lungs, count the timescale from the time of death
- To be adjusted according to:
  - **the pathogens:**
    - RSV very fragile
    - Mycoplasmas and Pasteurallae less labile than RSV
  - **sampling techniques:** for TTA < 24h is essential
  - **analysis techniques:**
    - cell culture: for RSV, 3 h. at ambient t°, 6 h maximum at 4° C (other viruses less labile)
    - detection of viral Ag or PCR: < 24 h

Conditions

- Cool but above freezing point (0 - 4° C):
  - *Histophilus*: stable for 2-4 hours
  - Pasteurellae: stable for 2 days
  - Mycoplasmas: stable for 4 days
- Freezing (-20° C):
  - **Ensure that this condition is maintained until the laboratory is reached**
  - Freezing diminishes the titre
  - Risk of false negative results
  - Variable effect:
    - according to the initial titre
      - ▸ Pasteurellaceae: major reduction (*Histophilus* in particular)
    - according to the pathogens
      - ▸ Viruses and mycoplasmas are more stable

- **Transport medium**
  - Not necessary if the timing and temperature are adhered to.

In practice: **if samples are taken on Friday**
(more than 48h between sampling and analysis),
it is better to freeze them.

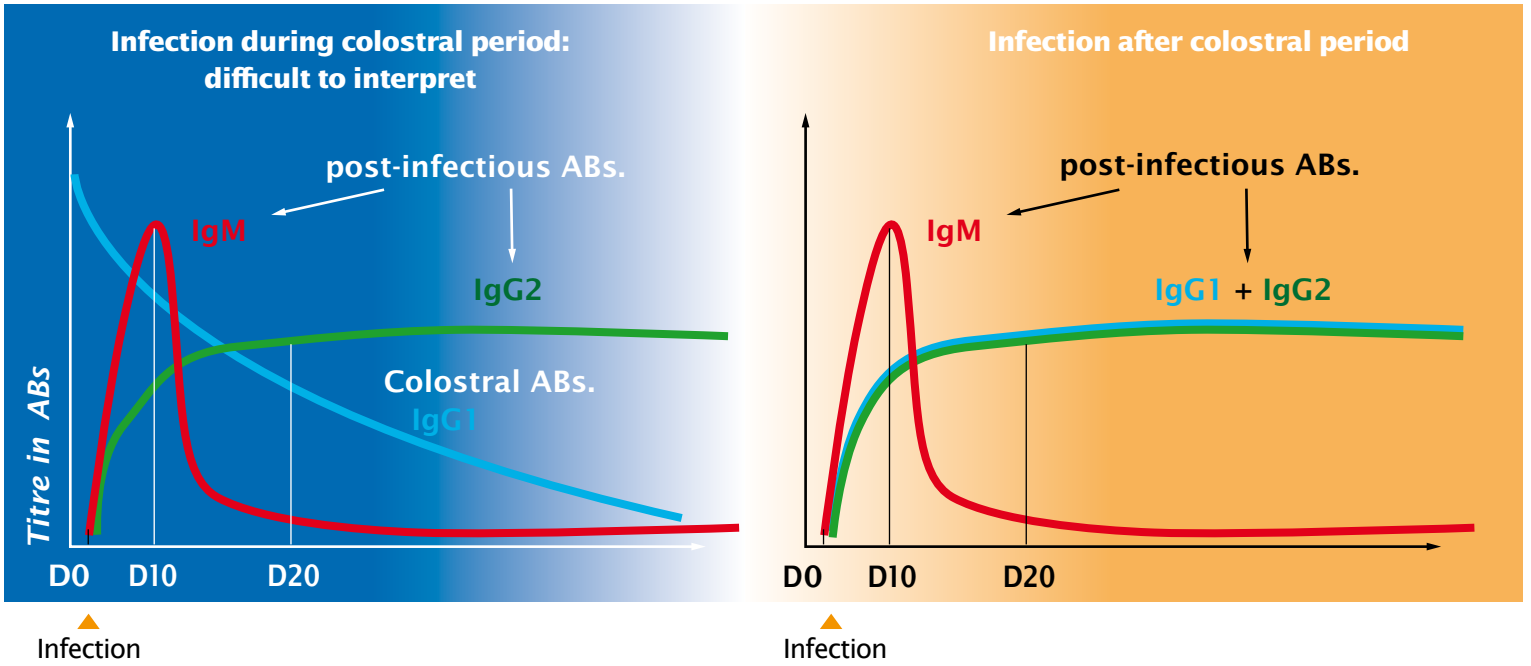
Timescale for results

Response time according to diagnostic method				
Bacteria	**Virus**			
Culture identification	Cell culture	IF	ELISA Ag	PCR
3 - 15 days	5 - 30 days	A few hours	A few hours	8 - 24 hours
Mycoplasmas: 10 days				

