

Echocardiographic findings in a goat with cor pulmonale secondary to chronic parasitic pneumonia

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Summary

A four-year old goat was presented for anorexia and apathy since kidding one week earlier. Physical examination revealed dyspnea, extensive ascites and bilateral distended jugular veins, suggestive of congestive right heart failure. The echocardiographic findings of severe right ventricular and atrial dilatation were consistent with right heart failure. In the absence of abnormalities in the right ventricular outflow tract a diagnosis of cor pulmonale secondary to lung disease was posed. Due to a poor prognosis, the goat was euthanized. Necropsy confirmed cor pulmonale and identified severe chronic parasitic pneumonia as underlying cause.

Echocardiography is an interesting tool also applicable in the farm for diagnosing heart diseases in goats, and its use should help to avoid unnecessary therapy in cases with a poor prognosis.

Keywords: echocardiography, cor pulmonale, right heart failure, pulmonary hypertension

Ultraschallbefunde bei einer Ziege mit Cor pulmonale infolge chronischer verminöser Pneumonie

Eine 4-jährige Ziege wurde eine Woche nach dem Ablammen wegen Apathie und Anorexie vorgestellt. Die klinische Untersuchung ergab Dyspnoe, einen hochgradigen Aszites und gestaute Jugularvenen, was für eine rechtsseitige kardiale Stauungsinsuffizienz sprach. Echokardiographisch konnte gestützt auf hochgradiger rechtsventrikulärer und rechtsatrialer Dilatation ein rechtsseitiges Herzversagen bestätigt werden. Nachdem keine Abnormalität im rechtsventrikulären Ausflusstrakt vorlag, wurde für diese Herzveränderungen im Zusammenhang mit der respiratorischen Symptomatik die Verdachtsdiagnose eines Cor pulmonale als Folge einer Lungenerkrankung gestellt. Aufgrund der schlechten Prognose wurde die Ziege euthanasiert. Die Autopsie ergab eine parasitäre Pneumonie und bestätigte den Verdacht eines sekundären Cor pulmonale. Die Echokardiographie ist ein interessantes Werkzeug, welches auch bei Ziegen im Stall für die kardiale Diagnostik eingesetzt werden kann, damit bei Fällen mit schlechter Prognose keine unnötigen Behandlungsversuche unternommen werden.

Schlüsselwörter: Echokardiographie, Cor pulmonale, rechtsseitiges Herzversagen, pulmonale Hypertension

Case History

A four-year-old 49 kg mixed breed goat was presented to the bovine ambulatory clinic of the Faculté de Médecine Vétérinaire February 2008 for anorexia and apathy since kidding one week earlier. The kidding was normal and she delivered one healthy kid. The goat was in a 40 meat-goat flock. The owner did not report any specific health problem in his flock, despite a foul ammoniac smell in the barn. The animals were not vaccinated and had not been dewormed since they were moved indoor in the early fall.

Clinical findings

The goat was weak, depressed, and frequently recumbent and had a distended abdomen. The respiratory rate was increased (60 breaths per minute; reference range 15–30 breaths per minute; Pugh, 2002). Dyspnea was observed with orthopnea and flared movements. The rectal temperature was normal (39.0 °C, reference range 38.9–40 °C; Pugh, 2002). The heart rate was increased (140 beats per minute; reference range 66–80 beats per minute; Pugh, 2002). No cardiac murmur or dysrhythmia was noted on physical examination. The thoracic auscultation revealed

82 Case report

increased normal respiratory noises without crackles or wheezes. The physical examination revealed bilateral distended jugular veins and retrograde venous pulse. A sternal pitting edema was also observed. The mucous membranes were normal with a capillary refill time less than two seconds. The abdominal auscultation showed rumenal hypomotility and splashing sounds when ballotting of both flanks. The abdomen was soft and no pain was elicited when performing deep abdominal palpation. The feces were macroscopically normal with no evidence of diarrhea. The udder was normal. The goat manifested normal micturition during the clinical examination.

