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# Suppurative pleuropneumonia and a pulmonary abscess in a ram: ultrasonographic and radiographic findings

U. Braun<sup>1</sup>, M. Flückiger<sup>1</sup>, D. Sicher<sup>1</sup>, D. Theil<sup>2</sup>

## Summary

This report describes a two-year-old White Alpine ram with suppurative pleuropneumonia and a lung abscess. Prior to admission, the ram had been unsuccessfully treated with antibiotics and levamisole. Clinical examination revealed that the general behaviour and condition of the ram were severely disturbed. The rectal temperature and respiratory rate were increased. Auscultation of the lungs revealed increased vesicular sounds. Based on clinical findings, a tentative diagnosis of bronchopneumonia was made. To confirm the diagnosis, blood was taken for serological testing for Maedi-Visna, and endoscopic examination of the respiratory tract and ultrasonographic and radiographic examination of the thorax were performed. Cytologic and bacteriologic examination of tracheal secretions revealed large numbers of neutrophils and *Actinomyces pyogenes* organisms. A pocket of gas, surrounded by a capsule of soft tissue density, overlying the base of the heart, and a horizontal fluid line were observed on radiographs.

Ultrasonographic examination revealed an effusion between the pleura and the lung on the left side of the thorax; an encapsulated abscess was seen on the right side of the thorax. Centesis and aspiration of this accumulation of fluid yielded foul-smelling pus. Post mortem examination confirmed the clinical, radiographic and ultrasonographic findings. The ram had severe chronic suppurative pleuropneumonia with abscess formation between the pleura and lung on the right side.

**Key words:** lung – pleuropneumonia – pulmonary abscess – sheep

## Ultraschall- und Röntgenbefunde bei einem Schafbock mit Pleuropneumonie und Lungenabszess

Es wird ein 2 Jahre alter Schafbock der Rasse Weisses Alpenschaf beschrieben, der an einer eitigen Pleuropneumonie mit Lungenabszess erkrankt war. Der Schafbock wurde vor der Einlieferung mehrmals erfolglos antibiotisch und mit Levamisol behandelt. Klinisch wies er ein stark gestörtes Allgemeinbefinden und eine erhöhte Rektaltemperatur von 41.0 °C auf. Die Atemfrequenz war erhöht. Bei der Auskultation der Lunge war verschärftes Vesikuläratmen zu hören. Auf Grund der klinischen Befunde bestand Verdacht auf eine Bronchopneumonie. Zur weiteren Abklärung wurden eine blutserologische Untersuchung auf Maedi/Visna, eine Endoskopie des Atemapparates, eine Röntgen- und eine Ultraschalluntersuchung des Thorax vorgenommen. Die zytologische und bakteriologische Untersuchung des aspirierten Trachealsekretes ergab einen hohen Gehalt an neutrophilen Granulozyten und *Actinomyces-pyogenes*-Keimen. Bei der Röntgenuntersuchung wurden ein horizontaler Flüssigkeitsspiegel und über der Herzbasis eine Gasblase, umgeben von einer weichteildichten Kapsel, gesehen. Bei der Ultraschalluntersuchung der linken Brustwand wurde zwischen Pleura und Lunge ein ausgedehnter Erguss, bei derjenigen der rechten Brustwand ein abgekapselter Abszess gefunden. Die Punktions- und Aspiration dieser Flüssigkeitsansammlungen ergab übelriechende eitrige Flüssigkeit. Bei der Sektion wurden die klinischen, röntgenologischen und sonographischen Befunde bestätigt. Der Schafbock wies eine hochgradige, chronisch-eitrige Pleuropneumonie mit Abszessbildung zwischen Pleura und Lunge auf.

