ADULTS: LOWER RESPIRATORY TRACT

GENERAL ASPECTS OF RESPIRATORY DISEASES

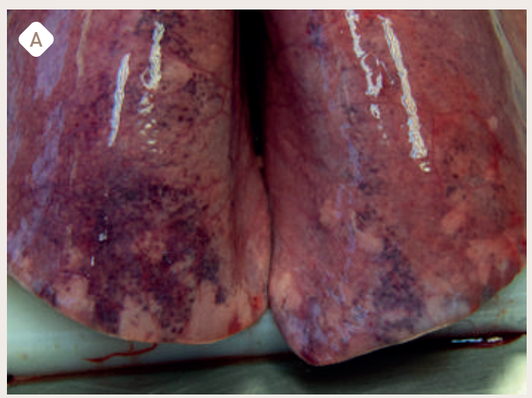
3.78. **Dyspnea.** Mixed or expiratory dyspnea are the main clinical signs associated with lower respiratory tract disorders. The animal takes an orthopneic position with an increased respiratory effort and shallow and abdominal breathing when the disorder is acute (A). When the condition is really severe, the animals can show streaking mouth breathing (B). If they are forced to exercise, they refuse and lie on the ground with their necks stretched out (C). Animals affected by chronic respiratory disorders show recurrent weight loss that leads to cachexia (D).

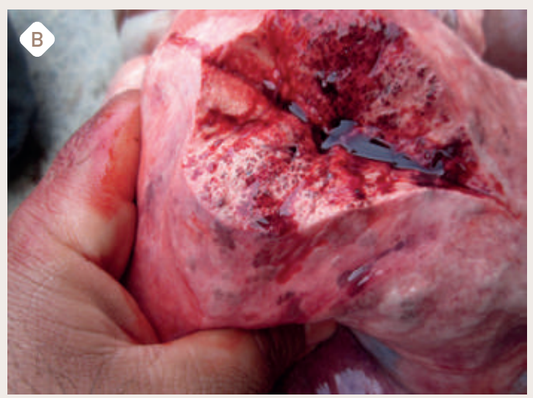
3.79. **Cough.** Exercise or sudden movements cause them to cough, especially in productive disorders.

3.80. **Risk factors.** Adverse weather, dust, stress, poor ventilation, etc., are predisposing factors for these disorders.

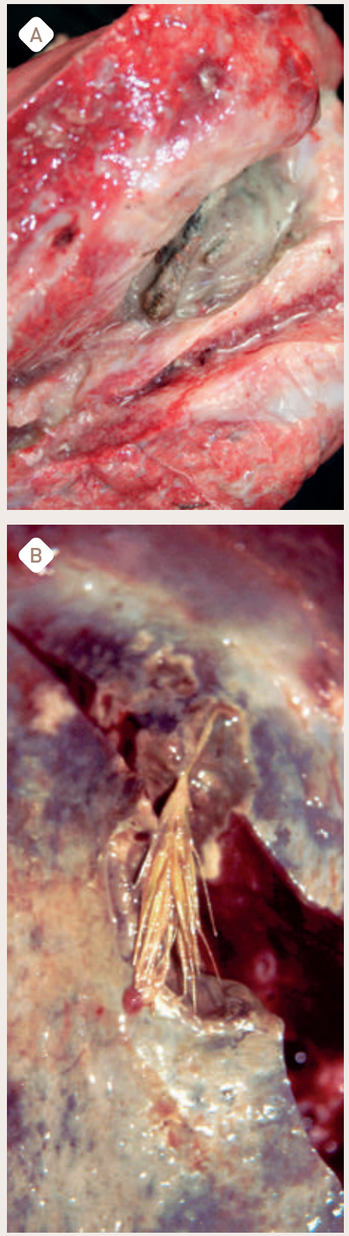
FOREIGN BODY ASPIRATION AND INHALATION PNEUMONIA

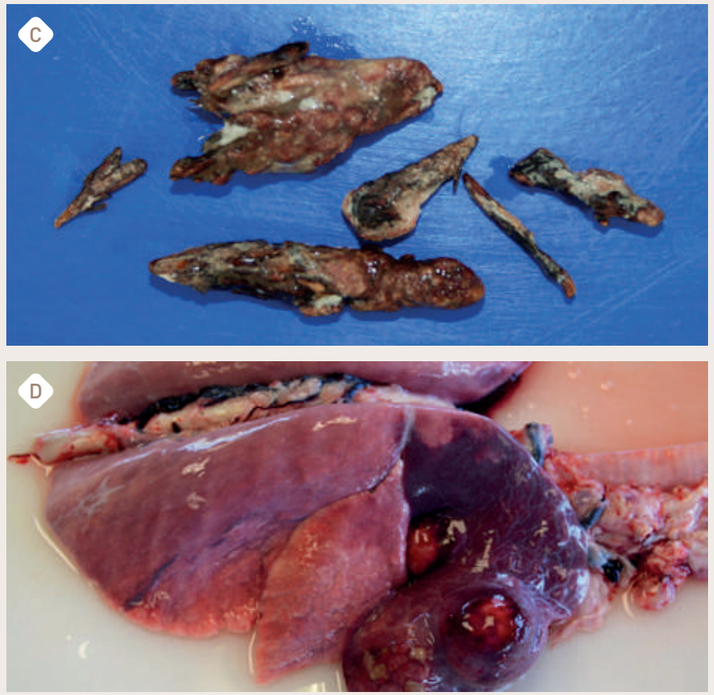
3.81. **Deviant swallowing and death.** Diverted swallowing of a significant amount of food can cause death by suffocation without respiratory clinical signs.

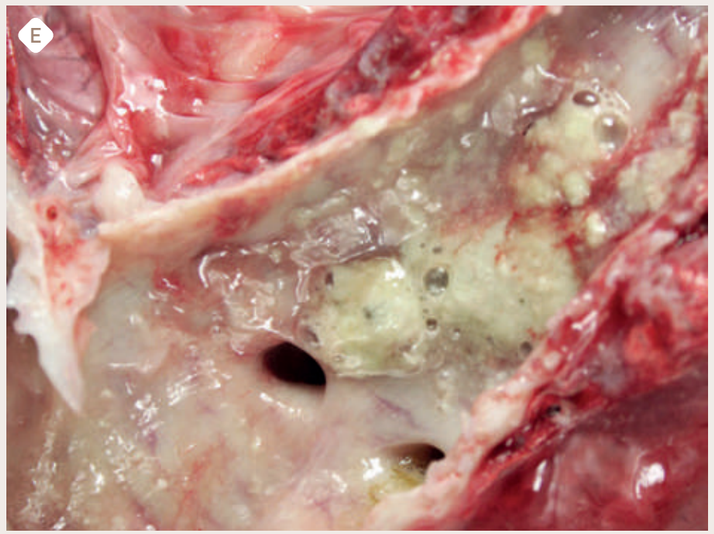




3.82. **Blood in the lung.** In some religious slaughtering where the trachea is cut along with the two jugular veins and carotid arteries, it is common to find haemorrhages in the lung. The inhaled blood will be distributed throughout the lung, especially in more ventilated areas (A and B), causing a similar picture to aspiration pneumonia.

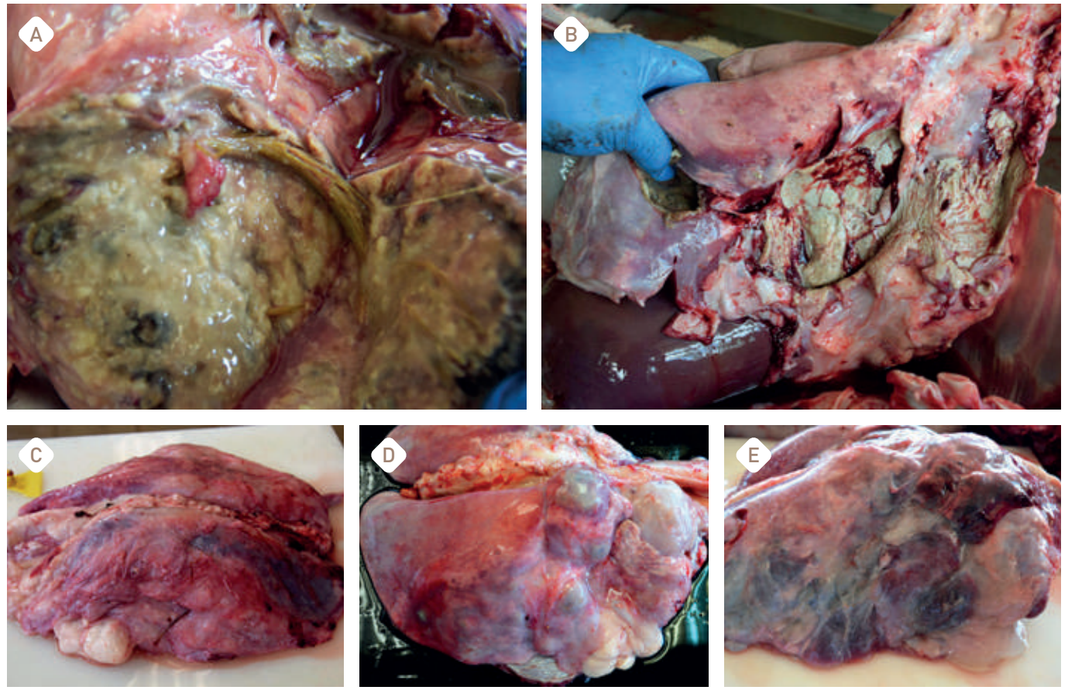




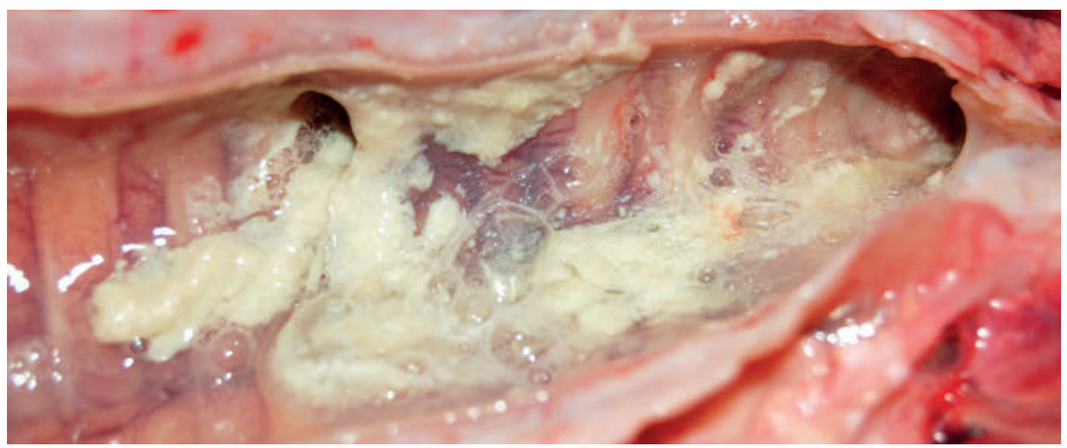


3.83. **Gangrenous pneumonia caused by inhalation of a foreign body.** The foreign bodies inhaled in a diverted swallow, generally of plant origin, are usually contaminated by environmental bacteria and lead to the development of purulent or gangrenous pneumonia (A-C) or lung abscesses (D). In either case, the purulent-putrid material flows into the bronchi and trachea (E).

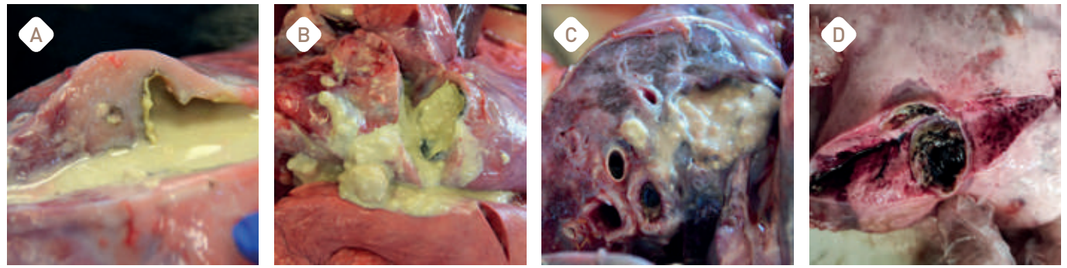
GANGRENOUS PNEUMONIA



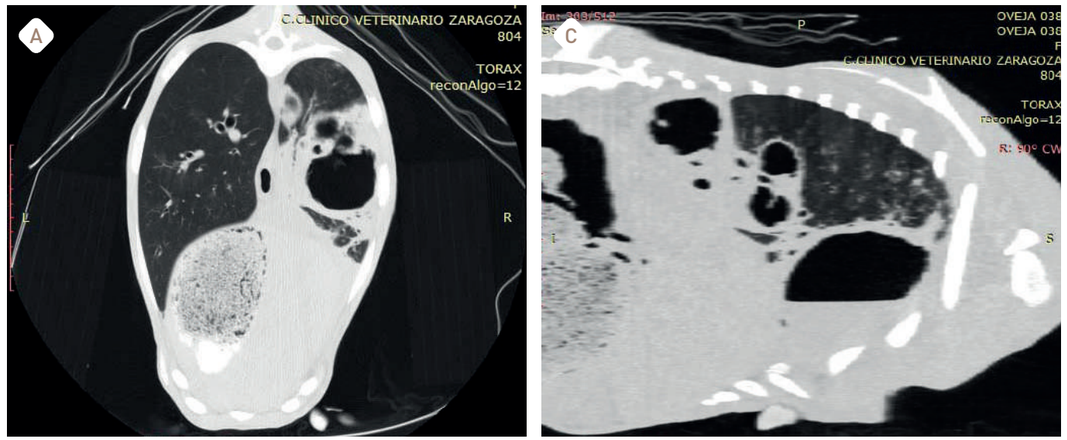
3.84. **Postmortem findings.** Gangrenous pneumonia is usually caused by saprophytic microorganisms that reach the lung after a deviant swallow (A and B). The lungs typically have a voluminous appearance and thickening of the pleura with a rough aspect (C-E).

