PESQUISA VETERINÁRIA BRASILEIRA
Brazilian Journal of Veterinary Research
ISSN 0100-736X (Print)
ISSN 1678-5150 (Online)

Pesq. Vet. Bras. 46:e07753, 2026
DOI: 10.1590/1678-5150-PVB-7753

Original Article
Livestock Diseases

Aspiration of *Araucaria angustifolia* branches as a cause of respiratory disease and mortality in cattle from Santa Catarina state, Brazil[1]

Fernanda F. Perosa[2,3]*, Frederico H.R.S.S. Wiggers[2,3], Jean C.O. Menegatt[3,4], Manoela M. Piva[2,3,5], Francielli C. Zimermann[4], Adriano T. Ramos[4], Ronaldo J. Piccoli[4], Teane M.A. Gomes[2],David Driemeier[3], Ricardo E. Mendes[2,6]

ABSTRACT.- Perosa FF, Wiggers FHRSS, Menegatt JCO, Piva MM, Zimermann FC, Ramos AT, Piccoli RJ, Gomes TMA, Driemeier D, Mendes RE. **Aspiration of *Araucaria angustifolia* branches as a cause of respiratory disease and mortality in cattle from Santa Catarina state, Brazil**. *Pesquisa Veterinária Brasileira 46:e07753, 2026*. Setor de Patologia Veterinária, Departamento de Patologia Clínica Veterinária, Av. Bento Gonçalves, Agronomia, Porto Alegre, RS 91530-350, Brazil. E-mail: fernandaperosa7@gmail.com

Araucaria angustifolia ("pine tree") is an evergreen tree from the South region of Brazil. Its sharp, leathery leaves (3–5 cm long) penetrate the nostrils and, once inhaled, are difficult to expel. Reports of *A. angustifolia* branch aspiration in cattle are scarce. Therefore, this study reports eight cases of this condition in cattle from Santa Catarina state, Brazil, describing its clinical signs, disease progression and presentation, and macroscopic and microscopic findings. Affected cattle ranged in age (4-month to 10-year-old), including dairy 50% (4/8), beef 25% (2/8), and mixed breeds 25% (2/8), from Concórdia (4/8; 50%), Curitibanos (3/8; 37.5%), and São Cristóvão do Sul (1/8; 12.5%) municipalities. Clinical presentations involved peracute (1/8; 12.5%), subacute (2/8; 25%), and chronic (5/8; 62.5%). The peracute form was seen in a 4-month-old calf found dead, with autopsy revealing a 40 cm branch obstructing the trachea and left bronchus. Subacute cases lasted four to seven days, presenting respiratory and systemic clinical signs, and cavitary pneumonia with pine branch fragments observed grossly. Histology revealed extensive areas of pulmonary necrosis with fibrin deposition, suppurative inflammation, bacterial myriads, and plant debris. Chronic cases, lasting two to six months, also exhibited respiratory signs, with *post mortem* findings mainly characterized by pulmonary abscesses with fragments of the plant, and bronchiectasis in one case. Bacterial cultures from two cases were identified: *Trueperella pyogenes* and *Corynebacterium* sp. Therefore, aspiration of *A. angustifolia* branches is a differential diagnosis in cattle with respiratory disease in the South region of Brazil, where this tree is endemic, underscoring the importance of the accurate clinical and *post mortem* diagnosis.

INDEX TERMS: Asphyxiation, aspiration pneumonia, cavitary pneumonia, pine tree.

RESUMO.- [**Aspiração de grimpas de *Araucaria angustifolia* como uma causa de doença respiratória e morte em bovinos no estado de Santa Catarina, Brasil.**] *Araucaria angustifolia* ("pinheiro brasileiro") é uma árvore perene do Sul brasileiro. Contém folhas aciculares, coriáceas, de 3 a 5 cm de comprimento, que penetram nas narinas e, após inalação, são de difícil eliminação. Relatos de aspiração de galhos de *A. angustifolia* em bovinos são escassos. Este estudo descreve oito

[1] Received on September 23, 2025.
Accepted for publication on November 2, 2025.

[2] Laboratório de Patologia Veterinária, Instituto Federal Catarinense, Campus Concórdia, Rodovia SC-283, Fragosos, Concórdia, SC 89703-720, Brazil. *Corresponding author: fernandaperosa7@gmail.com

[3] Setor de Patologia Veterinária, Departamento de Patologia Clínica Veterinária, Av. Bento Gonçalves, Agronomia, Porto Alegre, RS 91530-350, Brazil.