**Schlüsselwörter:** Lunge – Pleuropneumonie – Lungenabszess – Schaf

## Introduction

Pneumonia may occur at any age in sheep (Kimberling, 1988) and its causes are diverse. The most important types of pneumonia in sheep are enzootic pneumonia, progressive pneumonia and verminous pneumonia (Robinson, 1983; Kimberling, 1988; Dungworth, 1993; Braun, 1994). Verminous pneumonia is caused mainly by *Dictyocaulus filaria*. Enzootic pneumonia may be caused by various viruses (adenovirus, parainfluenza virus type 3, respiratory syncytial virus, reovirus), bacteria (*Pasteurella haemolytica*, *Pasteurella multocida* and *Actinomyces pyogenes* are several examples), Mycoplasma spp. and Chlamydia spp. In sheep, progressive pneumonia (Maedi-Visna), caused by a lentivirus, and pulmonary adenomatosis are of major importance. Pseudotuberculosis and tuberculosis are additional causes of ovine pneumonia.

Pneumonia usually can be reliably diagnosed based on clinical signs. However, determination of the aetiology, extent and nature of the pathological changes often is difficult. Additional diagnostic methods include virologic, bacteriologic and cytologic examination of tracheal secretions, serologic testing for antibodies to Maedi-Visna, parasitologic examination of faeces, endoscopy, radiography and ultrasonography. Radiography and ultrasonography are especially suited to providing information about the extent and nature of the lesions.

To our knowledge, there are no reports in which radiography and ultrasonography were used to diagnose pneumonia in sheep. The present paper describes a two-year-old White Alpine ram with pleuropneumonia and a pulmonary abscess. The ram originated from a flock of 42 sheep that were pastured daily. They were fed grass, hay, corn and chopped beets. The flock was treated with anthelmintics three times per year. Eight months prior to admission, the ram had been imported from France

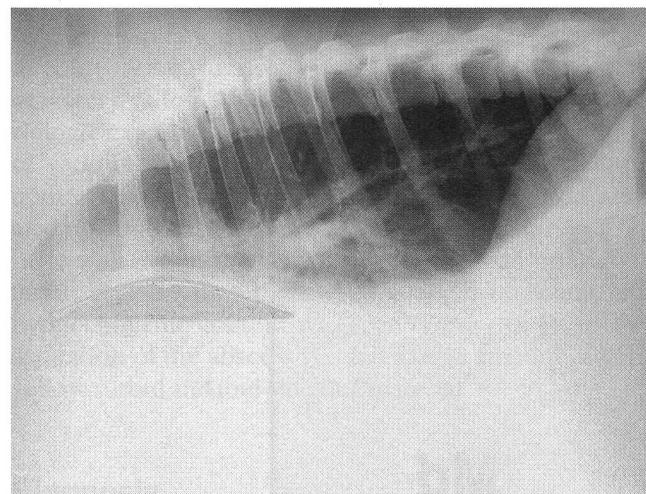


Figure 1: Radiograph and schematic representation of the lungs of a ram with pleuropneumonia. This is a laterolateral radiograph taken while the patient was standing. 1 = lungs; 2 = pulmonary vasculature; 3 = horizontal fluid line with a pocket of gas; 4 = image of heart (hatched), not visible because of the accumulation of fluid in the ventral thorax; 5 = aorta (hatched), not visible because of the accumulation of fluid in the ventral thorax; 6 = diaphragm

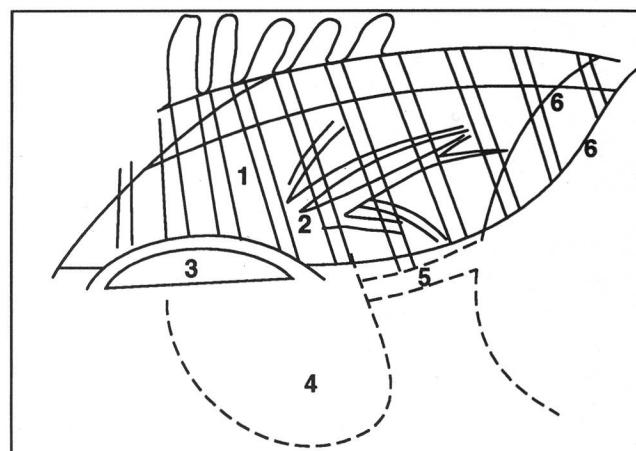
together with another ram from the same breeding farm. From the time of importation, the owner noticed that the ram's appetite was poor and that he gradually lost weight. Several weeks before admission, the owner noticed that the ram had a cough. Therefore, the ram was treated several times for bronchopneumonia with procaine penicillin and once with levamisole for possible lung worms. The ram did not improve and thus was referred to our clinic.