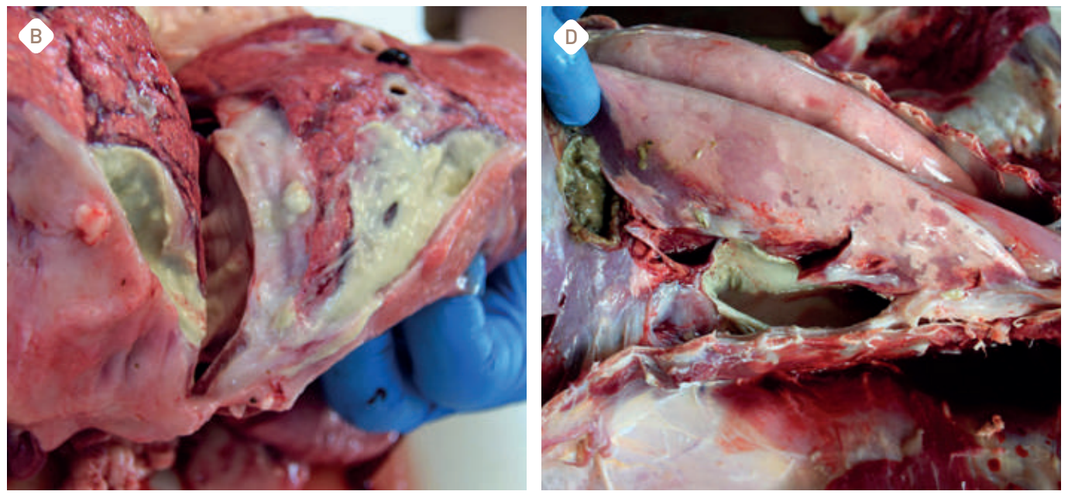


3.85. **Putrid odour.** As some of these necrotic areas drain their content into the respiratory tract, the exhaled air has a typical putrid smell.



3.86. **Section of affected areas.** The section of the affected areas shows the destruction of lung parenchyma, with foci of necrosis with dark green or blackish edges (A-D).

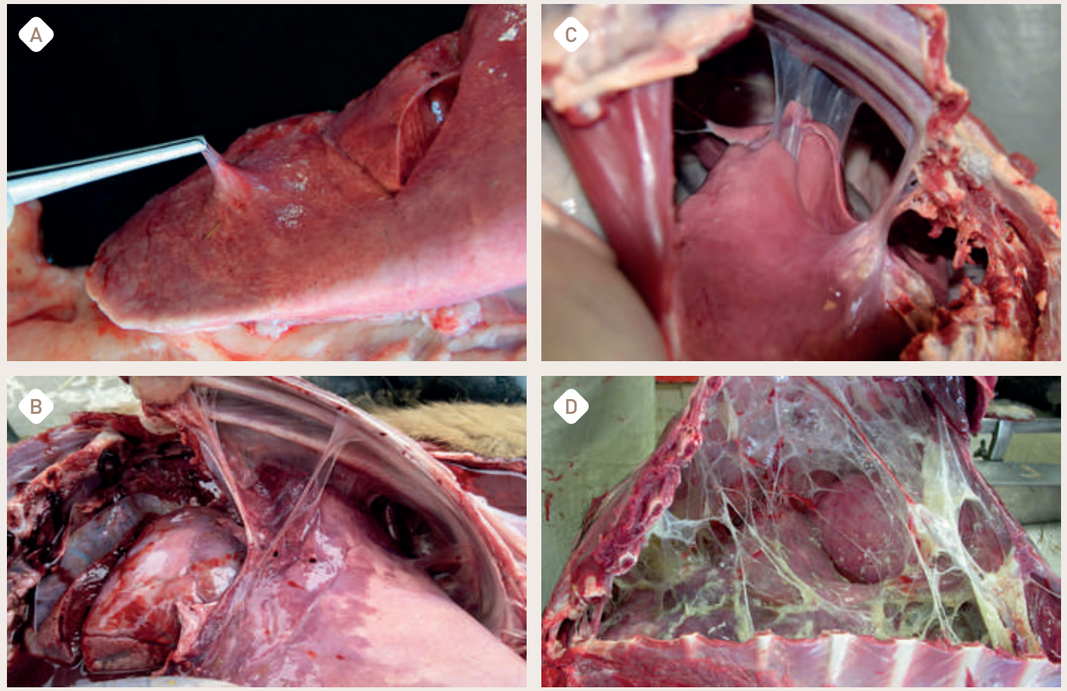




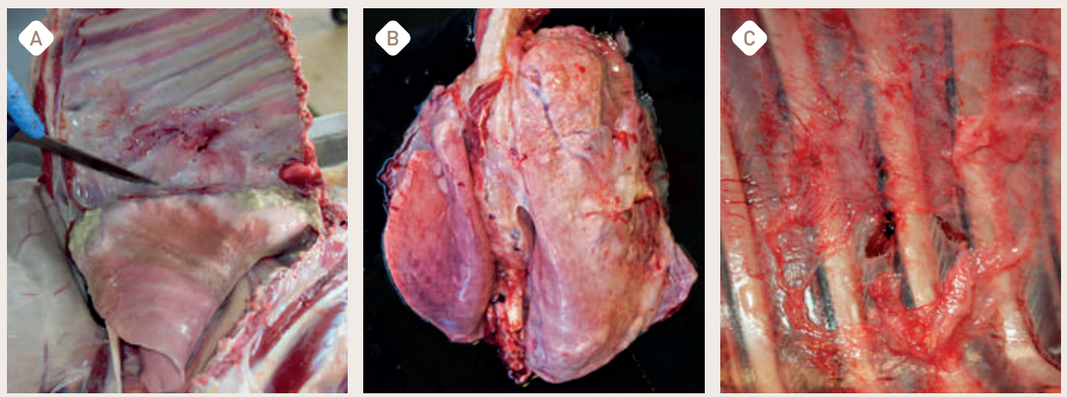
3.87. **Caverns.** In the most severe cases, necrotic areas forming medium-sized (A and B) or large caverns (C and D) can be observed. Images A and C show the CT scan images of the caverns.

PLEURITIS WITH PLEURAL ADHESIONS

Pleuritis with pleural adhesions are lesions that can be found with varying degrees of involvement and extension in different lung diseases.

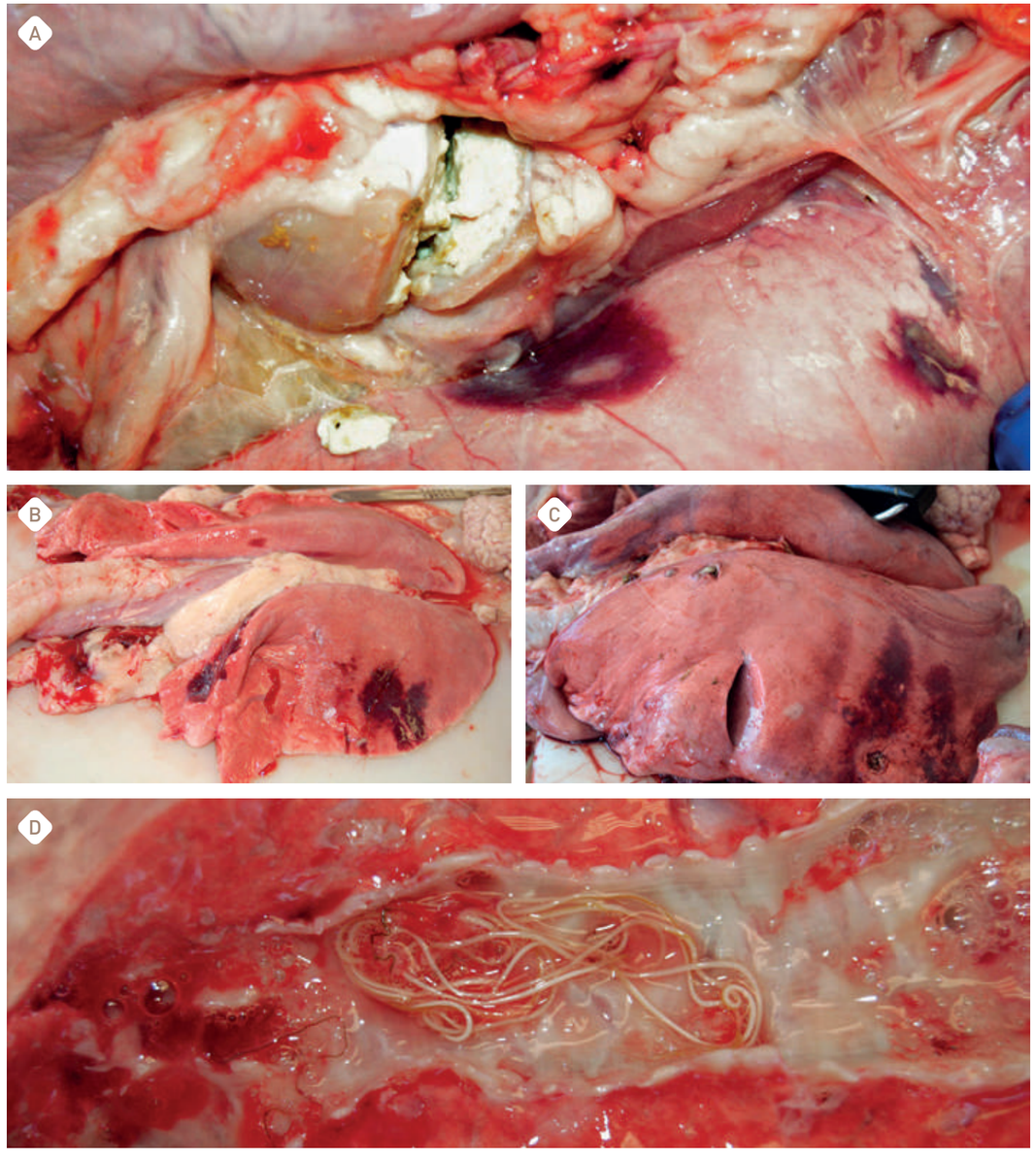


3.88. **Pleuritis with pleural adhesions.** Necropsy can show small (A), larger (B and C) or very extensive fibrous adhesions in the thoracic cavity, affecting practically the entire lung (D).

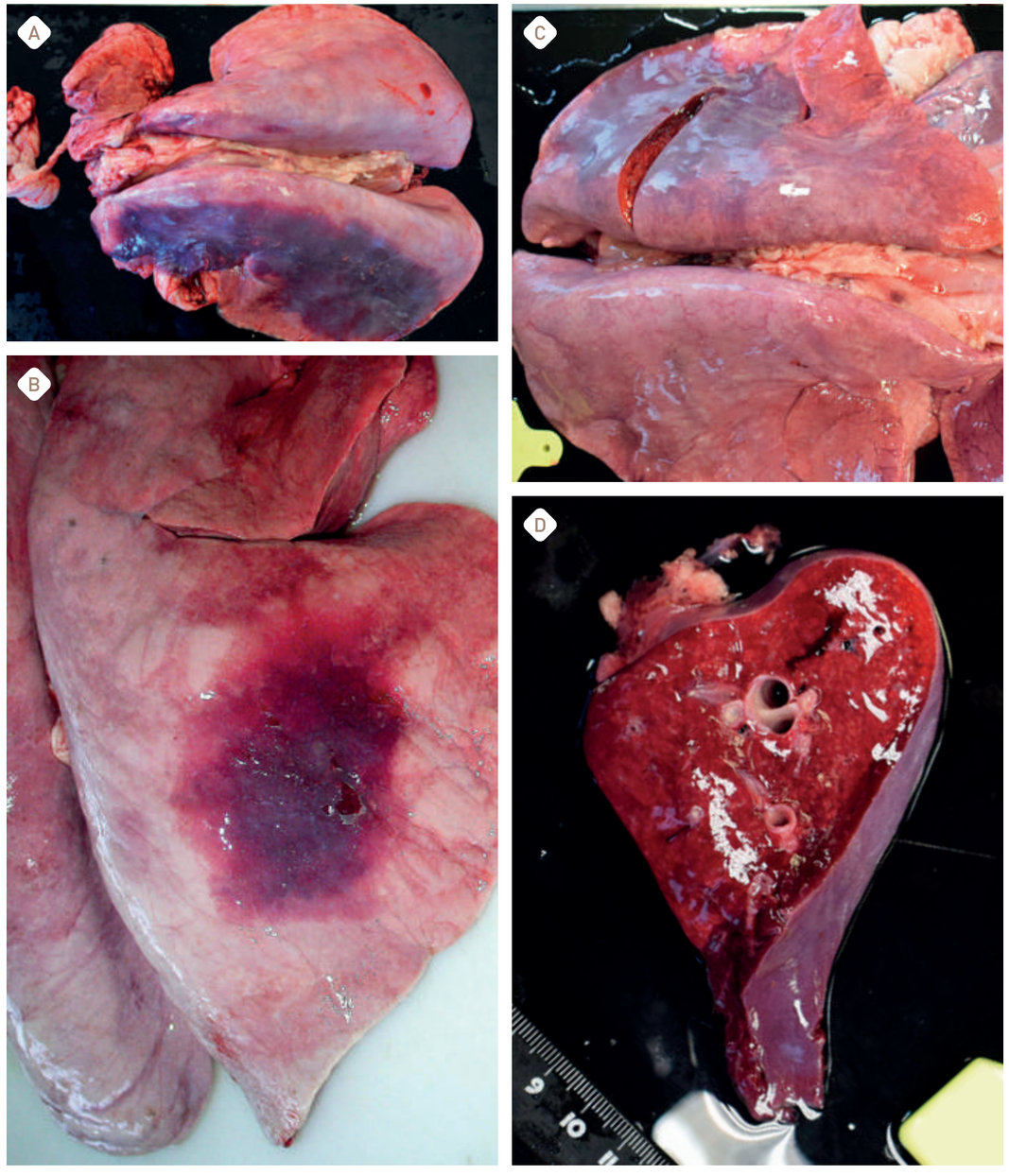


3.89. **Pleural adhesions.** The pleura may be completely adhered and require the need for a sharp instrument to separate it (A and B). This lets us observe the lesion's evolution and acute-chronic state (C).

PULMONARY ATELECTASIS

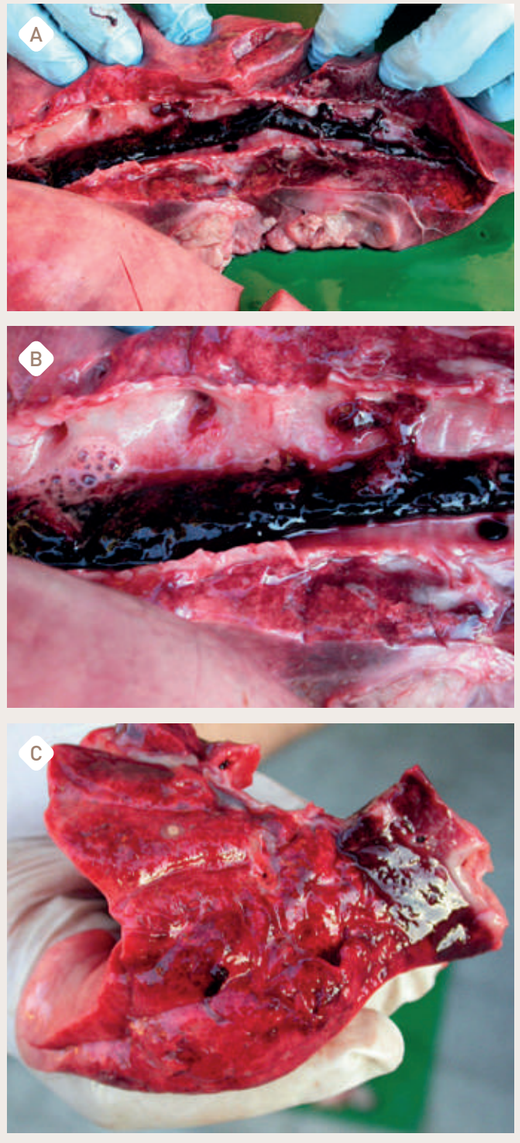


3.90. **Pulmonary atelectasis.** Atelectasis is the collapse of the alveoli of a more or less extensive area of the lung, which acquires a red-violet colour. It generally affects superficial areas that support external pressure, such as mediastinal caseous lymphadenitis (A), diseases that increase the size of the lung (Maedi), putting pressure on the ribs (B and C) or obstructive atelectasis due to *Dictyocaulus filaria* (D).