Blood: sample carefully

Age of the calf

3-6 months



IgM: 1 blood sample is sufficient, 10 days after infection, but not highly sensitive

IgG totals = Colostral ABs (IgG1) + Post-infectious ABs (IgG1 + IgG2) + (if vaccinated: Post-vaccinal ABs (IgG1 + IgG2))

The colostral ABs. (up to 3 - 6 months)

- are found at analysis after the first blood sample
- block the detection of post-infectious ABs of type IgG1

RSV, PI3 or IBR **vaccinations lead to a positive test result**

In practice:

ABs:

- Animals older than 6 months (colostral ABs have disappeared)
- Non-vaccinated
- 10% of the group with a minimum of 5 calves
- **1st blood sample as soon as possible after the onset of infection** (due to rapid seroconversion)
- **Paired sampling required**

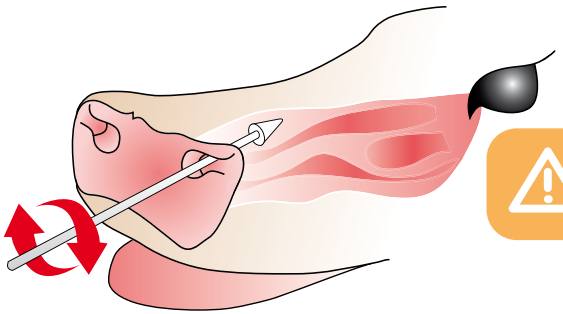
- 2 blood samplings at 2 - 3 week apart
- analysis at the same time in the laboratory:
- Inform the laboratory: it should freeze the first serum

(analysis and interpretation *sheet 32*)

Deep nasal swabbing

- **Materials**
  - Ideal swab:
    - with brush, plastic stem, protected

- **Procedure: schematic (section)**
  - Nasal meatus *(cf. sagittal section below)*
  - Vigorous “brushing” of the mucosa



RSV is closely linked to the cells:
vigorous brushing is indispensable in order to obtain a sample rich in cells.

Analyses

- **Pathogens**
  - Virus:
    - Good predictive value
    - RSV: in most laboratories
    - Other viruses: only certain laboratories
  - Bacteria:

Some animals are healthy carriers of bacteria in their nasal cavities (false positive results), taking samples from several animals (> 5) makes it possible to interpret the results (good agreement on a collective scale with BAL) .

- **Techniques:**
  - Bacteriology *(sheet 33)*
  - Virology according to the laboratory
    - Immunochromatography
    - Immunofluorescence (IF, *sheet 35)*
    - ELISA capture of Ag

    ▸ test for viral Ag
    - Cell culture

    ▸ cytopathogenic effect and identification (by IPX, for example, *sheet 36)*
    - PCR

    ▸ test for nucleic acids from the virus

Rapid qualitative analysis kit

- Immunochromatography or Ag capture ELISA
- Relatively sensitive
- Specific
- For RSV only
- Pooling possible (3 samples)

ANALYSES From sampling to pathogen

TTA *(Transtracheal Aspiration)*

Materials ❶

- Probe: Centracath Vigon®, ref. 137/20, 75 cm ❷

Procedure, key points ❸ ❹

- Good retention is vital
- Limit 1/3 inf – 1/3 centre of neck
- Catheter inserted 40-50 cm
- 50 ml of physiological saline solution injected then reaspirated immediately (only 2 - 10 ml are recaptured)

Analyses

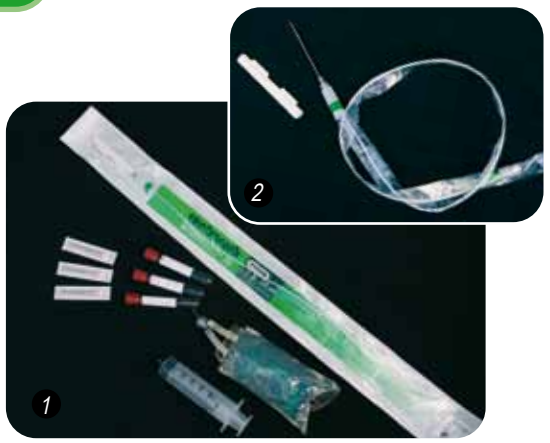
- **Pathogens**
  - Bacteria
  - Virus: RSV, IBR, PI3, adenovirus
- **Analysis techniques** *(sheets 29 and 33 - 36)*