## Clinical findings

The general behaviour and attitude of the ram were markedly abnormal. The ram was emaciated and exhibited bruxism. The rectal temperature was elevated to 41°C, and the respiratory rate was in the high normal range. Auscultation of the lungs revealed increased vesicular sounds. The heart rate was increased to 132 beats per minute. There was no ruminal motility, and intestinal motility was severely reduced. There were no other abnormal findings. The clinical findings indicated inflammatory disease of the lower respiratory tract, and it was suspected that the ram had bronchopneumonia. Blood was collected for haematological and biochemical examination and for serological testing for antibodies to Maedi-Visna. In addition, parasitological examination of faeces, endoscopic examination of the respiratory tract and radiographic and ultrasonographic examination of the thorax were performed.

## Haematologic and biochemical findings

Haematocrit (27%), haemoglobin concentration (8.4 g/dl) and erythrocyte count ( $8.04 \times 10^6 \mu\text{l}$ ) were in the lower normal range. The MCH (10 pg) indicated mild



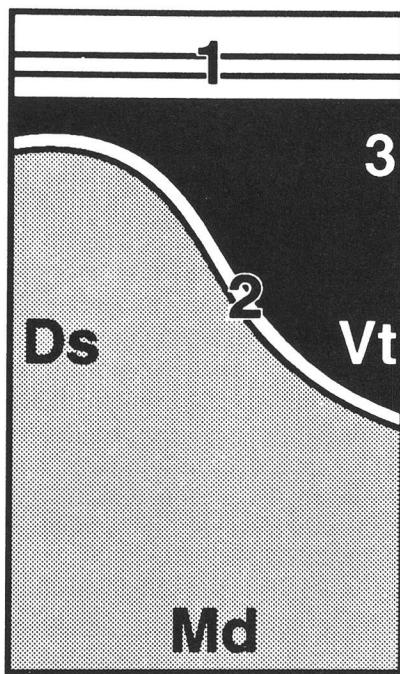
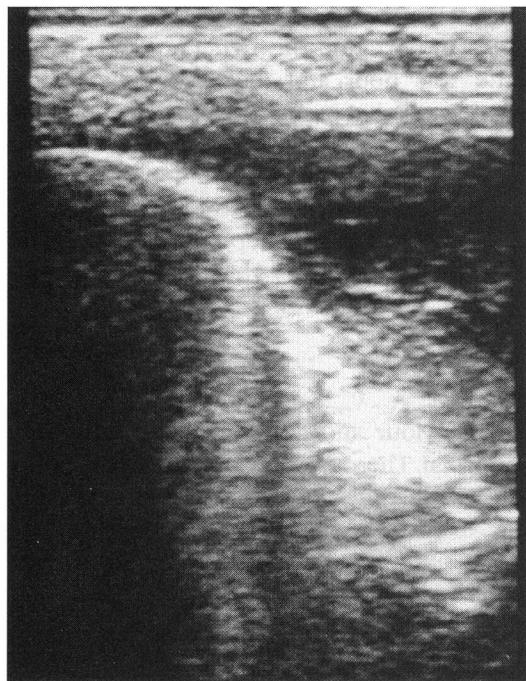


Figure 2: Ultrasonogram and schematic representation of a pulmonary effusion in a ram. The ultrasonographic examination was performed through the left thoracic wall using a 5.0-MHz convex transducer. 1 = thoracic wall; 2 = visceral pleura; 3 = hypoechogenic effusion between the thoracic wall and the lung. Ds = dorsal; Vt = ventral; Md = medial