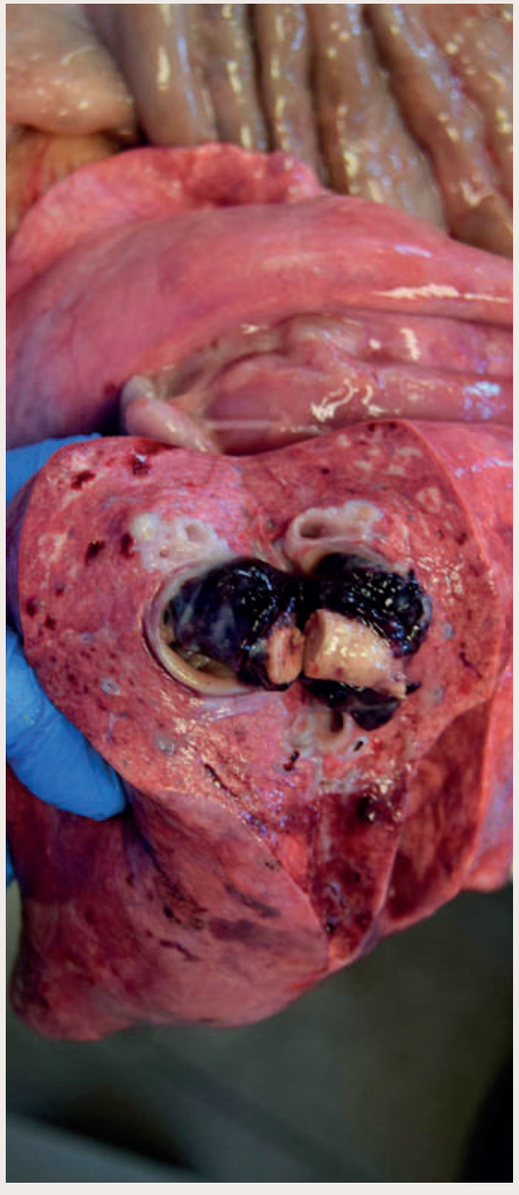


3.91. **Pulmonary atelectasis due to decubitus.** A particular case that should not be confused with respiratory diseases is atelectasis caused by prolonged lateral decubitus. The pressure of the viscera against the lower coastal wall, for a long time, causes the lung surface in contact to acquire the specific red colour (A and B). In the section on the affected area, we can see that it is a superficial lesion and does not necessarily have to be associated with pneumonic disorders (C and D).

PULMONARY HAEMORRHAGES

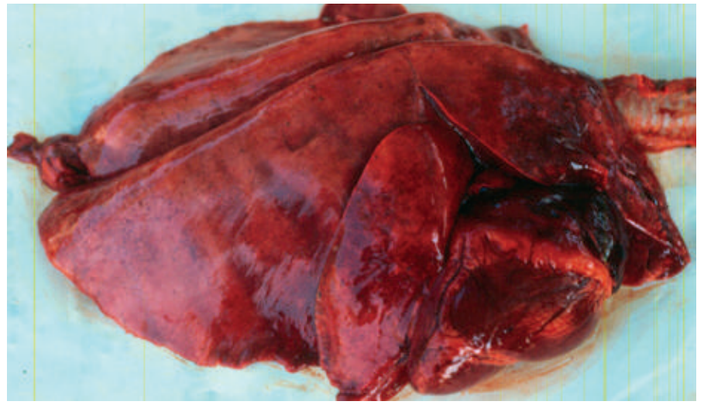


3.92. **Blood in the bronchi and bronchioles.** Bleeding of different aetiologies can occur in the lung, and blood may appear in the airways (A). If the animal does not die from suffocation, foam is formed with the air breathed and the inflammatory fluids and traces of blood (B). The parenchyma section is red and moist (C).

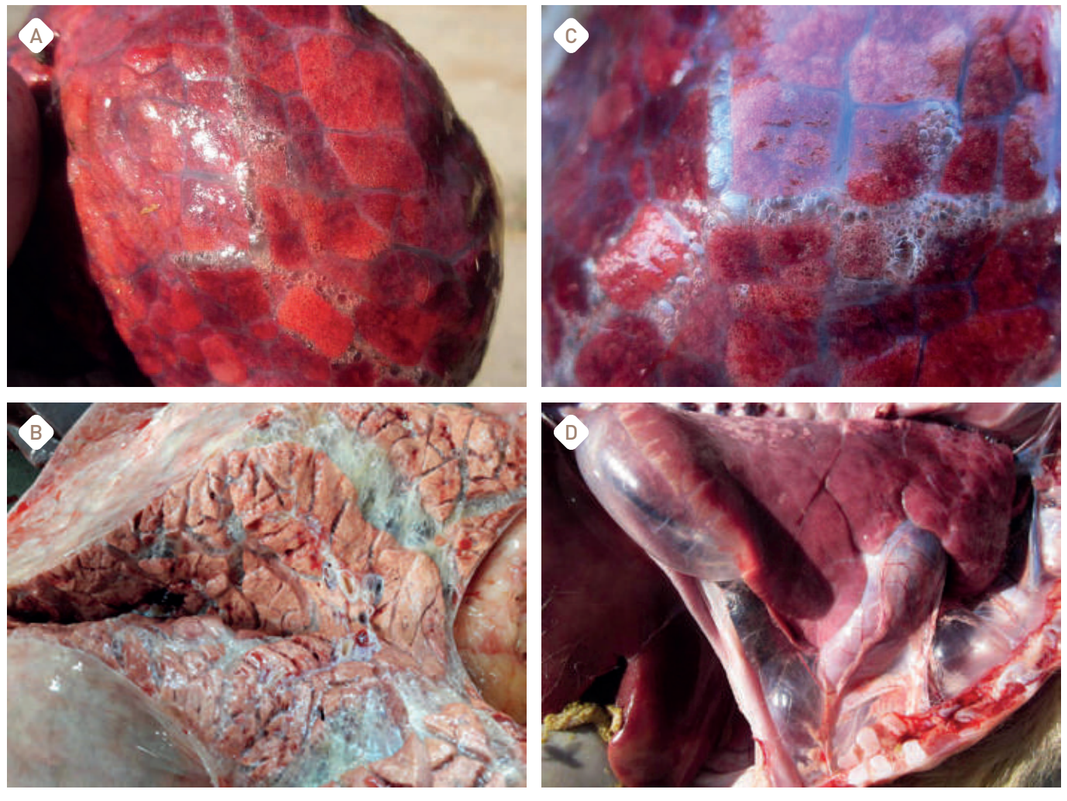


3.93. **Blood clots.** The blood accumulated in some bronchi can coagulate, and we find clots that hinder air passage and behave like a foreign body, favouring secondary infections.

EMPHYSEMA

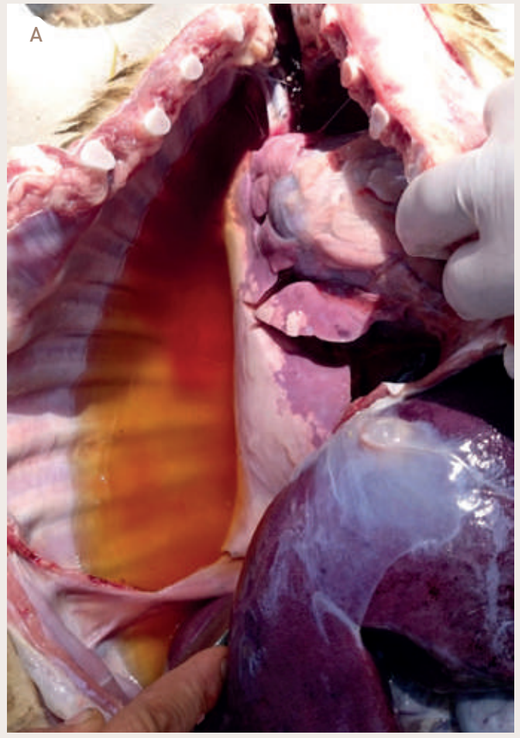


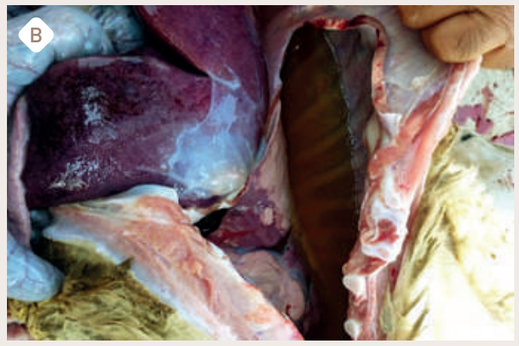
3.94. **Anaphylactic shock after vaccination.** Is a rare but severe reaction that can have respiratory consequences. Alveolar emphysema may be caused by severe bronchoconstriction generated by histamine compounds that are generated in anaphylactic shock induced by some vaccine products or drugs. The lungs are enlarged, and even rib reliefs can be seen. On palpation, it shows a soft and crackling consistency.



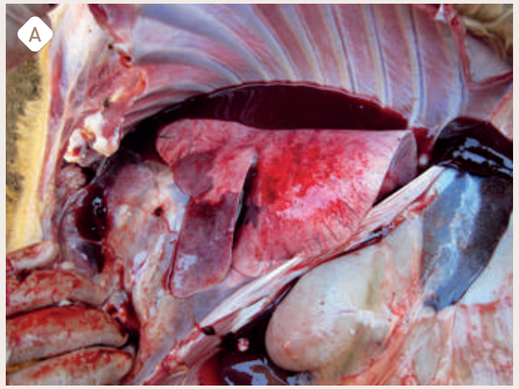
3.95. **Pulmonary emphysema.** It is a secondary condition resulting from a variety of pulmonary lesions that is defined as an abnormal permanent enlargement of airspaces distal to the terminal bronchiole, accompanied by destruction of alveolar walls (A-D).

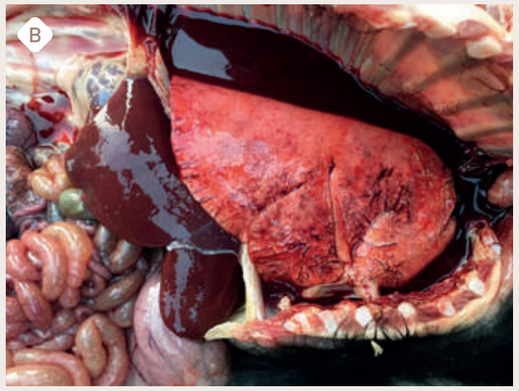
PLEURAL EFFUSION

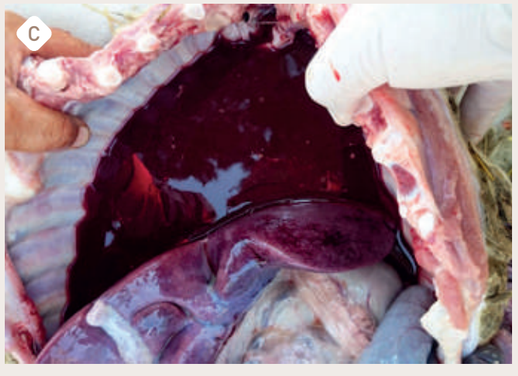




3.96. **Hydrothorax.** The aqueous fluid (transudate) is found in the thoracic cavity and does not coagulate in contact with air (A and B). It is usually caused by increased hydrostatic pressure (congestive heart failure), decreased oncotic pressure (hypoproteinemia due to liver, kidney or intestinal disease or starvation), alterations in vascular permeability, and lymphatic obstruction. It may cause compressive atelectasis.

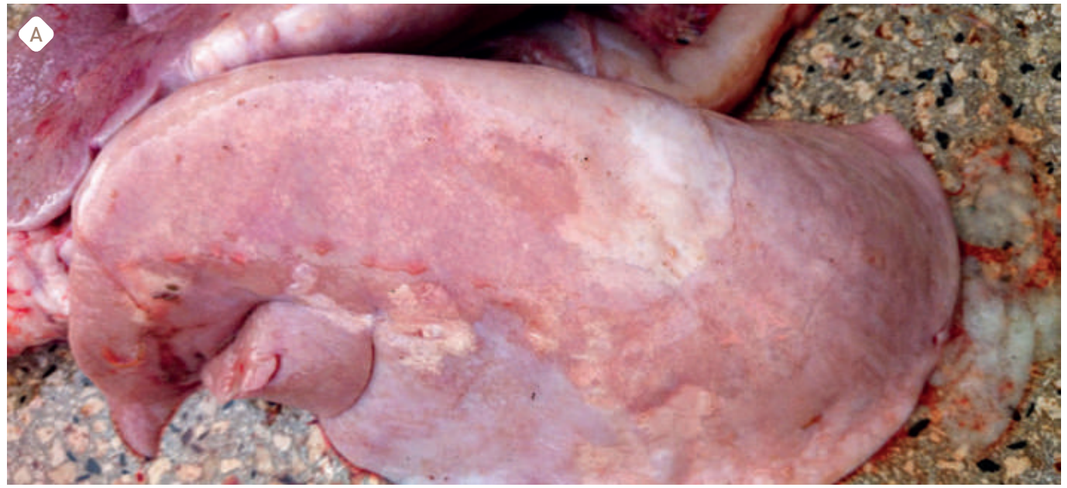


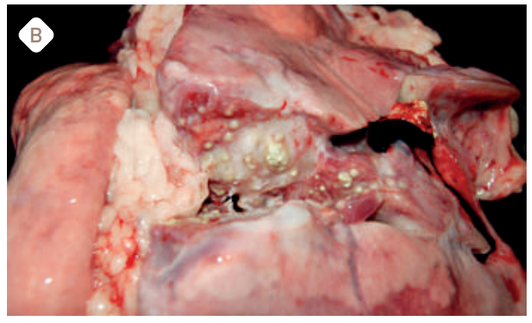


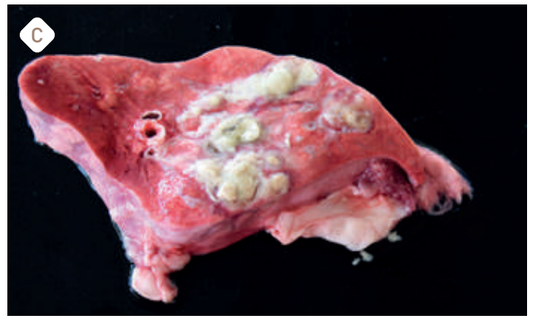


3.97. **Haemothorax.** It is the accumulation of blood in the chest cavity, with partially or totally collapsed lungs. Its origin can be trauma, spontaneous rupture of blood vessels (tumours, aneurysms, inflammation), coagulopathies, etc. (A-C).