Interpretation

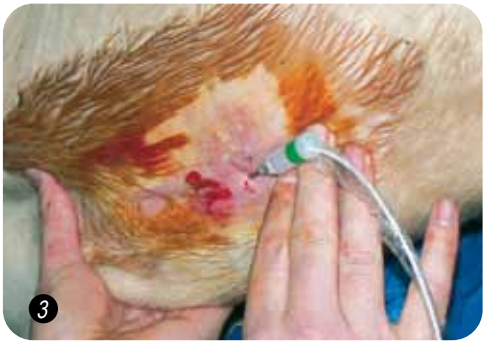
- **Presence of virus: implication certain**
- **Presence of bacteria: see "bacteriology"** *(sheet 34)*

- **2 ml per animal is sufficient**
- **Possibility of pooling up to 3 animals without reducing sensitivity***
- **The advantage of the technique (in comparison with deep nasal swabbing) is when searching for bacteria: there are no healthy carriers in the lung, in contrast to the nose.**

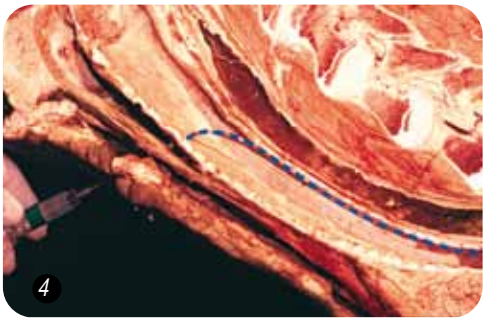
** It is easier to pool TTA than deep nasal swabs*



Catheter for TTA



Tracheal puncture



Sagittal section of the neck: position of the catheter in the trachea

"Easy" BAL *(Bronchoalveolar Lavage)*

In practice

- "Academic" BAL is performed with a fibroscope and under anaesthetic. Under these conditions, its routine application is limited.
- However, with an adapted probe, BAL without a fibroscope can be conducted and produces good results 5 6

Advantages

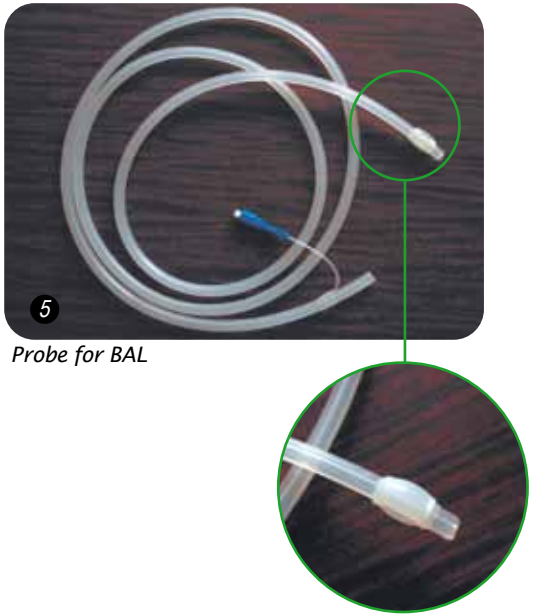
- Lower respiratory system
- Sample rich in cells (RSV is linked to cells)
- High volume collected: for 60 - 200 ml injected, one can recover 30 – 100 (useful for RSV, fragile and difficult to cultivate)

Disadvantages

- Possible contamination in the upper airways
- More complex and expensive than TTA (price of the probe)

Procedure

- Several techniques
- With or without fibroscope 6
- Probe diameter/age
  - Adults: 8 - 10 mm X 2.45 m (Bivona, Cook, Genia, with reference to horses)
  - Calves: human gastric probe (Vygon)



Probe for BAL

BAL without fibroscope

ANALYSES From sampling to pathogen

Lung

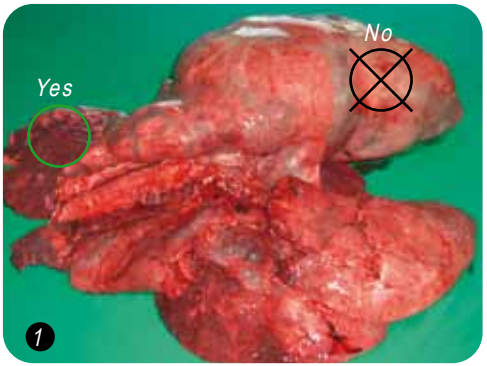
Where should samples be taken? 1

- **Cranial** area, if possible
- Indurated area
- Junction between healthy/affected tissue