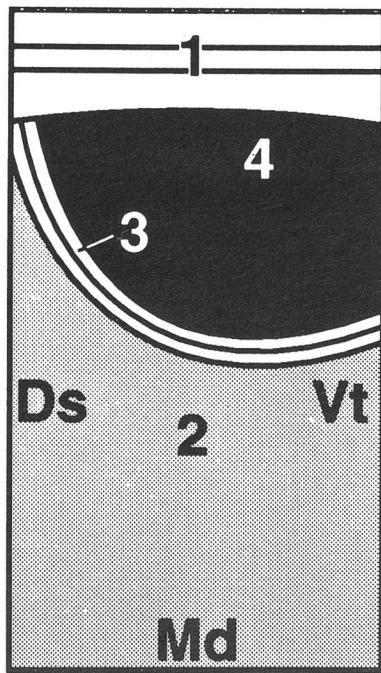
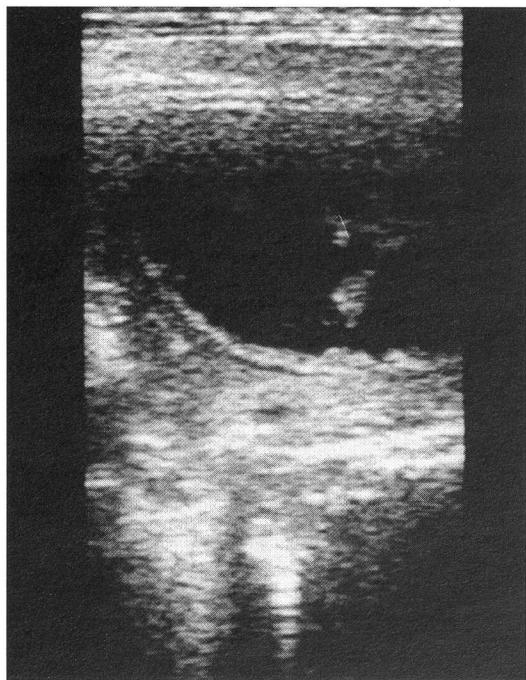


Figure 3: Ultrasonogram and schematic representation of a pulmonary abscess in a ram. The ultrasonographic examination was performed through the right thoracic wall using a 5.0-MHz convex transducer. 1 = thoracic wall; 2 = lung; 3 = capsule of abscess; 4 = hypoechogenic content of abscess; See Fig 2 for key

hypochromic anaemia. The leukocyte count was 11,600 cells/ $\mu$ l, and the concentration of plasma protein (82 g/l) and fibrinogen (8 g/l) were increased. Activities of hepatic enzymes and the concentrations of serum urea, serum electrolytes and ruminal chloride were normal. The serological test for antibodies to Maedi-Visna was negative. Parasitological examination of faeces revealed small numbers of *Trichuris* eggs.

## Endoscopic, radiographic and ultrasonographic findings

Endoscopic examination of the respiratory tract revealed a slightly reddened bronchial mucosa that was covered with a small amount of liquid secretion. Cytologic and bacteriologic examination of the respiratory secretion revealed large numbers of neutrophils and *Actinomyces pyogenes*.

On latero-lateral radiographs of the thorax, a horizontal fluid line was observed at the level of the base of the heart (Fig. 1). Ventral to this point, no structures were visible due to the accumulation of fluid in the pleural space. A pocket of gas, surrounded by a capsule and approximately 1 cm thick, was superimposed on the image of the heart.

Ultrasonographic examination of the thorax was performed on both sides using a 5.0-MHz convex transducer. The intercostal spaces (ICS) were examined from dorsal to ventral. On the left side of the thorax in the dorsal aspects of the ICS, the surface of the lung appeared as a hyperechogenic line, which is a normal finding. The lung tissue could not be imaged because the air-filled pulmonary tissue reflected the ultrasound waves, thereby causing reverberation artefacts seen as concentric echogenic lines. Approximately at mid-thorax, the pleura was displaced from the thoracic wall by an extensive hypoechoogenic effusion (Fig. 2). Ultrasound-guided centesis and aspiration of this effusion, by means of a spinal needle (0.9×90 mm) with stylet, yielded a large amount of watery, yellow, foul-smelling pus. Cytologic and bacteriologic examination of the pus revealed a large number of various types of bacteria and 206,500 degenerated neutrophils per  $\mu$ l. Ultrasonographic examination revealed no abnormalities in the dorsal area of the right thoracic wall. When the transducer was moved ventrally, a large abscess with a thick hyperechogenic capsule and hypoechoogenic content was seen (Fig. 3). Centesis and aspiration of the abscess yielded a large amount of light yellow, turbid and foul-smelling material.