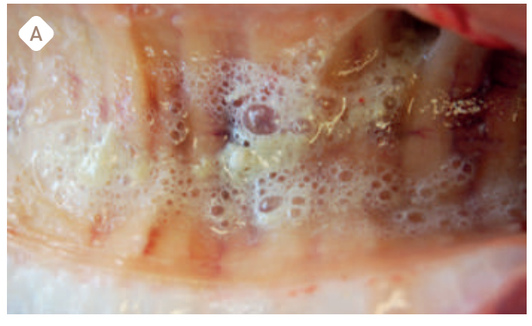
PURULENT PNEUMONIA AND THORAX CAVITY ABSCESSES

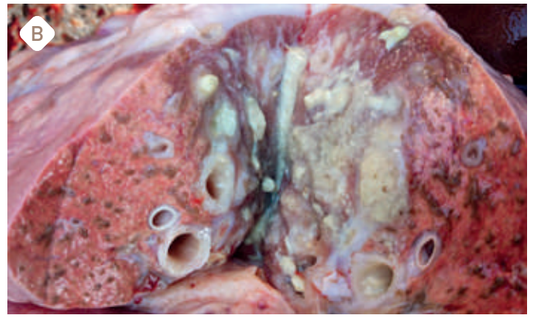




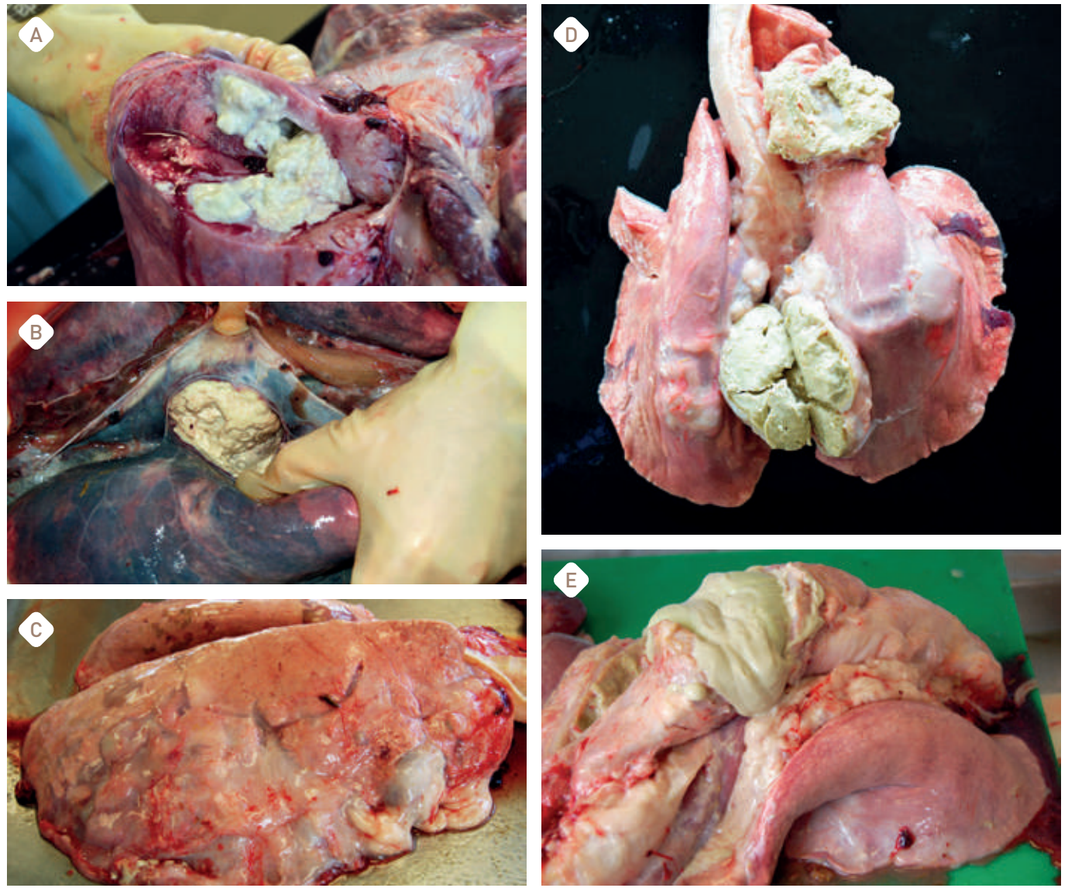


3.98. **Purulent pneumonia.** Productive cases of pneumonia usually present inflammatory exudates at the beginning. These can become purulent due to the action of the causative microorganisms and other secondary or contaminating agents. In these cases, the lung section will show exudative lesions with larger or smaller purulent foci (A-C).

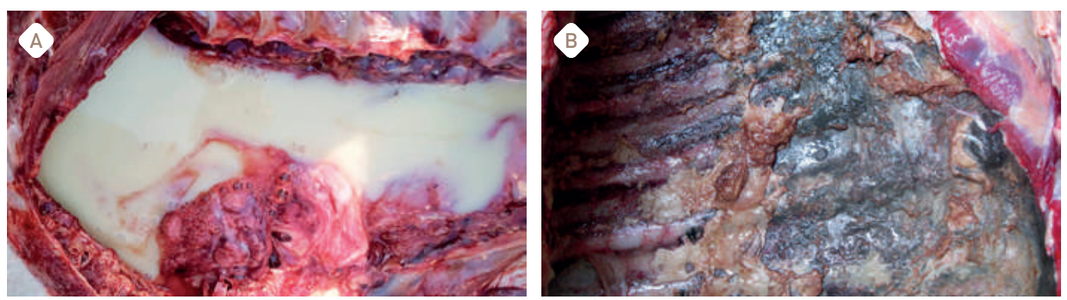




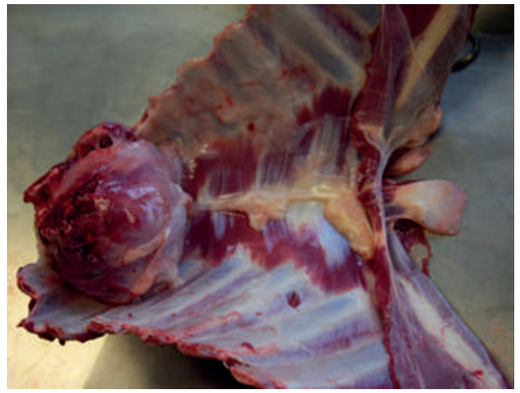
3.99. **Purulent secretions in the respiratory tract.** In purulent pneumonia, it is easy to find the pus draining into the bronchi and trachea, where we can find traces of pus and foam (A and B).



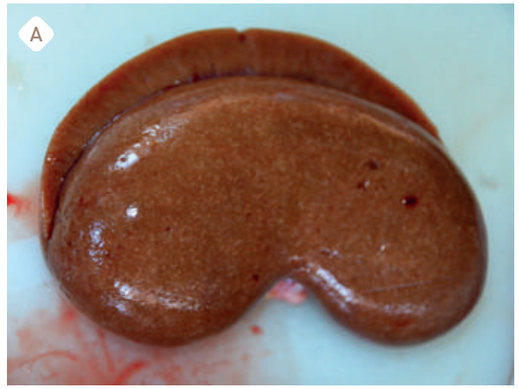
3.100. **Lung abscesses.** Pulmonary infections by pyogenic microorganisms can generate single (A and B) or multiple (C and D) abscesses, which can reach different sizes (E).



3.101. **Pyothorax or thoracic emphyema.** Pyogenic disorders of the lung can spread to the pleural space, as well as injections or punctures that cross the coastal wall and reach the pleural space. In both situations, we can find pus in the pleura and pleural adhesions (A and B).

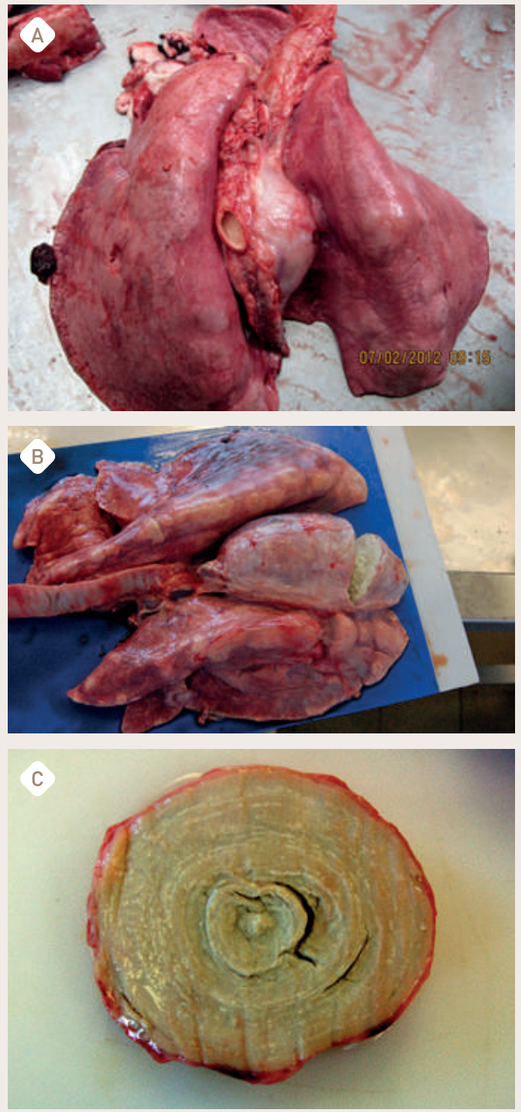


3.102. **Abscesses not associated with respiratory disorders.** The thoracic cavity may contain abscesses that are neither respiratory in origin nor located in the respiratory system but may make breathing difficult due to pressure on the trachea or other respiratory structures.

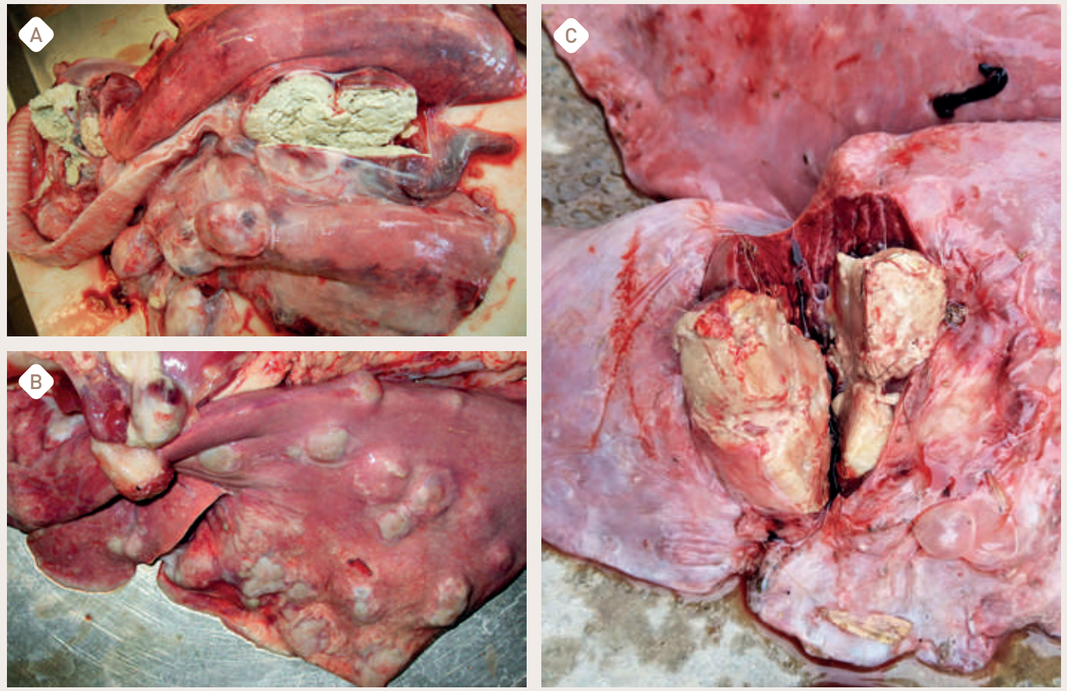


3.103. **Renal amyloidosis.** Many of these cases, especially when they become chronic, are associated with renal amyloidosis (A) and loss of body condition (B).

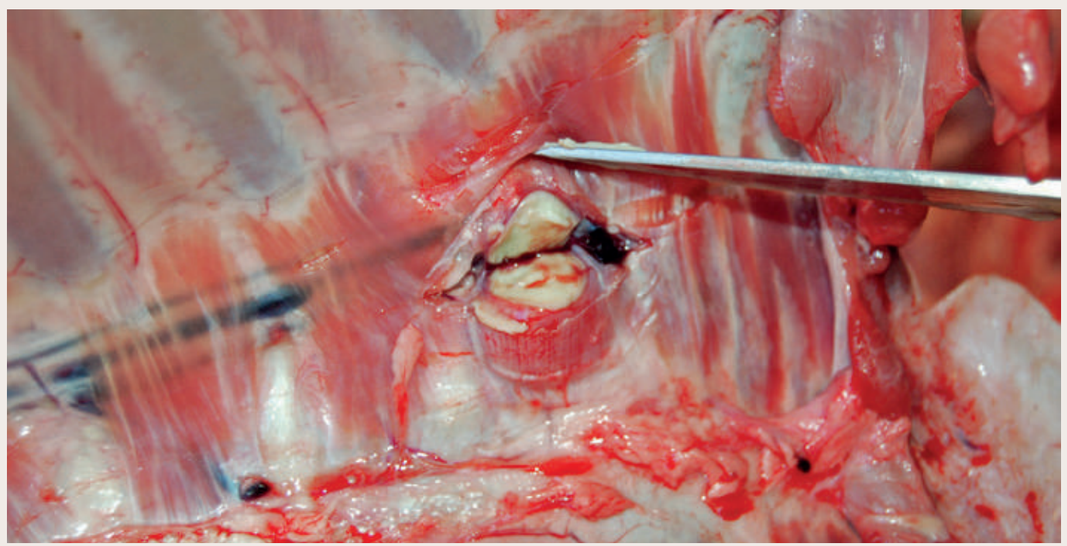
CASEOUS LYMPHADENITIS (CLA) (VISCERAL FORM)



3.104. **Mediastinal lymph nodes affection.** In a high percentage, the visceral presentation of CLA is located in the thoracic cavity, causing respiratory clinical signs. In this presentation, the mediastinal lymph nodes are usually affected (A and B). These lymph nodes' cross-sections offer the typical image of onion layers (C).