▸ Virology and bacteriology

▸ Histology

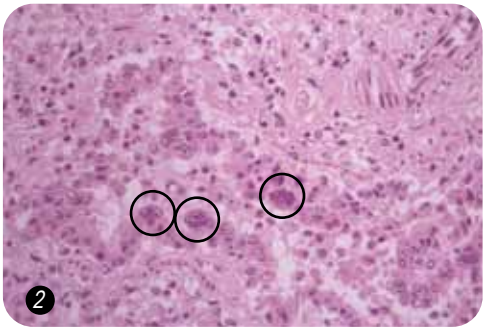
Do not take samples from the emphysematous area 1



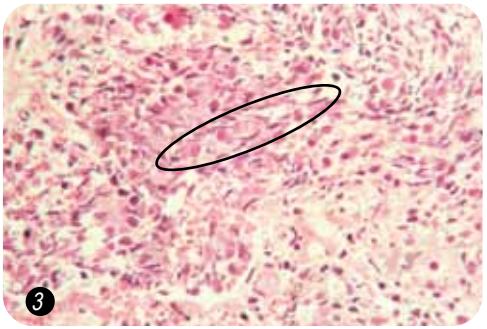
Where to take samples from?

Analyses

- **Virology:** RSV, PI3, adenovirus, BVD (ELISA Ag or IF from frozen section)
- **Bacteriology**
- **Histology:** lesion orientation for a "hesitant" macroscopic analysis
  - **Physiopathological orientation** *(sheet 10)*:
    - Interstitial pneumonia
    - Alveolar pneumonia
  - **Aetiological orientation** in relation to the clinical examination and the picture of lesions
    - Syncytia: RSV or PI3 possible 2
    - Necrotic foci and oat cells: *M. haemolytica* possible *(sheet 11)* 3
    - Mycelial elements (PAS coloration): Aspergillosis



Syncytia: RSV or PI3



Oat cells: M. Haemolytica

- **For histology:**
  - **Contact a specialist veterinary pathology laboratory**
  - **Interpret the results in the context of the clinical signs and lesions**

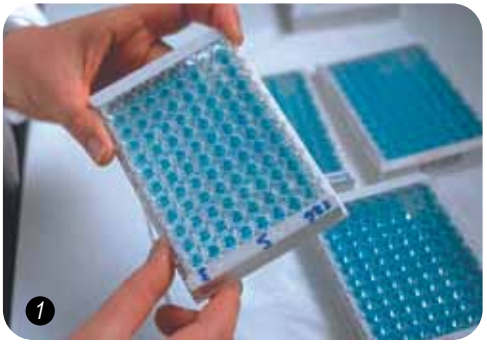
Blood

Routine serology

- Virus: RSV, PI3, IBR, adenovirus, BVD
- *Mycoplasma bovis* (according to laboratories)
- **No serology in routine practice for pasteurellae**

Techniques

- ELISA in routine practice in all laboratories, semi-quantitative ❶



ELISA plate

What about seroneutralisation?

- **It is only used for viruses**
- **It can only be conducted in a small number of laboratories equipped for cell culture** ❷ ❸

Seroneutralisation is a quantitative test mostly performed in microplates.

Virus and the serum to be tested are pre-incubated for a certain time prior to the addition of cells.

In case of cytopathogenic viruses, the neutralisation will be judged after reading for cytopathogenic effects. Detection of non-cytopathic viruses requires immunostaining (fluorescence or enzymes like peroxidase).

The result is quantitative due to the serial dilutions of the serum to be tested.

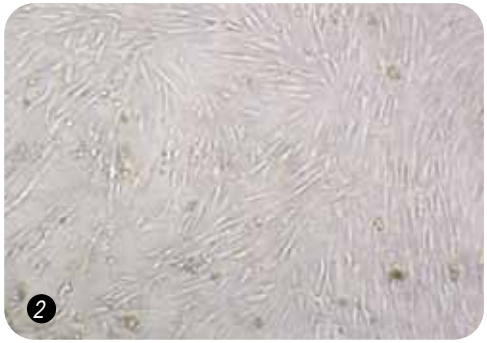
Interpretation

- Compare with the maternal seroprevalence
- Useful for germs with **low individual prevalence**
- For germs with **high individual prevalence** (RSV, PI3, adenovirus), seropositivity of animals is very frequent and makes the 2nd blood sampling compulsory.
  The higher the initial seropositivity, the less chance one has of identifying an increase
- Compare with the maternal seroprevalence
  - If seroconversion: 0 ⟶ +
  - If there is an increase:
    - of **2 dilutions (titer X4) with** seroneutralisation
    - of **2 +** in ELISA, to be adjusted according to the kits