Laboratory findings

The complete blood count findings included a decreased packed cell volume (20%; reference range used at the CHUV: 24–38%, no reticulocytes on the blood smear), despite a normal haemoglobin content (92.0g/L, reference range 74.0–120.0g/L) and red blood cells values ($14,400 \times 10^9$ red blood cells/L; reference range $13,100–20,100 \times 10^9$ /L), leukocytosis (21.31×10^9 WBCs/L; reference range: $8.40–19.60 \times 10^9$ WBCs/L) with neutrophilia (19.39×10^9 cells/L; reference range: $3.0–8.5 \times 10^9$ cells/L), lymphopenia (0.85 cells/ μ L; reference range: $3.0–8.5 \times 10^9$ cells/L), monocytosis (1.1 cells/L; reference range: 0.2–0.8 $\times 10^9$ cells/L), and hypofibrinogenemia (1 g/L; reference range: 3–5 g/L). The serum biochemical profile include increased aspartate aminotransferase activity (AST 175 IU/L; reference range: 28–96 IU/L), increased gamma-glutamyltransferase (GGT, 74 IU/L; reference range: 34–52 IU/L), increased creatine kinase activity (CK 465 IU/L; reference range: 58–80 IU/L) and potassium value (6.02 mmol/L; reference range: 5.20–5.80 mmol/L). Hypoproteinemia (5.4 g/dL; reference range: 6.0–8.0 g/dL) was observed with a severe hypoalbuminemia (1.76 g/dL; reference range: 2.60–3.80 g/dL). Hypocalcemia (1.90 mmol/L; reference range: 2.31–2.70 mmol/L) and hypophosphatemia (0.84 mmol/L; reference range: 1.6–2.9 mmol/L) were also noted.

Ultrasonographic findings

The transabdominal ultrasonography performed with a 4 MHz sectorial probe (LogiqBook, General Electric Healthcare, Wauwatosa, WI, USA) revealed a massive anechoic peritoneal effusion (Fig. 1) without other abnormal findings. The paracentesis revealed large amounts of non clotting transparent fluid compatible with a modified transudate (protein determined with the refractometer: 25g/L). The echocardiography was performed as previously described by Olsson et al. (2001) and revealed severe right ventricular distension compared to the left ventricle (Fig. 2), decreased shortening fraction of the left ventricle (Tab. 1) and a small amount of pericardial fluid.

The tricuspid valve, the pulmonary trunk and the pulmonary valve appeared normal. There was no evidence of ventricular or atrial septal defect, or other congenital anomaly. A small amount of pleural fluid was also observed in the right thorax with no apparent lung parenchymal anomalies.



Figure 1: Ultrasonographic appearance of peritoneal fluid in a goat with ascites and cor pulmonale. The right transabdominal ultrasonography reveals a massive anechoic peritoneal fluid accumulation (*). The liver is observed with important edema at the insertion of the falciform ligament (arrow). Sectorial 4 Mhz probe, depth: 15cm.

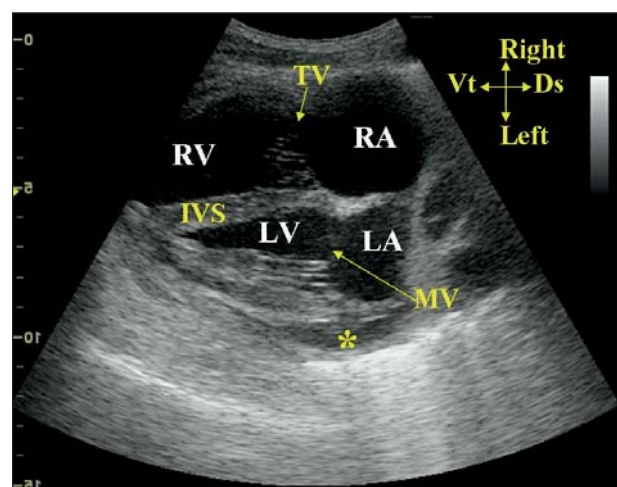


Figure 2: Right long axis “four-chambers” view of the heart at the early ventricular systole showing the severe right ventricular dilation when compared to the left ventricle. The right ventricle (RV) is severely distended when compared to the left ventricle (LV). Both the right (RA) and the left atria (LA) are also observed. IVS, interventricular septum; TV, tricuspid valve; MV, mitral valve; *, small pericardial effusion; Ds, dorsal; Vt, ventral. Sectorial 4 MHz probe, depth: 15cm.

Table 1: Echocardiographic measurements in the goat with congestive heart failure.

	Case report	References ranges ^{1,2}
Ao	2.08	2.34–2.43
PT	2.14	NA
RA (cm)	4.11	NA
RVEDD (cm)	4.32	NA
RVESD (cm)	4.21	NA
LA (cm)	2.91	2.73–2.85
LVEDD (cm)	3.25	3.95–4.15
LVESD (cm)	2.65	2.33–2.43
SF (%)	18.5	40.0–42.2
HR (bpm)	140	66–80

Ao: diameter of the aorta, PT; pulmonary trunk diameter, RA: right atrium, RVEDD: right ventricle end-diastolic diameter, RVESD: right ventricle end-systolic diameter, LA: left atrium, LVEDD: left ventricle end-diastolic diameter, LVESD: left ventricle end-systolic diameter, SF: shortening fraction of the left ventricle, HR: heart rate, NA: not available.