## Diagnosis

A diagnosis of suppurative pleuropneumonia with a pulmonary abscess adjacent to the right thoracic wall was made based on the clinical, radiographic and ultrasonographic findings. *Actinomyces pyogenes* was suspected

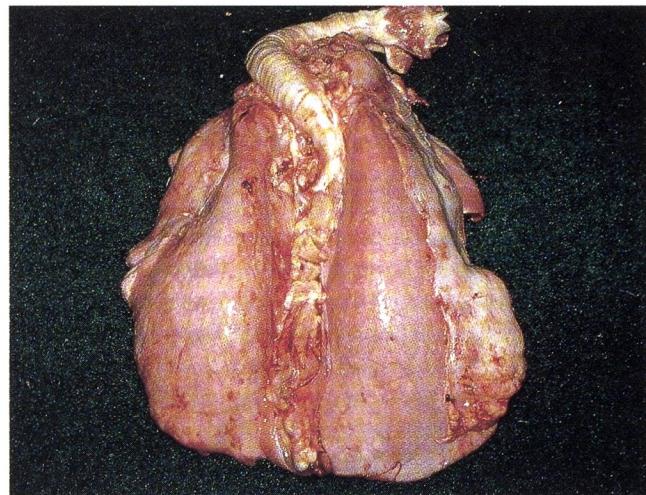


Figure 4: The lung of a White Alpine ram with pleuropneumonia. The pulmonary pleura of the right lung has extensive changes in the diaphragmatic lobe. These consist of adhesion of the costal pleura and the pulmonary pleura with accumulation of pus between the two

to be the cause of the infection. Uncomplicated bronchopneumonia, Maedi-Visna and *Dictyocaulus* infection could be ruled-out. The ram was euthanatized because of the poor prognosis, and a post mortem examination was performed.

## Post mortem findings

The thorax was filled with 3 to 4 liters of white milk-like fluid. On both sides there was adhesion of the costal pleura to the pulmonary pleura. In the area of pleural adhesion in the right lung, there were several cavities filled with yellow to red fluid and pus (Fig. 4). The lungs were poorly retracted, slightly firmer than normal and yellow to red. The pulmonary lymph nodes were markedly enlarged. There was follicular hyperplasia in the spleen. The other organs had no macroscopic abnormalities. Histologically, there was severe pleural fibrosis with foci of necrosis and plasma cell infiltration. In the lungs, there was fibrosis and infiltration of plasma cells and lymphocytes, predominantly in subpleural areas. In deeper areas of the lungs, there was only mild peribronchial and perivasculär infiltration of plasma cells and lymphocytes. Based on these findings, a definite diagnosis of severe chronic pleuritis with abscessation, mild chronic bronchopneumonia and chylothorax was made.

## Discussion

In a patient such as the one described in this report with chronic pneumonia that is non-responsive to therapy, it is imperative to determine whether further treatment is warranted. Thus, a correct diagnosis including determination of the aetiology and the morphological changes caused by the disease is necessary. First, *Dictyocaulus* infection and *Maedi-Visna* had to be ruled-out; both diseases must be suspected in a case of chronic ovine pneumonia that is non-responsive to antibiotics. Next, adenomatosis had to be ruled-out. Weight loss and the chronic ailment that was non-responsive to antibiotic therapy might have supported a diagnosis of adenomatosis; however, the ram had a fever and lacked the characteristic moist cough and watery to foamy nasal discharge. An accurate diagnosis of adenomatosis can be made only by histological examination of carcinomatous tissues.