[4] Laboratório de Patologia Veterinária, Universidade Federal de Santa Catarina, Rua Germano A. Souza 1, São Francisco, Curitibanos, SC 89520-000, Brazil.

[5] Departamento de Ciências Veterinárias, Universidade Federal do Paraná (UFPR), Setor Palotina, Rua Pioneiro 2153, Jardim Dallas, Palotina, PR 85953-128, Brazil.

[6] Athens Veterinary Diagnostic Laboratory (AVDL), Department of Pathology, College of Veterinary Medicine, University of Georgia (UGA), Athens, GA 30602, USA.

casos dessa condição em bovinos em Santa Catarina, Brasil, abordando os sinais clínicos, apresentação e progressão clínica, e achados patológicos. Bovinos acometidos, entre 4 meses e 10 anos de idade, de raças leiteiras (4/8, 50%), corte (2/8, 25%), e mestiças (2/8, 25%), eram provenientes de Concórdia (4/8, 50%), Curitibanos (3/8, 37.5%) e São Cristóvão do Sul (1/8, 12.5%). Formas clínicas incluíram hiperaguda (1/8, 12.5%), subaguda (2/8, 25%) e crônica (5/8, 62.5%). A forma hiperaguda foi observada em um bezerro encontrado morto, com um galho obstruindo a traqueia e brônquio esquerdo. Casos subagudos persistiram de quatro a sete dias, com sinais clínicos respiratórios, e lesões macroscópicas de pneumonia cavitária com fragmentos da planta. Microscopicamente, observaram-se áreas de necrose pulmonar com deposição de fibrina, inflamação neutrofílica, bactérias cocóides e fragmentos vegetais. Casos crônicos duraram dois a seis meses, também apresentando sinais respiratórios, com abscessos pulmonares associados a fragmentos da planta e bronquiectasia em um dos animais. Houve isolamento bacteriano de *Trueperella pyogenes* e *Corynebacterium* sp. em dois casos. A aspiração de galhos de *A. angustifolia* é um diagnóstico diferencial em bovinos com doença respiratória no Sul do Brasil, onde essa árvore é endêmica, ressaltando a importância do diagnóstico clínico e *post mortem* preciso.

TERMOS DE INDEXAÇÃO: Asfixia, pneumonia aspirativa, pneumonia cavitária, pinheiro-do-Paraná.

INTRODUCTION

Aspiration pneumonia in cattle is commonly iatrogenic. It is more frequent in young animals fed milk or colostrum through an esophageal feeding tube or by forced feeding in calves without suckling reflex (Gomez et al. 2019, Sala et al. 2019). It may also occur in adult animals due to errors on the administration of oral drugs and supplements (Dhillon et al. 2020, Kaliappan et al. 2021). Recumbent cattle — particularly during anesthesia, in cases of bloat, or in paralytic neurologic diseases (i.e., rabies, botulism, or hypocalcemia) — may aspirate ruminal contents (Braun et al. 2005, Smith et al. 2018, López & Martinson 2022). Similarly, cattle with ruminal acidosis can regurgitate and aspirate the ruminal content (Kaliappan et al. 2021).

Araucaria angustifolia, popularly known as "pine tree", "Paraná pine" or "Brazilian pine", is an evergreen tree found in the South region of Brazil, as well as in parts of Paraguay, Argentina, and Uruguay. It has branches with acicular, leathery, and glabrous leaves, 3–5 cm long (Lorenzi 2008). The leaves are arranged at an acute angle to the stem. They are tough and unpliable, with a sharp, pointed tip. Due to these characteristics, when a branch is inhaled, it resists being dislodged, whether by force or naturally. The most common consequence is its progression inwards (Tokarnia et al. 2012).

Aspiration of *A. angustifolia* branches had been sporadically reported in cattle, with clinical signs including dyspnea, mucopurulent or hemorrhagic nasal discharge, anorexia and hyperthermia. At autopsy, the animals presented with a branch of the plant inside the bronchi, covered by a purulent exudate and necrotic debris (Tokarnia et al. 2012). A similar disease had been reported in horses in southern Brazil (Barussi et al. 2020, Molossi et al. 2022).