- The phenomenon of heterospecific increase of ABs can explain an isolated increase of ABs in 1 animal in a batch
- No virus isolation in the blood for RSV, IBR and PI3
- Cannot be a diagnostic method for emergency use: the sero-conversion require a minimum of 3 weeks

In the future …

The amount of IgG2 (even during the colostral period), would enable interpretation using a single blood sampling, without paired samples (sensitivity to be specified)



Cell culture: uninfected bovine foetus kidney cells

Cell culture: CPE due to PI3 virus

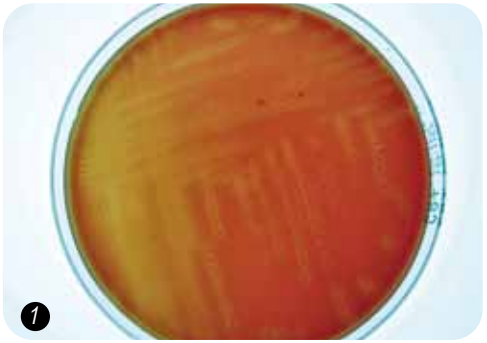
Bacteria

Techniques

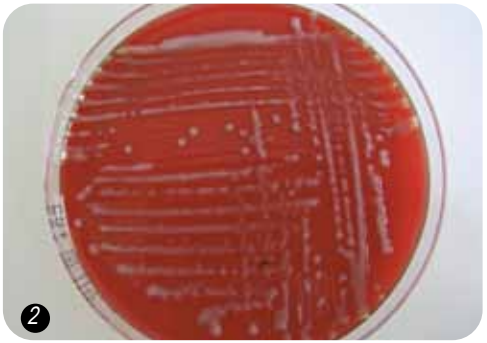
- Serology:
  - Conducted for *Mycoplasma bovis*
  - **Not routinely used for pasteurellae**

- Culture:
  - In routine practice: Pasteurellae *(Mannheimia haemolytica* ❶, *Pasteurella multocida* ❷*), Arcanobacterium pyogenes*
  - Specific request **from the practitioner** for:
    - *Mycoplasma bovis* and *Mycoplasma dispar*
    - *Histophilus* ❸
    - Salmonellae

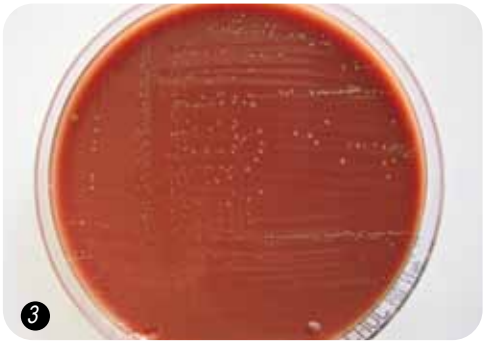
Identification of species is obligatory for the mycoplasmas, most laboratories restrict themselves to diagnosing the Mycoplasma type *(sheet 34)*



Area affected by hemolysis: Mannheimia haemolytica



Pasteurella multocida



Histophilus somni

Samples

- TTA, BAL, lung : +++ *(sheets 30 and 31)*
- Deep nasal swabbing *(sheet 29)*:
  - Healthy carriage of pathogenic bacteria in the upper airways
  - Contaminations due to commensal bacteria or fungi, which are not relevant, compromise isolation

Transport *(sheet 27)*

- Within 24 h
- Transport media unnecessary if delay and temperature respected
- Store cool but above freezing point (2 - 4°C)
- Freezing if sampling – analysis interval > 48 h

Some bacteria are very fragile
(false negative results possible): *Histophilus somni*

Bacteria *(Interpretation)*

The result should be interpreted according to the pathogenicity recorded and the problems observed.

Major pathogens

Common	Uncommon
Mannheimia haemolytica *Pasteurella multocida* *Histophilus somni* *Arcanobacterium pyogenes* *Mycoplasma bovis*	*Salmonella typhimurium* *Salmonella dublin* *Aspergillus sp.*

Controversial or minimal role

- *Mycoplasma dispar* (1)
- *Mycoplasma bovirhinis*
- *Mycoplasma arginini*
- *Streptococcus pneumoniae*
- *(Pseudomonas)*

Contaminants

- *Escherichia coli* (2)
- *Klebsiella*
- Staphylococcus
- *Aspergillus sp.*
- *Proteus etc.*

(1) *pathogenicity recognised but moderate*

(2) *it is possible to isolate colibacilli of septicemic pathovar in the lungs, in the absence of true pulmonary lesions*

- *Aspergillus* grows in conventional media (blood agar) if it is abundant in the sample: no specific request is necessary 1
- Nevertheless, the attribution of respiratory problems to Aspergillosis must take into account the gross pathology aspect *(sheet 21)*

Aspergillus fumigatus

Serotyping of *Mannheimia haemolytica* ?