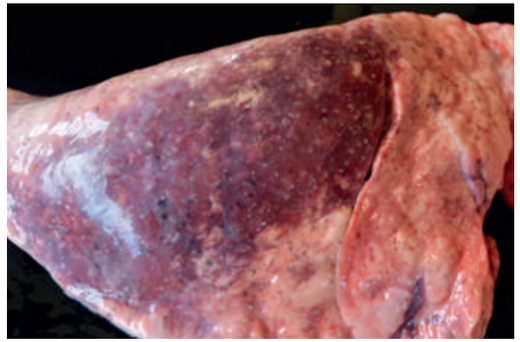
3.105. **Pulmonary affection.** Together with the involvement of the lymph nodes, we can find caseous nodules in the lung parenchyma (A). Although sometimes, only lung CLA lesions can be seen without lymph node involvement (B and C).



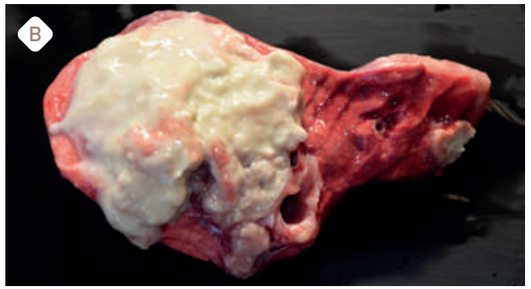
3.106. **Other locations.** A similar lesion can be found in the diaphragm or the parietal pleura-intercostal muscles.

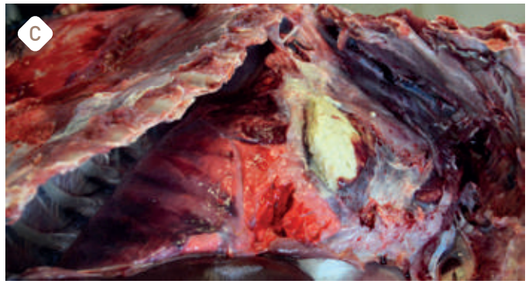
TUBERCULOSIS

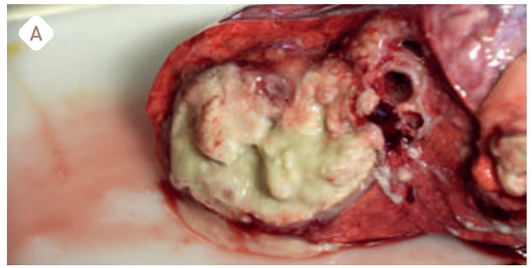
Tuberculosis is an infectious disease, mainly respiratory, caused by the *Mycobacterium tuberculosis* complex. Its incidence is much higher in goats than in sheep. In sheep, when diagnosed, it is usually associated with the close presence of goats or cattle.

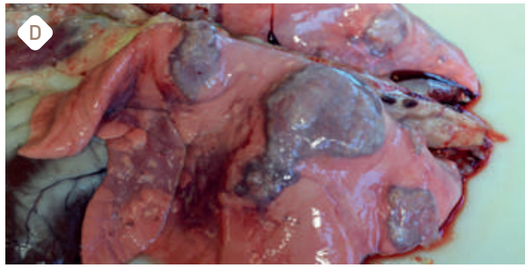


3.107. **Miliary clinical presentation.** Miliary tuberculosis is characterised by the presence of multiple small foci distributed over large areas of the lung.

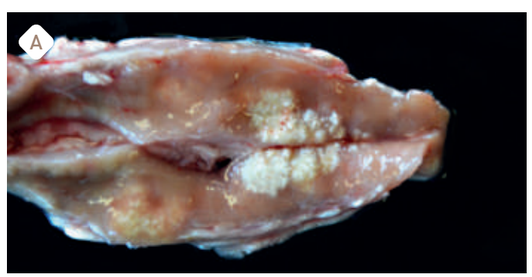


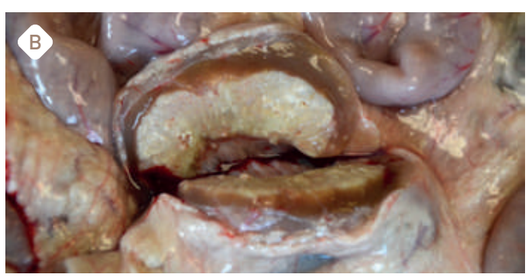






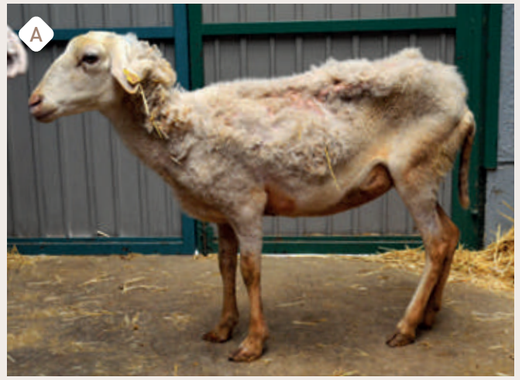
3.108. **Nodules and caverns.** The primary complex (minimal and single lesions) is not usually diagnosed at necropsy, except when very detailed and fine sections of the lung are performed. The presence of tuberculous nodules of variable size (A-C) and caverns (D) is more frequently found.



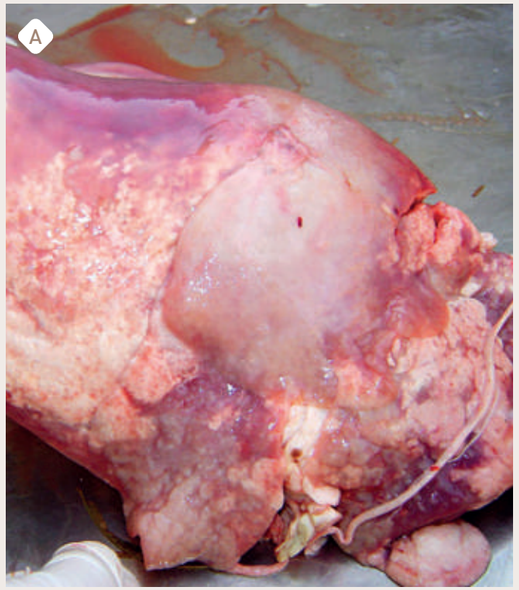


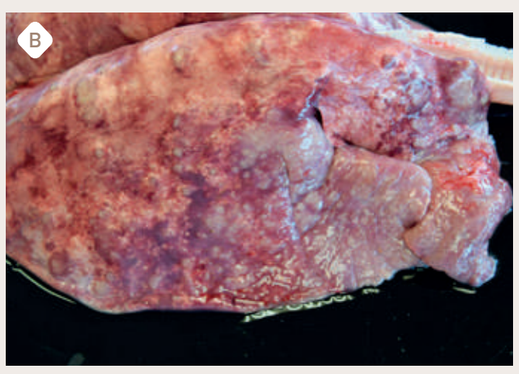
3.109. **Lymphatic involvement.** In association with the previous lesions, it is common to find involvement of the lymph nodes, especially the mediastinum, which appears increased in size with caseated and calcified foci (A and B).

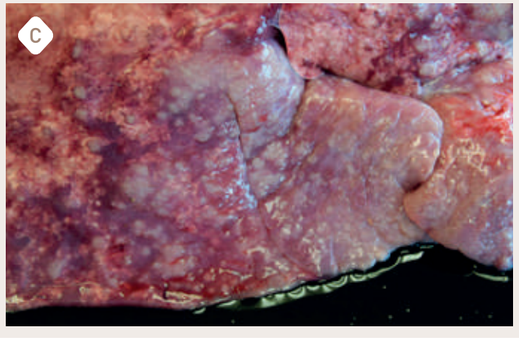
OVINE PULMONARY ADENOCARCINOMA (OPA)

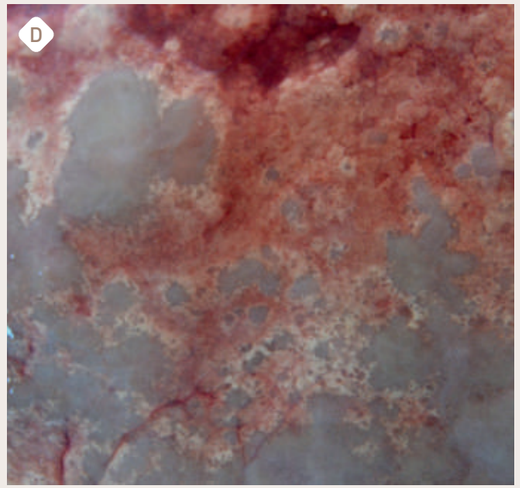


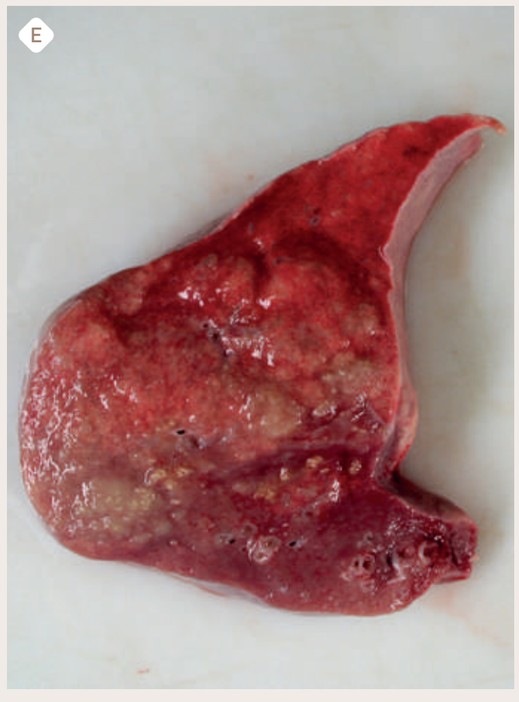
3.110. **Clinical picture.** Ovine pulmonary adenocarcinoma is caused by an oncogenic retrovirus, Jaagsiekte sheep retrovirus. Animals affected by OPA have dyspnea and wet cough associated with weight loss, leading to cachexia (A). When performing the wheelbarrow test, a greater or lesser amount of foamy liquid falls through the nostrils (B), except in the few cases where the atypical form occurs.



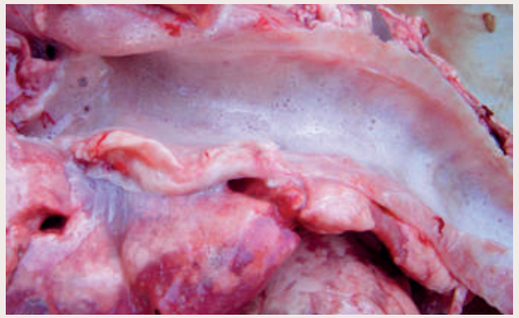




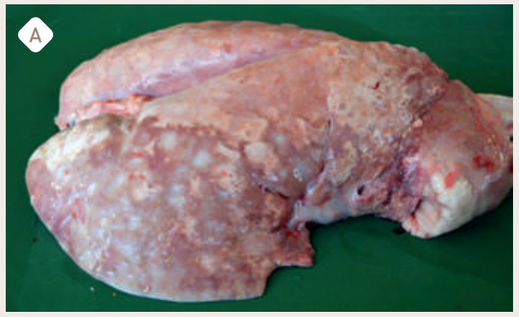


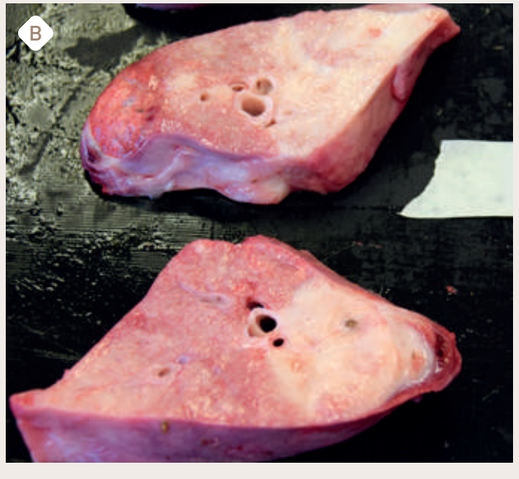


3.111. **OPA classic pathological form.** The neoplastic lesion is greyish, has a firm texture, and is usually located in the cranioventral areas of the lung (A and B). Other smaller metastatic nodules can be seen surrounding the broader and more consolidated area (C and D). The section of the affected area appears moist (E).



3.112. **Exudates in the trachea.** The opening of the trachea shows fluid, foamy and more or less abundant content, which will come out through the nostrils in the wheelbarrow test.

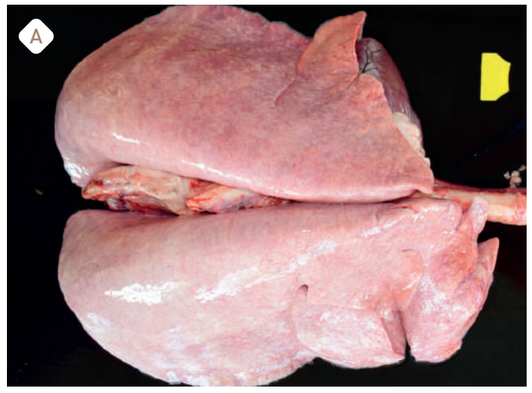


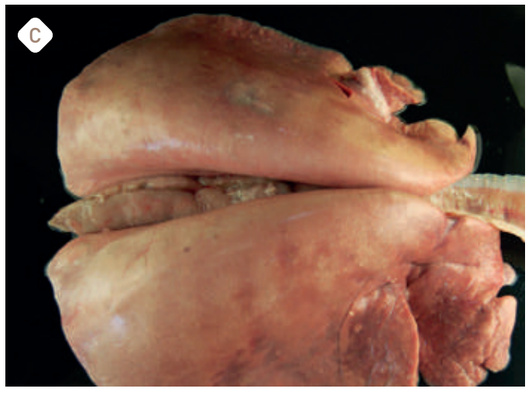


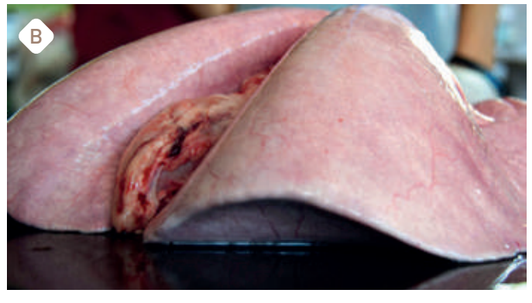
3.113. **OPA atypical pathological form.** In this presentation, single or multiple white tumour nodules appear in the lung parenchyma (A), and their section is not as moist as in the classic form (B).

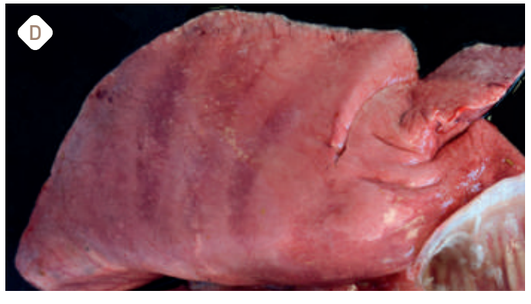
PULMONARY LENTIVIRUSES (MAEDI)

3.114. **Clinical picture.** Pulmonary clinical presentation of lentiviral infection is caused by the small ruminant lentivirus (SRLV). In the most advanced cases, affected animals are presented with low body condition and orthopneic position (stretched neck, extended head and mouth breathing) (A and B). If there are no concomitant infections, the cough is dry, and the dyspnea is mixed and diffuse. Clinical signs are not always clear and the disease may go unnoticed.