Parasitological examination

One fecal sample taken intra-rectum was submitted for a fecal eggs count by the Wisconsin method and a Baermann flotation test. This yielded an increased fecal eggs count (1543 eggs of strongylids per gram of feces). The Baermann flotation test was negative. Those results were in accordance with a severe gastrointestinal parasitism since worms reproduction is normally decreased during the winter months.

Clinical diagnosis

Based on the clinical signs and ancillary tests results, a clinical diagnosis of right-sided heart failure and severe gastrointestinal parasites infestation was posed. The ascites and peripheral edema were probably due to right-sided heart failure as attested by the relatively high level of protein in the peritoneal effusion. In the absence of abnormalities in the tricuspid and pulmonic valves and main pulmonary artery, considered causes for the right ventricular dilation were pulmonary hypertension and primary myocardial disease. No treatment was then attempted because of the poor expected prognosis and the low value of the goat, which was therefore humanely euthanized and submitted for a complete macroscopic and microscopic post-mortem examination.

Necropsy and histology

The post-mortem examination revealed severe sub-cutaneous edema in sternal, abdominal and appendicular

regions as well as mild hydrothorax and hydropericardium and severe ascites. The caudal lung lobes failed to collapse, had a robbery texture, were deep red speckled with white and presented a 2 cm abscess in the caudal part of the left caudal lobe. The heart was rounded with marked right side's distension. No other cardiac anomalies were detected. The liver surface was irregular; the Glisson's capsule markedly thickened and covered by strands of fibrin and a typical nutmeg pattern was present on cut surfaces. Histopathologic examination revealed a severe diffuse interstitial pneumonia with alveolar septa markedly thickened by fibrosis. Hypertrophy of the pulmonary vessels was observed that was considered to have contributed to pulmonary hypertension. The lung parenchyma was infiltrated by some lymphocytes as well as plasma cells with occasional lymphoid nodules formation. There was moderate hyperplasia of type II pneumocytes. Alveoli were filled with edema, macrophages and occasional multinucleated cells and fibrin clumps. Numerous fibrous polyps were present in alveoli and occasionally in bronchioli. Some alveoli contained numerous 8 µm round fungi compatible with *Pneumocystis* or few sections of nematodes larvae and adults (Fig. 3). Liver presented changes compatible with right side heart failure: 1) centrolobular and midzonal hepatocytes were replaced with erythrocytes, 2) surrounding hepatocytes presented atrophy and vacuolization (lipids) while 3) Glisson's capsule was thickened by fibrosis and covered by fibrin. Other changes included marked congestion of spleen, adrenal glands and kidneys. The pathological findings were compatible with a cor pulmonale secondary to a chronic interstitial pneumonia.

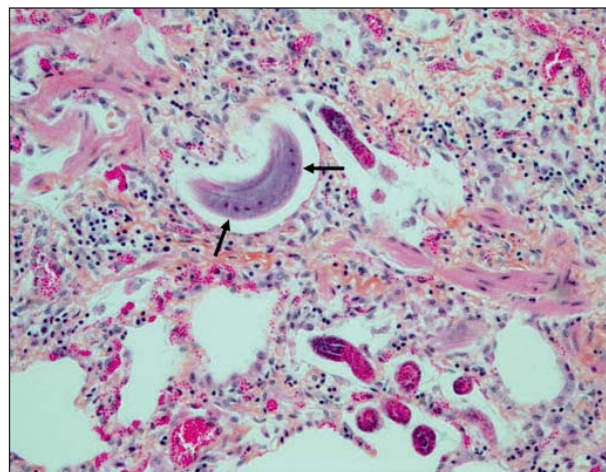


Figure 3: Chronic interstitial pneumonia. Alveolar septa are expanded by fibrosis and infiltrated by lymphocytes and plasma cells. There is smooth muscle hypertrophy. Note sections of nematode within alveolar lumen (arrow). Hematoxylin-eosin-phloxin and safran, 200x.

84 Case report

Discussion

Heart diseases are rarely diagnosed in small ruminants. There are no available studies describing the relative incidence and prevalence of heart diseases in small ruminants. The main mentioned heart diseases consisted in nutritional myopathy (Ross et al., 1989), pericarditis (Akkoc, 2007), bacterial endocarditis (Scott and Sargisson, 2001), congenital heart defects (Parry et al., 1982; Gardner et al., 1992), intoxication (East et al., 1994) and neoplasms (Braun et al., 1995). Most of those affections have a poor prognosis, since there are no reported cases of survival except for case reports of some congenital heart diseases such as ventricular septal defects (Parry et al., 1982) or Ebstein anomaly (Gardner et al., 1992).