- Unnecessary in practice, serotypes **A1** and **A6** are the most prevalent
- Some recent vaccines provide cross protection

Antibiotic resistance test

Is the antibiogram useful ?

- **NO, if no common resistance is known** *(P. multocida, H. somni, A. pyogenes)* or, *A. fortiori*, if pathogenicity has not been identified or suggested *(E. coli, Pseudomonas)*
- **YES, in case of frequent antibioresistance** *(M. haemolytica,* Salmonella spp., etc.)

Technique

- The disc method is most frequently used in routine practice ❷ ! !
- This method is not applied to mycoplasmas

Interpretation

Ensure that the sample is representative

If the sample is taken from a treated animal, the isolated bacterium may have been produced by selection pressure due to the antibiotic treatment and **is not representative of the bacterium that caused the problem.**

In practice

Samples taken from an **untreated living** animal are **preferable and even obligatory**.

RSV

Particular characteristics of RSV

- Virus closely associated with the cells
- Highly labile virus: very rapid transport required if the cell culture technique is used

Technique

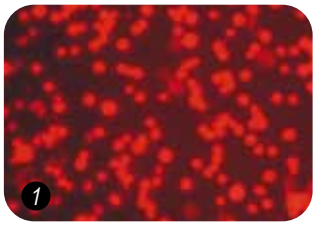
- Serology
  - Obligatory kinetics (high seroprevalence: an isolated blood sampling is difficult to interpret - *sheet 32)*
- Virology
  - Cell culture: method unsuitable in practice (1)
  - Detection of Ag: good sensitivity
    - **Immunofluorescence** (IF): at the analysis laboratory only ❶ ❷
    - **Immunoenzymology** (IPX, ELISA Ag, rapid tests) ❸ ❹
  - PCR: small number of laboratories ❺

Miraculous PCR?

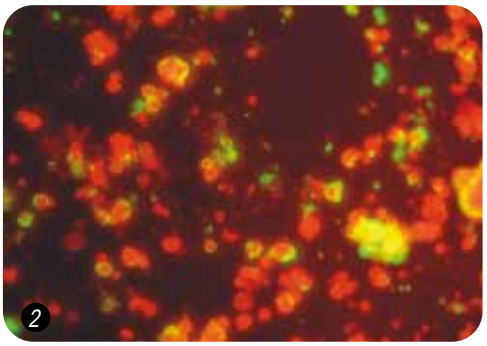
In practice, epidemiological sensitivity, which takes into account the sampling and transport phases, is often lower than that of common methods for the detection of Ag

- Histology: *sheet 31*

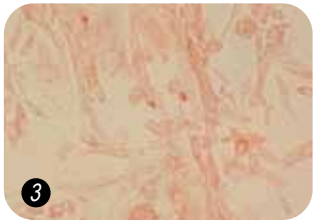
(1) *Because the virus is very labile. However, following rapid transport (3h or 6h max. at 4°C) of good samples, this technique produces excellent results.*



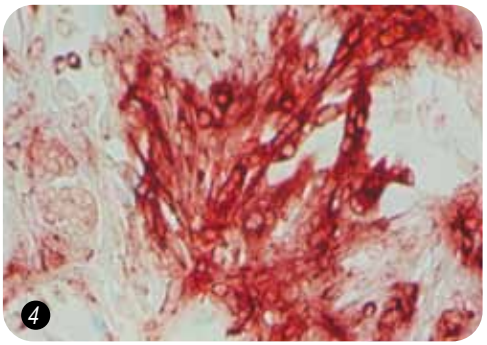
IF: control



Positive immunofluorescence in RSV



IPX: control cells



Cell culture infected by RSV: positive in IPX

Samples

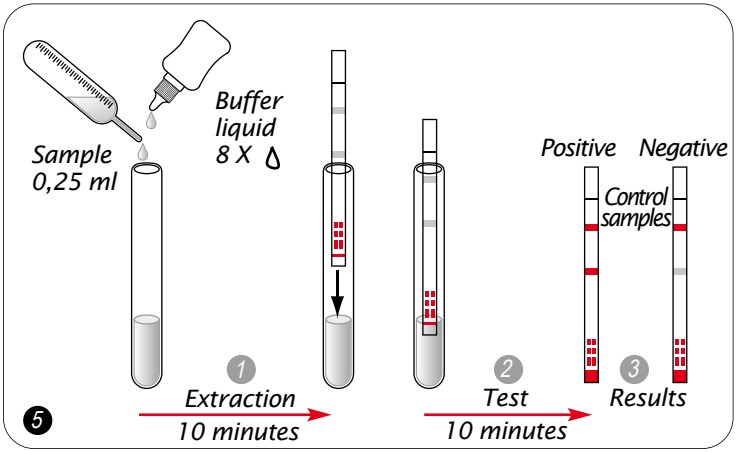
- Deep nasal swabbing, BAL, lung : +++
- TTA: centrifugation can make it possible to recover a sediment rich in cells