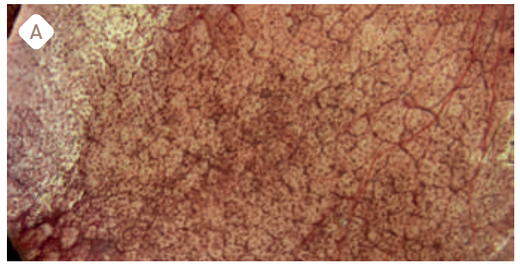


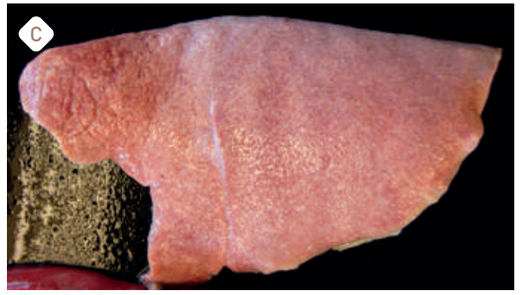




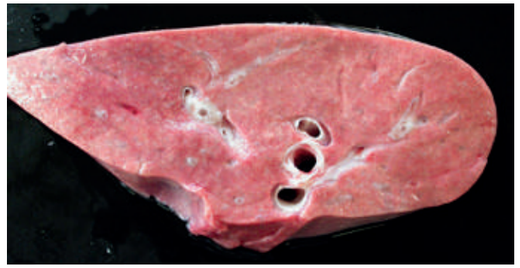


3.115. **Macroscopic pulmonary lesions.** Although this disease has four clinical presentations (pulmonary, mammary, nervous and articular), only the pulmonary pathological findings will be described here. SRLV produces a diffuse, chronic and progressive interstitial pneumonia that generates firm, lightened lungs that do not collapse when the chest cavity is opened and remain bell-shaped (A and B). The mediastinal lymph node is enlarged and may extend beyond the posterior border of the lung (C), and rib markings are often visible (D).



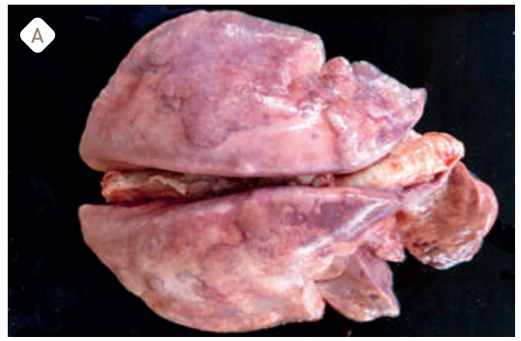


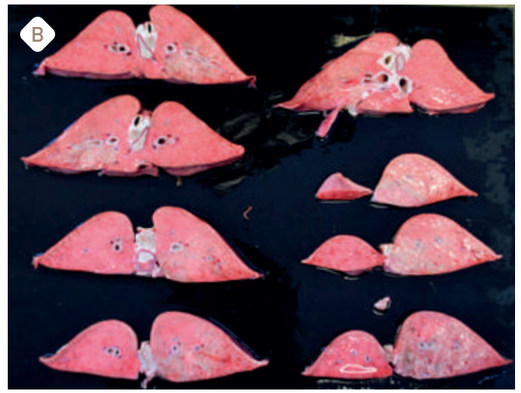
3.116. **Lymphoid follicles.** Close observation allows us to distinguish a surface dotted with greyish spots (A). When interstitial inflammation is significant, these small nodules are very marked and can come together to form grey spots (B) and even stand out on the lung surface (C).



3.117. **Cross section.** The lung sections show more rounded edges that have not lost shape after opening the thoracic cavity.

3.118. **Secondary complications.** Concomitantly with maedi lesions, many different pathogens can settle in the affected lungs. The most frequent pulmonary *Lentivirus* complication is catarrhal pneumonia, but gangrenous, fibrinous pneumonia or OPA associated lesions are also easily found.

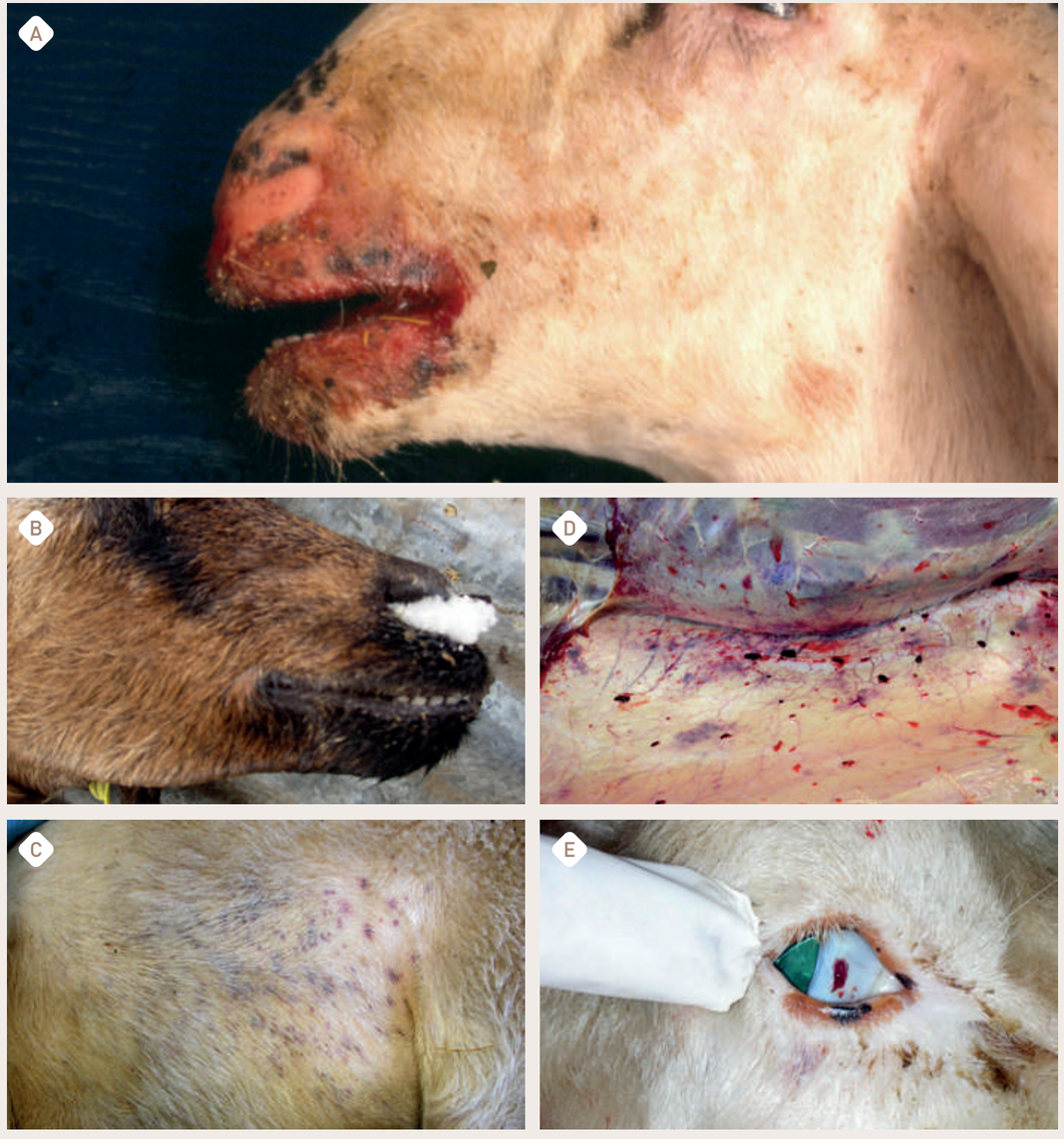




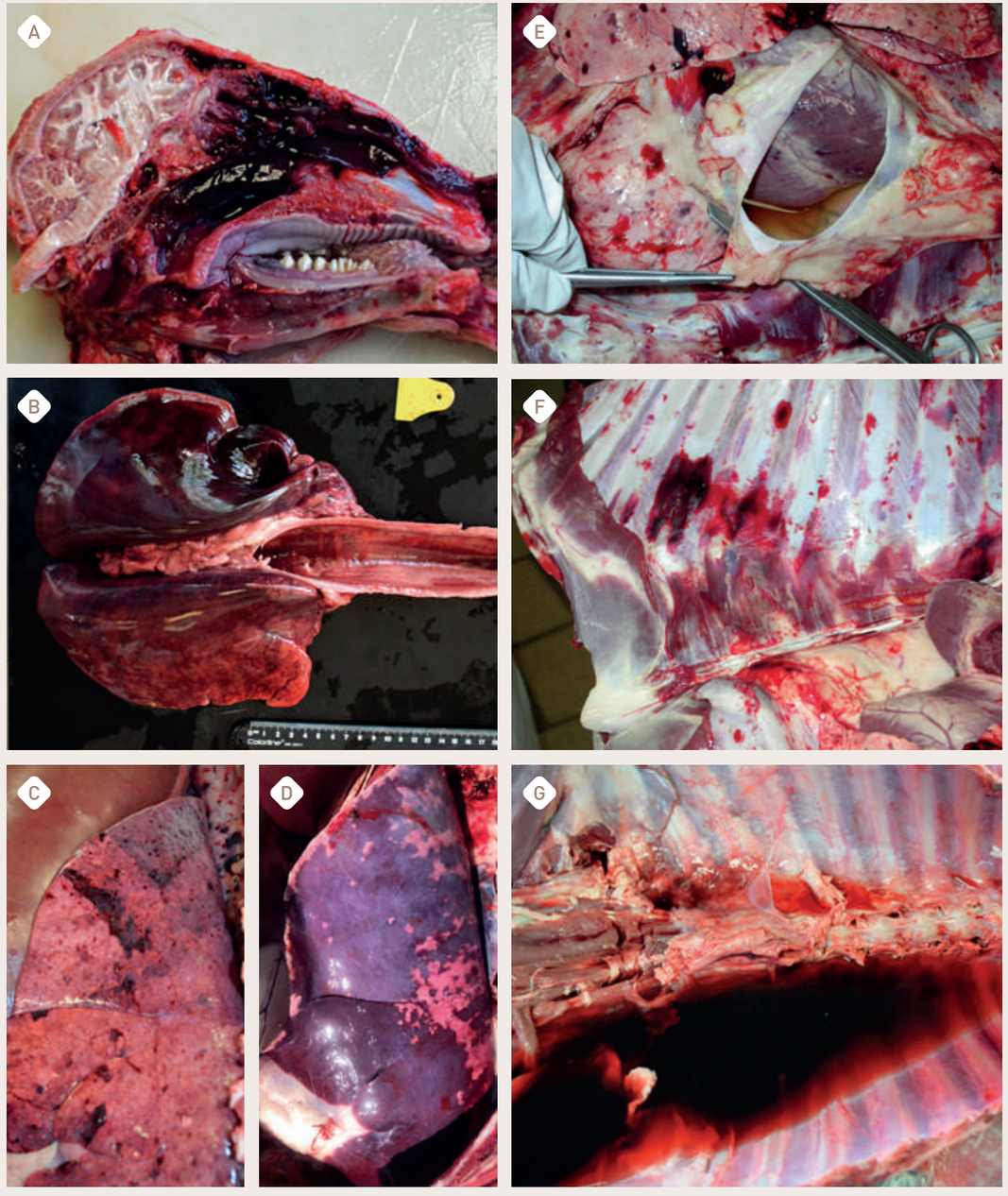
3.119. **Atypical cases of interstitial pneumonia.** This atypical presentation shows demarcated areas of interstitial pneumonia surrounded by healthy parenchyma (A and B).

OVINE RESPIRATORY COMPLEX (ORC)

The general characteristics of ovine respiratory complex (ORC) have already been described in page 60, and are the same in both young and adult animals. The clinical development can be peracute, acute or chronic.



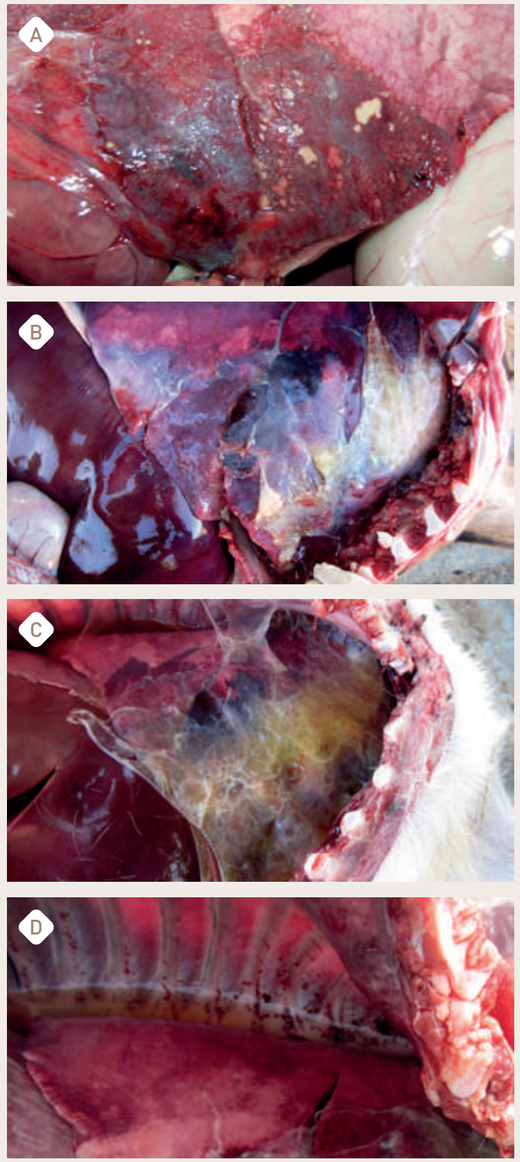
3.120. **Peracute: sudden death and haemorrhages.** The peracute form of ORC causes sudden deaths. At necropsy, the presence of foamy or bloody fluids coming out of the nostrils (A and B) and petechiae of the subcutaneous tissue (C and D) or in the ocular conjunctiva (E) can be observed.