The clinical signs of heart failure described in textbooks are similar in small ruminants and cattle (Pugh, 2002). The jugular venous distension and pulse as well as peripheral edema and ascites are the main indicators of right-sided heart failure (Pugh, 2002). The ancillary tests available to diagnose heart diseases are the same in small ruminants and in cattle. The echocardiography has been described for small ruminants examination (Gardner et al., 1992; Braun et al., 1995; Olsson et al., 2001) as a non invasive test to assess heart dimensions (Olsson et al., 2001), the myocardium, the valvulae (Gardner et al., 1992) and the pericardium (Braun et al., 1995). There are no previous reported cases of echocardiographic findings in small ruminants with a cor pulmonale. Echocardiographic abnormalities include right ventricular dilation, right atrial dilation and increased calculated pulmonary arterial pressure (Armstrong, 2005). The pulmonary arterial pressure (PAP) can be calculated by measuring the velocity of the tricuspid or the pulmonary regurgitant jet using the modified Bernoulli equation (Berger et al., 1985; Johnson et al., 1999). Unfortunately, due to only a large sectorial probe available for the examination it was not possible to image high quality regurgitant jets of tricuspid or pulmonic valve insufficiencies to calculate PAP in this case. Direct pulmonary trunk catheterization has also been used to determine exact pulmonary arterial pressure in cattle (Angel and Tyler, 1992; Holt and Callan, 2007) and small ruminants (Rovira et al., 1994).

Cor pulmonale in ruminants is a rare manifestation of pulmonary hypertension (Gay and Richards, 1983; Angel and Tyler, 1992). It has been defined as a hypertrophy and/or dilation of the right ventricle resulting from diseases affecting the function of the lungs except when these pulmonary alterations are the results of diseases that primarily affect the left side of the heart (Han et al., 2007). Although the entire pathophysiological process is not fully understood in cases of parenchymal diseases, the pulmonary arterial vasoconstriction due to hypoxia secondary to lung disease (Han et al., 2007), the destruction of the pulmonary vasculature due to the lung disease (Weitzenblum et al., 1983), and the vascular obstruction due to perivascular fibrosis that may lead to vascular thrombosis

may all result in pulmonary hypertension and cor pulmonale (Han et al., 2007). Many individual and environmental factors also have an influence on the development of pulmonary hypertension. In cattle, the PAP is influenced by the breed, individual variability, the age of the patient, the environment, the presence of toxins as well as concurrent lung disease or systemic illness (Holt and Callan, 2007). Despite the high prevalence of infectious or parasitic pneumonia, cor pulmonale secondary to those diseases are rare in ruminants (Gay and Richards, 1983; Angel and Tyler, 1992), suggesting that individual susceptibility is an important part of the pathophysiology of cor pulmonale at low altitudes. Since no additional test was done in order to determine the eventual infection of this goat by the caprine-arthritis-encephalitis virus (CaEV), the implication of this virus in the pathological changes of the lungs can not be totally excluded. However, the age of the goat, the absence of other typical clinical manifestation of CaEV in this flock and the presence of parasites in the lungs were in accordance with a parasites induced pneumonia rather than a viral-induced pneumonia.

When the diagnosis of congestive heart failure is made, the prognosis is grave to poor in small ruminants (Pugh, 2002). The data concerning therapeutic approach of cor pulmonale is limited to a case report in ruminants (Angel and Tyler, 1992) and was successful in 1 of 3 cases. The cow that healed with a follow-up of 6 months had a left displaced abomasum (LDA) and pulmonary hypertension but no echocardiography was performed. She was treated by fenbendazole administration as well as surgical correction of LDA. Depending on the suspected etiology other treatments have been attempted and consisted in oxygen therapy, antimicrobial treatment depending on the pneumonia aetiology, anti-inflammatory treatments and diuretics (Angel and Tyler, 1992). In human, where cor pulmonale is a complication of various pulmonary diseases, the success rate depends on the cardiac changes induced by the respiratory disease as well as the etiology of the pulmonary disease. This rate is quite low in patients with advanced cardiac changes or with irreversible pulmonary fibrosis (Han et al., 2007). In the present case, due to the acute presentation, and the absence of cardiac changes (except a dilation of the right heart) it is unfortunately not known if the prognosis could have been better due to the absence of therapeutic attempts.

Even if cardiac diseases are rare in goats, a cor pulmonale should be suspected in individuals demonstrating weakness, anorexia, respiratory anomalies and a distended abdomen combined with a deficient deworming program. Echocardiography is of tremendous help in the diagnosis of heart modifications especially because it is non-invasive and can be done directly in the farm with an immediate diagnosis for the owner. This is particularly interesting to avoid unnecessary treatments in case of commercial animals which will not be referred to a hospital.

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