Transport

- Store cool but above freezing point: 2 - 4°C
- Freezing possible if the timescale for sampling – analysis > 24 h (and no thawing)

- Importance of prompt sampling in relation to the clinical phase *(sheet 26)*
- Importance of transport, for the cell culture technique (very labile RS virus)

- **Deep nasal swabbing is an excellent sampling technique**
- **Rapid methods for the detection of Ag are reliable and can be conducted in the practice** ❺



Other viruses

Particular characteristics

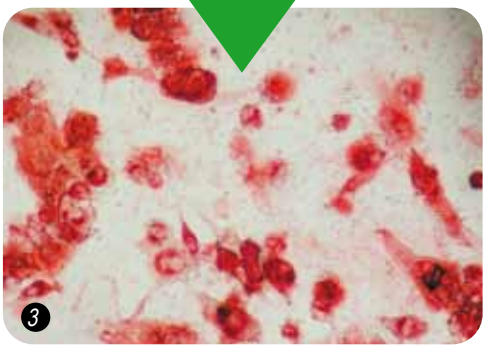
- Viruses less labile than RSV
- High prevalence of **PI3** and **adenovirus**
- Clinical **IBR** is rare
- The **BVD** virus contributes to respiratory problems, particularly due to immuno-supression

Techniques

- Serology
  - Less useful for PI3 (high prevalence)
  - More useful for IBR (see status of the herd)
  - Kinetics obligatory, 2 blood samples analysed at the same time *(sheet 28)*
- Virology
  - Cell culture: much more sensitive for IBR ❶ and PI3 ❷ than for RSV
  - Ag detection methods (IF, ELISA, IPX) ❸ ❹
  - No approved rapid test can be conducted in the surgery
  - PCR: not in routine practice except for BVD

Cell culture. ECP due to BoHV1 (IBR)

Identification by IPX



Cell culture infected by BoHV1 (IBR): positive in IPX

Samples

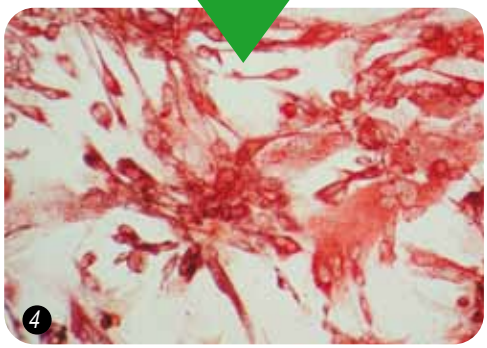
- Deep nasal swabbing, BAL, lung : +++
- TTA: centrifugation will enable to recover a pellet rich in cells
- Blood: for virology, only of BVD (Transient or Persistent Viraemia)
  - **no viremia for strictly respiratory viruses**

Transport

- Store cool but above freezing point: 2 - 4°C
- Freezing of the lung if delay for sampling
  - Freeze if timing from sampling to analysis is >24h (do not thaw)

Cell culture. CPE: PI3

Identification by IPX



Cell culture infected by the PI3 virus: positive in IPX

Dictyocaulus

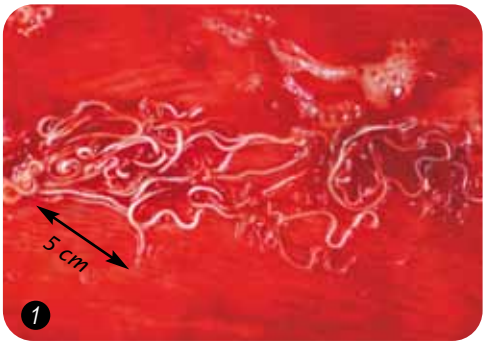
Particular characteristics

- **Adult Dictyocaulus**
  - visible to the naked eye (5 - 6 cm) ❶
    - at the opening of bronchi *(sheet 7)*
    - if the necropsy is conducted without delay (parasite lysis after 48 h)
  - are abundant except for:
    - onset of infestation
    - chronic carrier
    - first infestation in prepatent phase: arrival of larvae en mass
    - reinfestation and allergy
- **The larvae** are identified using a specific coproscopic technique