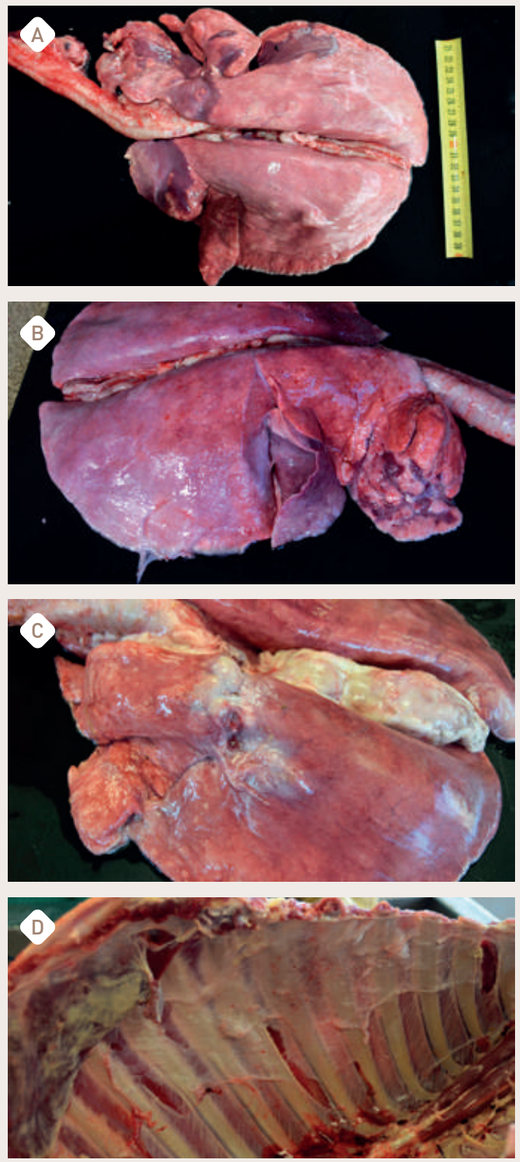
3.121. **Peracute: disseminated haemorrhages.** Generalised haemorrhages are observed at necropsy. The most frequent findings are rhinitis and nosebleeds (A), tracheitis, pulmonary oedema (B) and petechiae in the lung (C and D), heart (E) and pleura (F). These injuries are usually accompanied by bloody-looking hydrothorax (G).

3.122. **Peracute: pulmonary section.** The lung section allows us to appreciate the output of foamy and bloody secretions (A and B).

3.123. **Acute: consolidated pneumonic areas.** Acute and subacute forms are characterised by varying degrees of lung consolidation (A-C), with a moist or bloody appearance on section (D).



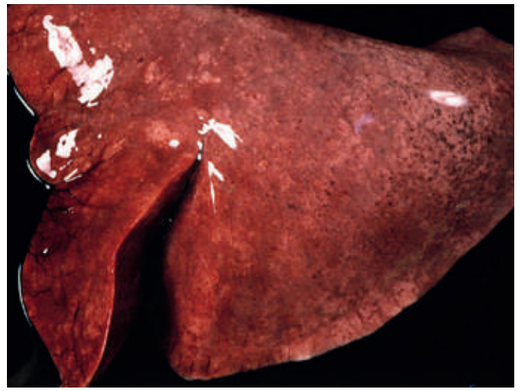
3.124. **Acute: exudates.** The exudates produced can include pus causing suppurative or catarrhal pneumonia (A) or fibrin, causing fibrinous pneumonia, and especially affecting the cranioventral areas of the lung (B). It is also possible to find pleural adhesions, hydrothorax (C) and pleural haemorrhages (D).



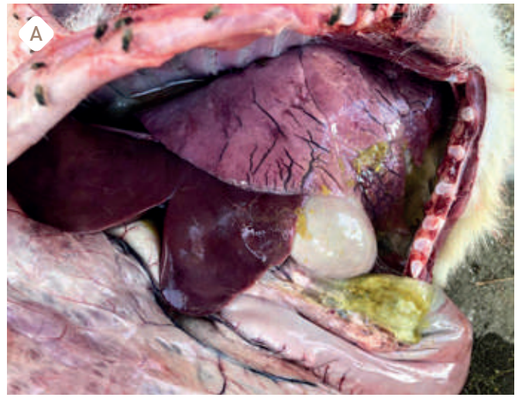
3.125. **Chronic: consolidation of pneumonic areas.** The chronic form can be an evolution of the acute presentation, although it may have exacerbating phases, leaving a heterogeneous appearance. The pneumonic areas retract and lose the intense colour of the acute presentations (A), leaving fibrous remains, along with scars (B and C) and pleural adhesions (D).

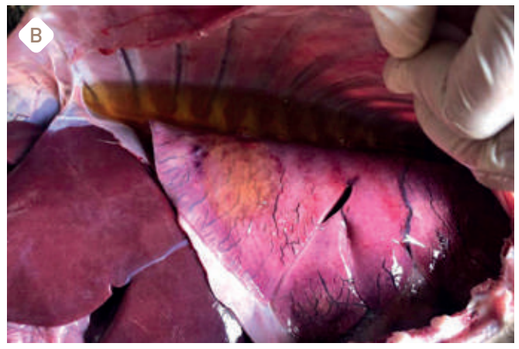
OTHER BACTERIAL INFECTIONS OF THE LUNG

3.126. **Contagious caprine pleuropneumonia (CCPP).** It is a classical disease of goats, associated with *Mycoplasma capricolum* subsp. *capripneumoniae*. Sheep can be infected experimentally. In goat herds, it causes high mortality in kids and adults, with clinical signs restricted to the respiratory system (A).
Postmortem findings are limited to the lungs, especially right cranioventral lobe and pleura. Lesions include hepatisation, increased pleural fluid and fibrinous pleuritis (B-E).



3.127. **Septicaemia caused by *Bacillus anthracis*.** After cases of septicaemia or shock, emphysema, oedema, and haemorrhages can be seen in the lung.

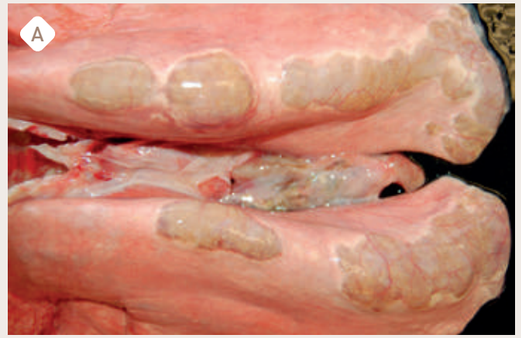


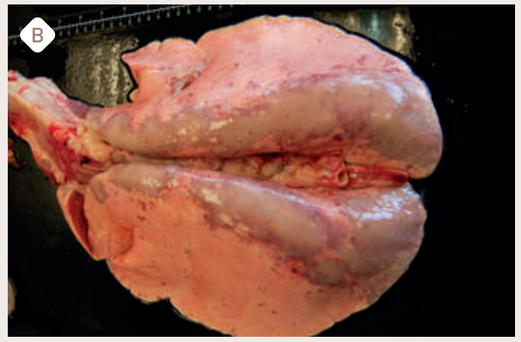


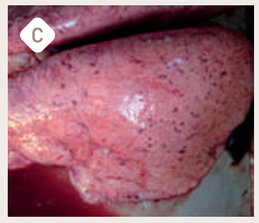
3.128. **Enterotoxaemia.** Pulmonary oedema, especially at the edges of the lung, is one of the helpful findings in the diagnosis of enterotoxaemia (A and B) (*see chapter 4, pages 139 and 238*).

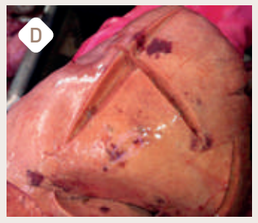
VERMINOUS PNEUMONIA

The pulmonary worms of small ruminants are located in the most ventilated areas of the lung (dorsal and diaphragmatic areas). They are divided into two large groups: large strongyles (*Dictyocaulus* spp.) and small strongyles (*Protostrongylus*, *Muellerius*, *Cystocaulus* and *Neostrongylus*).

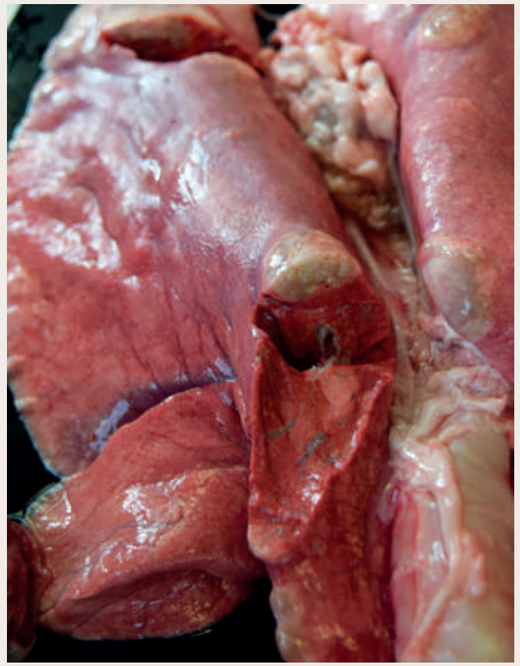




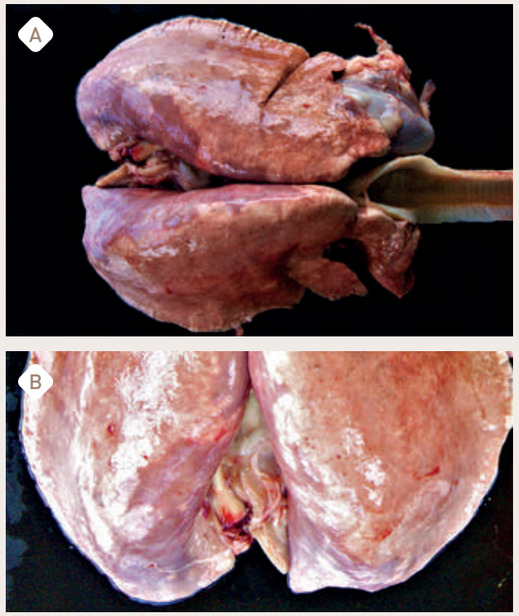




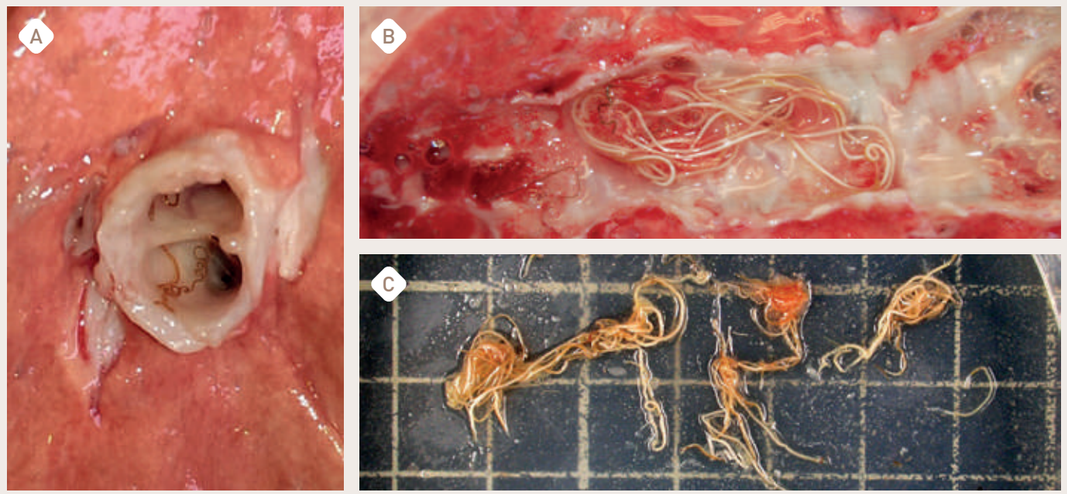
3.129. **Verminous pneumonia due to small strongyles.** Parasitic lesions are located in the dorsal area, preferably dorsal-caudal. They present round shapes of different sizes on the lung surface since they are often confluent (A and B). *Cystocaulus* is usually found in the terminal bronchi of well-ventilated areas (C), and *Muellerius* lesions can be small in size and distributed anywhere on the lung surface. They are reddish or grey nodules, sometimes calcified (D).



3.130. **Section of the parasitic nodules.** The section of the nodules shows how they penetrate the parenchyma and their light grey to greenish colouration.

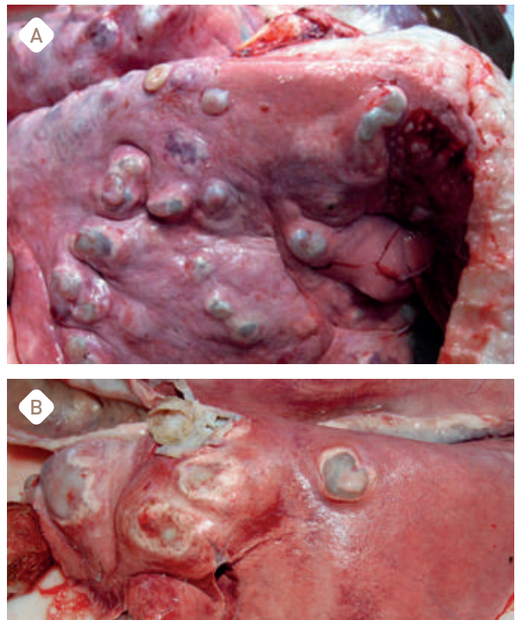


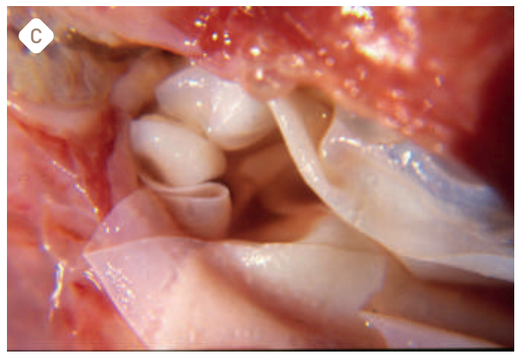
3.131. **Verminous pneumonia by *Dictyocaulus*.** *Dictyocaulus* is the largest lung parasite. The lesions are located in the dorsal-distal portion of the diaphragmatic lobes and usually lead to obstructive atelectasis of the area, which gives it a violaceous colour (A and B).



3.132. **Parasites in bronchi.** By opening the airways, it is possible to observe both the small strongylids (*Protostrongylus*) (A) and the large, more than 10 cm in the case of *Dictyocaulus* (B), being easy to extract them for study (C). The correct coprological analysis easily shows us the presence of larvae in the faeces.