In this report, an accurate diagnosis could not be made based on clinical findings. Thus, additional diagnostic methods were employed. Haematologic examination revealed mild hypochromic anaemia and mild leukocytosis, which indicated a chronic infection. The results of this report demonstrated that the endoscopic, radiographic and ultrasonographic findings complimented one another. Endoscopic examination allowed visualization of the tracheal and bronchial mucosa and the collection of tracheal secretion. Examination of the latter revealed a severe infection with *Actinomyces pyogenes*. In ruminants, *Actinomyces pyogenes* infection is usually associated with suppurative processes, abscessation and a poor prognosis (Fischer et al., 1987). The radiographic examination of the thorax, which was performed primarily to determine the extent and severity of the diffuse parenchymal pulmonary disease, revealed a horizontal fluid line and a pocket of gas. These findings were interpreted as pleural effusion and an abscess, respectively. Pleural effusion and abscesses can be diagnosed by radiography only when they reach a certain dimension, as occurred in this case. The information obtained from radiographic examination is limited when the goal is to visualize a small amount of pleural effusion or pulmonary changes beneath an extensive pleural effusion (Reef et al., 1991). The ram described in this report is a rare example of a patient with an extensive effusion in the ventral thoracic area, whereby the lungs could not be visualized radiographically. Ultrasonography has been used for a number of years in humans (Banholzer, 1993), dogs (Stowater and Lamb, 1989) and horses (Rantanen et al., 1981; McClellan, 1991a,b; Reimer et al., 1989; Reimer, 1990; Reef et al., 1991; Rantanen 1993) for examining patients with pleural and pulmonary disease. In cattle, Reef et al. (1991) described the ultrasonographic findings of two cows with pleural changes and pleural effusion. To our knowledge, there are no similar reports in sheep or goats. The results of ultrasonographic examination are far superior to those obtained through radiographic examination for determining a small amount of pleural effusion or the type of effusion (Rantanen et al.,

1981; Rantanen, 1986; Reimer et al., 1989; Reef et al., 1991). Ultrasonography is an excellent method of visualizing the pleural space, the parietal pleura of the thoracic wall and the visceral pleura of the lungs. The parietal and visceral surfaces of the lung are seen as thin white lines medial to the inner surface of the thoracic wall and lateral to the surface of the lung (Rantanen, 1981). Pleural effusion appears as an anechoic or hypoechoic zone located between the two pleural surfaces. Via radiographic methods, the lungs cannot be examined in cases with extensive pleural effusion, whereas in the ultrasonographic examination, the effusion functions as an acoustic window through which the lungs often can be visualized (Banholzer, 1993). Additional ultrasonographic characteristics often make differentiation of pleural effusions possible (Banholzer, 1993). In right-sided cardiac insufficiency, the pleural effusion is anechoic. Moreover, additional symptoms may reveal the primary disease. Inflammatory pleural effusion, which was described in this case report, has distinct internal echoes caused by cells and fibrin. As inflammatory pleural effusion becomes more organized, its echogenicity increases. Fibrinous strands and septa, which move during respiration, are often visible and appear as hyperechoic structures located in the pleural effusion between the lung and thoracic wall. In patients with chronic inflammation, thick fibrinous or fibrous deposits may occur on the lungs and parietal pleura. The greatest advantage of ultrasonography is that centesis and aspiration of pleural effusion may be performed under visual control; the aspirated fluid can be examined cytologically and bacteriologically.

It is important to remember that because the lungs contain air, ultrasonographic examination of this organ has its limitations. The ultrasonographic waves are completely reflected by the surface of the air-filled lung, resulting in typical artefacts, which are caused by reverberation of the ultrasonographic waves between the reflecting pulmonary surface and the transducer (Rantanen, 1993). These artefacts appear as hyperechoic concentric lines on the ultrasound screen. However, ultrasonographic examination is extremely helpful in patients with pathological processes that are located near the thoracic wall. Lesions that originate from the thoracic wall or extend to the surface of the lungs can be visualized (Banholzer, 1993). This was demonstrated in this case in which a pulmonary abscess, situated between the lung and the pleura, could be visualized in its entirety and aspirated. Changes located within the lung can be identified ultrasonographically only if they extend to the thoracic wall. Pulmonary tissue is visible if there are no air-filled areas between the transducer and affected tissue. The ultrasonographic appearance of pulmonary tissue that is not filled with air is similar to a parenchymatous abdominal organ; the air-filled bronchi are seen as hyperechoic structures.