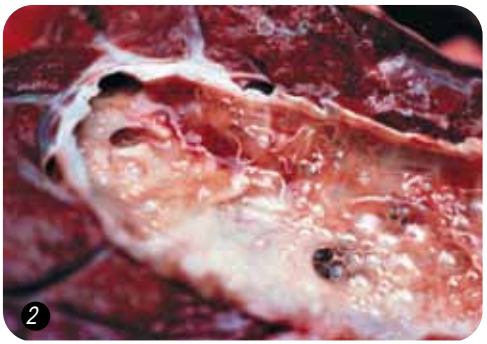
Techniques

- Dead animal: Necropsy and opening of trachea and bronchi ❷
- Live animal: Analysis of faeces, Baermann technique (Baermann device + microscope) ❸ ❹

The Baermann technique can be used in the surgery



Adult Dictyocaulus



Abundant mucus + parasites

Baermann device

Samples

- Faeces
- 5 - 10% of animals
- Sample from the rectum

Transport

- rapid (within 12 h), kept cool but above freezing point (lability of larvae)

Dictyocaulus larva

STOP

- **Viability of larvae in faeces: 12 h**

DO NOT CONFUSE

- **Viability of adults in the bronchi: it takes several days before adults are found in bronchi**

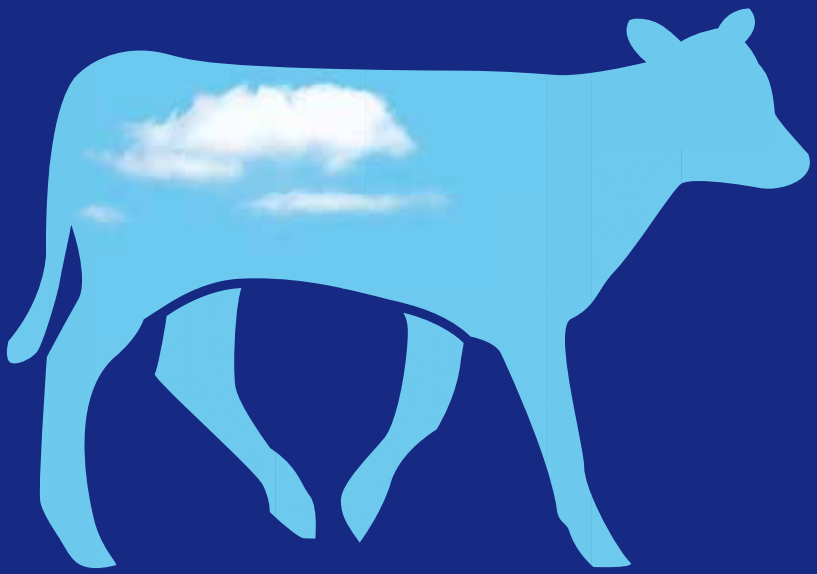
- **A single negative Baermann test does not necessarily exclude verminous bronchitis:** the larval excretion is variable (time of sampling, immunity etc.)technique
- **Several samples are therefore necessary to exclude Dictyocaulosis**

INDEX

Abbreviations

ABs	Antibodies
Ag	Antigen
ARDS	Acute Respiratory Disease Syndrome
BAL	Bronchoalveolar lavage
BVD	Bovine Viral Diarrhoea
BS	Blood Sample
CPE	Cytopathic Effect
CVC	Caudal Vena Cava
DNS	Deep Nasal Swabbing
EIBP	Enzootic Infectious Bronchopneumonia
ELISA	Enzyme Linked Immunosorbent Assay
ENV	Ecole Nationales Vétérinaire
ENVT	Ecole Nationales Vétérinaire Toulouse
FB	Foreign Body
IBP	Infectious Bronchopneumonia
IBR	Infectious Bovine Rhinotracheitis
IF	Immunofluorescence
Ig	Immunoglobulin
Ig G	Immunoglobulin G
Ig M	Immunoglobulin M
IPI	Immunotolerant Persistently Infected
IPX	Immunoperoxidase
ND	Notifable Disease
PMN	Polynuclear Neutrophil
PAS	Periodic Acid of Schiff
PCR	Polymerase Chain Reaction
Pi3	Parainfluenza 3
RBC	Red Blood Cells
RSV	Respiratory Syncytial Virus
SVS	State Veterinary Services
TTA	Transtracheal Aspiration

Lung Health



EVERY BREATH COUNTS

MSD Animal Health

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