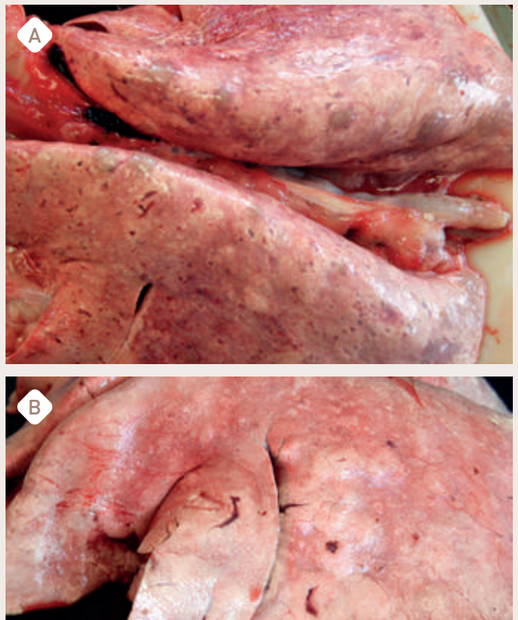
HYDATIDOSIS

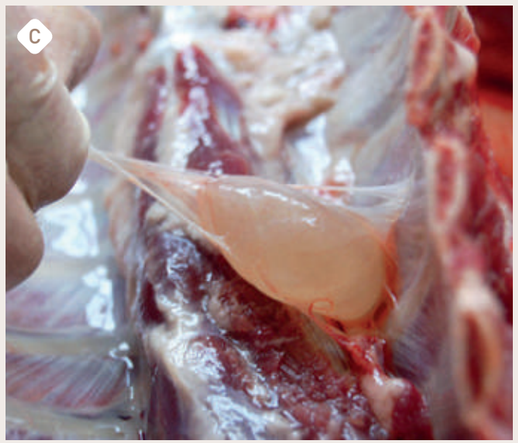




3.133. **Hydatid cysts.** The lung is one of the target organs of hydatid disease. In small ruminants, as intermediate hosts, hydatid cysts, the larval stage of *Echinococcus granulosus*, are found. They appear as nodules inserted in the lung parenchyma or standing out on the surface (A). Its touch is turgid; if the larva dies, the cyst calcifies and takes on a hard consistency (B). Upon opening them, the hydatigenic membrane is observed, which is easily detached (C).

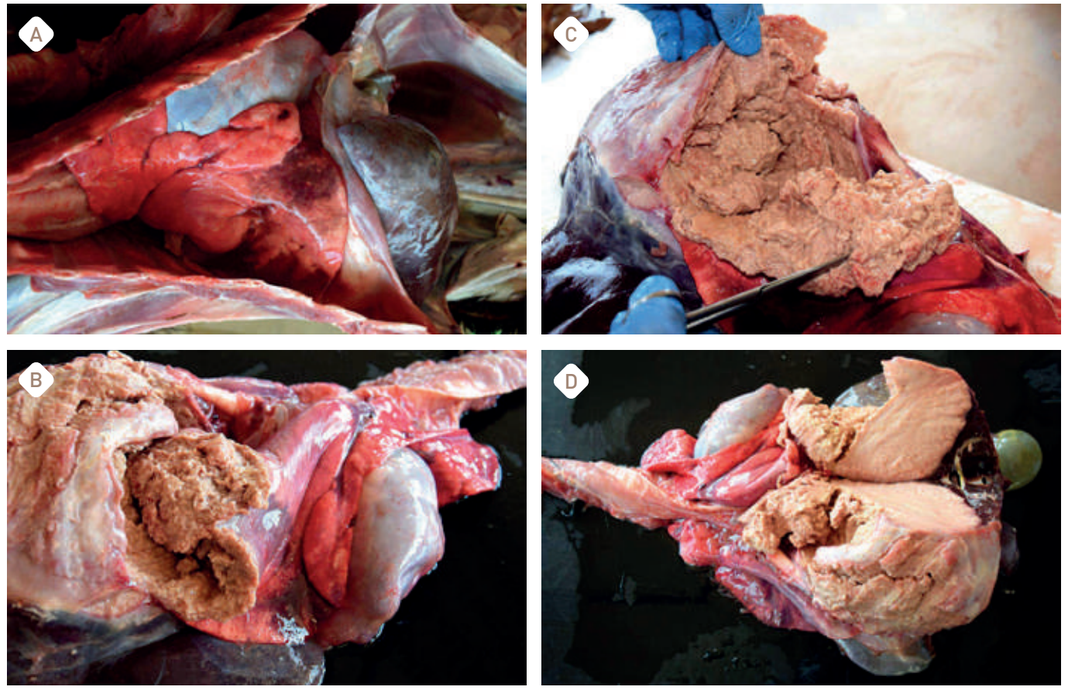
CYSTICERCOSIS



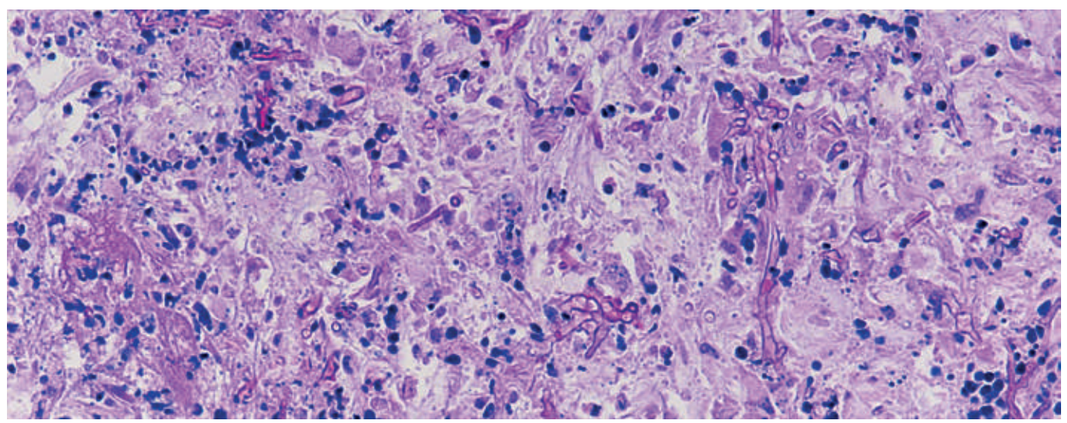


3.134. **Cysticercosis in the lung.** Pulmonary cysticercosis is caused by *Cysticercus tenuicollis*, the larval stage of *Taenia hydatigena*. In the lung, we can see the parasite's red dots and small migration paths (A and B). We can also find vesicles attached to the pulmonary surface or the costal pleura with their corresponding invaginated scolex (C).

INFILTRATIVE MYCOTIC GRANULOMA

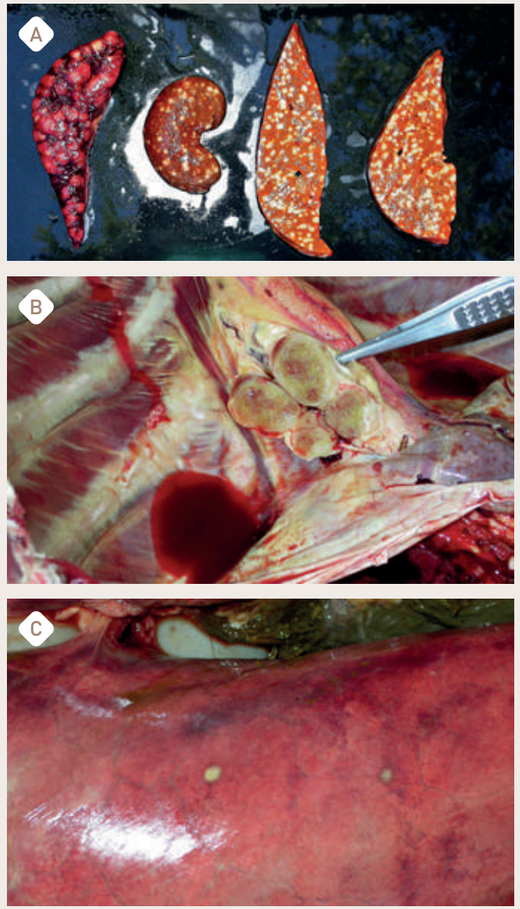


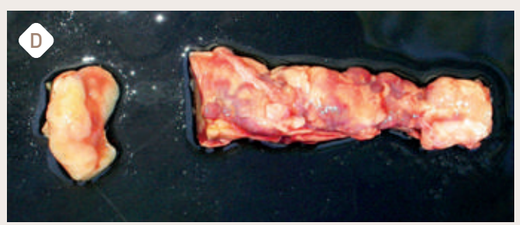
3.135. **Mycotic granuloma in the lung.** The fungus acts infiltratively in an *Aspergillus fumigatus* infection, leaving the lung enlarged and deformed (A). The parenchyma breaks easily, showing a grainy appearance (B and C) and being completely smooth when cut (D). The granuloma can also infiltrate the costal wall and the thoracolumbar vertebrae, causing locomotor disorders in the hindlimbs.



3.136. **Histopathological image.** The histopathological study of the lung allows us to see the structures of *Aspergillus fumigatus* distributed throughout the granuloma. *Picture courtesy of Dr. M.J. Buitrago.*

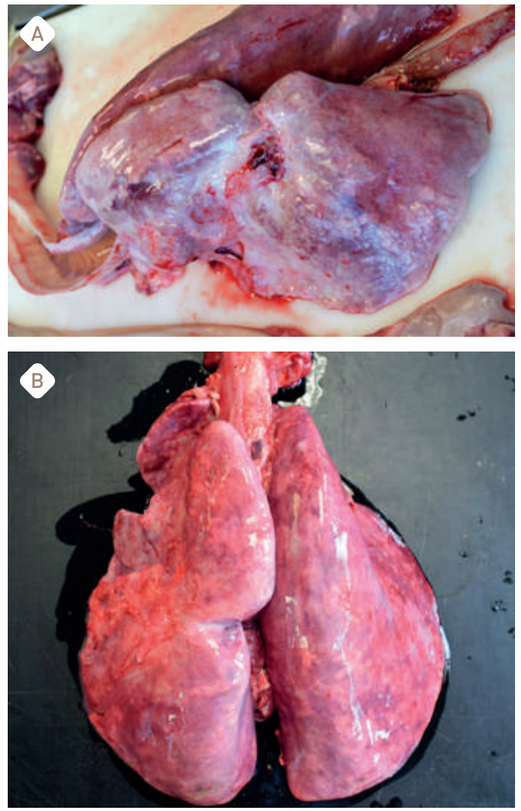
LEUKOSIS

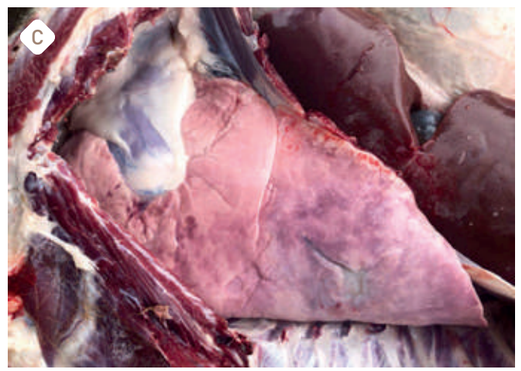




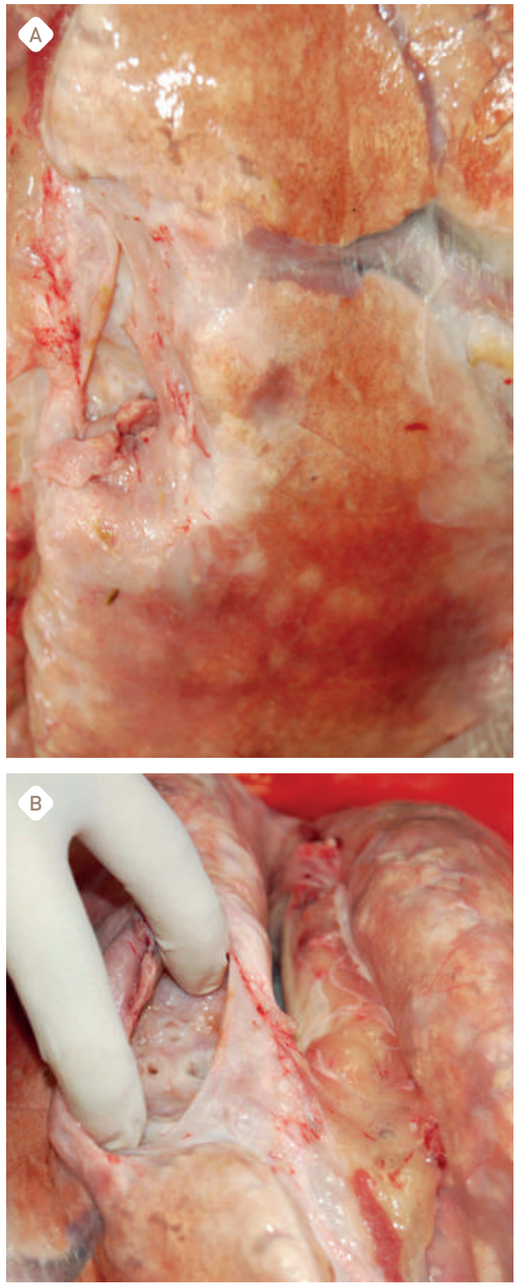
3.137. **Postmortem findings.** Ovine leukosis is a very rare disease, possibly related to the bovine leukosis virus. It can be found in a multisystemic way, forming white nodules in the parenchyma of different organs (A). At the respiratory level, we can find it in the thoracic cavity wall, lung and mediastinal lymph nodes (B-D).

SCAR RETRACTIONS AND ASEPTIC CAVERNS



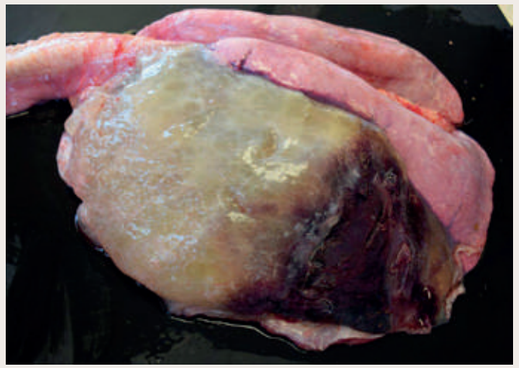


3.138. **Scar retractions.** After suffering chronic pneumonic disorders, it is possible to find lungs with atrophied areas, possibly of scar origin (A-C).

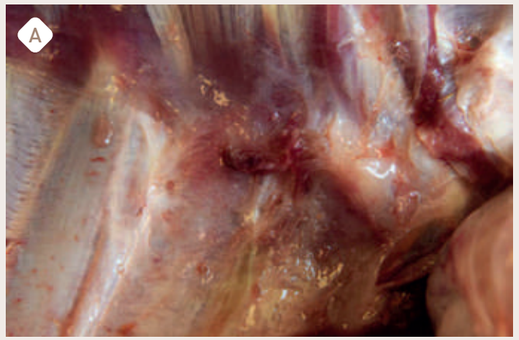


3.139. **Caverns.** It is also possible to find clean, empty, aseptic caverns of unknown aetiology (A and B).

IATROGENIC PNEUMONIA DUE TO VACCINE INJECTION IN THE LUNG



3.140. **Acute pneumonia.** The accidental injection of a vaccine directly into the lung produces acute pneumonia and abundant fibrinous pleurisy in a few hours.



3.141. **Vaccination of the injection tract.** Confirmation is easy after locating the entry point through the costal wall (A) and the pulmonary tract (B).

Digestive system disorders