In conclusion, endoscopy, radiography and ultrasonography are valuable aids in the diagnosis of pleural and pulmonary disease. It is imperative to remember that a

thorough clinical examination is the most important part of a diagnosis. The most important clinical findings in cases with pleuritis are fever, anorexia, weight loss, pain in the thoracic wall and dyspnea due to extensive pleural effusion. Percussion and auscultation of lungs that are displaced dorsally due to an effusion may reveal important information such as absence of normal lung sounds in the ventral thorax and decreased intensity of percussion sounds in this areas. In any disease, a synopsis of all relevant findings is required for a correct diagnosis.

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### Observations par ultrasons et radiologie chez un bélier avec une pleuropneumonie et un abcès du poumon

Le cas d'un bélier de la race Blanc des Alpes âgé de 2 ans atteint d'une pleuropneumonie purulente avec un abcès du poumon est décrit. Le bélier avait été traité plusieurs fois avant son admission par des antibiotiques et du Levamisol. L'examen clinique a révélé une condition générale fortement perturbée et une température rectale élevée de 41 °C. La fréquence respiratoire était élevée. Lors de l'auscultation du poumon, une respiration vésiculaire plus prononcée a été entendue. Sur la base des observations cliniques, une bronchopneumonie a été suspectée. En complément, un examen sérologique du sang pour le Maedi/Visna, une endoscopie de l'appareil respiratoire et un examen radiologique et ultrasonique du thorax ont été performés. L'examen cytologique et bactériologique de la sécrétion trachéale aspirée a révélé un nombre élevé de granulocytes neutrophiles et de germes *Actinomyces pyogenes*. L'examen radiologique a révélé la présence d'une ligne de liquide horizontale et, sur la base du cœur, une poche de gaz entourée d'une capsule de tissu mou. L'examen ultrasonographique de la paroi gauche du thorax a décelé un épanchement important entre la plèvre et le poumon et l'examen de la paroi droite un abcès encapsulé. La ponction et l'aspiration de cette accumulation de liquide a révélé un liquide purulent et d'une odeur repoussante. Lors de l'autopsie, les observations cliniques, radiologiques et sonographiques ont été confirmées. Le bélier avait une pleuropneumonie chronique purulente prononcée avec une formation d'abcès entre la plèvre et le poumon.

### Risultati ultrasonografici e radiologici in un montone con pleuropneumonia e ascesso polmonare

Viene descritto il caso di un montone di due anni della razza alpina bianca, affetto da una pleuropneumonia purulenta con ascesso. L'animale era stato in precedenza trattato più volte con antibiotici e con Levamisol senza alcun successo. Il suo stato clinico generale era molto disturbato e la temperatura rettale era di 41 °C. La frequenza respiratoria era al di sopra della norma. Durante l'auscultazione dei polmoni si riscontrava un mormorio vescicolare rafforzato. In base al referto clinico veniva sospettata una broncopneumonia. Al fine di una ulteriore caratterizzazione vennero effettuate delle analisi emato-serologiche, per l'eventuale presenza di Maedi/Visna, una endoscopia dei polmoni, una radiografia ed una sonografia del torace. Il referto citologico e batteriologico del secreto tracheale aspirato mostrava un alto contenuto di granulociti neutrofili e microorganismi del tipo *actinomyces pyogenes*. Nella radiografia si vedeva un livello orizzontale di liquido e sopra la base cardiaca una sacca di gas, avvolta da una capsula di consistenza molle. Nell'analisi sonografica della parete toracica sinistra si riscontrava fra la pleura ed il polmone un travaso esteso, mentre nella sonografia della parete toracica destra si vedeva un ascesso incapsulato. Il liquido ottenuto mediante punzione ed aspirazione era puzzolente e purulento. Durante la sezione dell'animale vennero confermati i referti clinici, radiologici e sonografici. Il montone difatti aveva una pleuropneumonia forte, cronico-purulenta con formazione di un ascesso fra la pleura ed il polmone.

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