Reports of aspiration of *A. angustifolia* branches in cattle are scarce and are restricted to a few cases published in conferences' journals. Therefore, this study aims to report eight cases of this condition in cattle from Santa Catarina state, Brazil, describing its clinical signs, disease progression and presentation, and macroscopic and microscopic lesions.

MATERIALS AND METHODS

Ethical approval. Since all the data were obtained from database searches, this study did not perform any animal experiments. It was not necessary to submit to the local committee on animal use.

A retrospective study was conducted in the database of the "Laboratório de Patologia Veterinária" (LPV) from the "Instituto Federal Catarinense", Campus Concórdia, located in Concórdia, western Santa Catarina state and of the "Laboratório de Patologia Veterinária" (LABOPAVE) from the "Universidade Federal de Santa Catarina" (UFSC), located in the municipality of Curitibanos, midwestern Santa Catarina state. The database of both laboratories was searched for autopsy cases of aspiration of *Araucaria angustifolia* branches as a cause of death from 2014 to 2025. The search was performed manually by reviewing the 2,066 autopsies performed by the LPV and the 198 autopsies performed by the LABOPAVE during the study period (2014–September 2025). Cases were selected if gross and histological descriptions were consistent with aspiration of *A. angustifolia* branches and/or the observation of the branches inside the airways. Submission forms and pathology reports were reviewed for signalment, clinical signs, and pathology findings. Furthermore, photographic files were assessed.

The clinical signs were reported by the farmer or the veterinarian submitting the case at the moment of necropsy. Additionally, the clinical course of each case was classified according to Divers & Peek (2008) as peracute (0–24 hours), acute (24–96 hours), subacute (4–14 days), and chronic (more than 14 days).

During the necropsies, organ fragments were collected, fixed in 10% formalin solution and routinely processed for the preparation of histological slides, which were stained with hematoxylin and eosin (HE). Lung samples from Cases 5 and 6 were submitted for bacteriological analysis, whereas bacterial culture and isolation from the remaining cases were not available at the time of necropsy. Also, Cases 3 and 7 were stained with Brown-Hopps Gram, and Case 2 was stained with Masson's trichrome.

RESULTS

Eight cattle were diagnosed with aspiration of *Araucaria angustifolia* branches as the cause of their deaths, representing 0.19% and 2.02% of the diagnoses in necropsied cattle from LPV and LABOPAVE, respectively. In Table 1 are depicted the signalment and year of each case. Among them, 50% (4/8) were dairy, 25% (2/8) were beef, and 25% (2/8) were dairy crossbreed. Regarding the origin of the animals, 50% (4/8) were from the municipality of Concórdia, located in the western region of Santa Catarina. Meanwhile, three cases were from Curitibanos (37.5%), and one from São Cristóvão do Sul (12.5%), both municipalities situated on the Santa Catarina plateau.

Data concerning the clinical signs and course of each case are shown in Table 2. The time of disease evolution ranged from one day to six months. Of the eight cattle, six (75%) died spontaneously, while one (Case 5) was euthanized (12.5%). In all cases, farmers reported *A. angustifolia* trees (Fig. 1), with branches frequently found on the ground (Fig. 2) in the paddocks where cattle grazed.

Clinical courses

Following the clinical classification proposed by Divers & Peek (2008), Case 1 was classified as peracute, Cases 2 and 3 were classified as subacute, and Cases 4–8 as chronic. The main clinical signs, as well as the macroscopic and histological findings for each clinical classification, are summarized below.

Peracute

Case 1, classified as peracute, was characterized by a 4-month-old calf found dead without observation of clinical signs. At autopsy, a single 40 cm-long *A. angustifolia* branch was found inside the trachea and extending to the left bronchus (Fig. 3), associated with blood clots and the mucosa displaying diffuse and marked red discoloration. The lung was moderately congested. At histological examination, there were multifocal to coalescent and marked alveolar hemorrhage and edema, associated with a mild inflammatory infiltrate of neutrophils. In the tracheal mucosa, there was marked necrosis of the epithelium with intense inflammatory infiltration of neutrophils, lymphocytes, plasma cells, and fibrin deposition (Fig. 4). In the mucosa and submucosa, there was focally extensive, marked hemorrhage.

Table 1. Identification, age, sex, breed, municipality of origin, and year for cases of aspiration of *Araucaria angustifolia* branches in cattle

Case	Animal identification			Municipality	Year
	Age	Sex	Breed		
1	4-month-old	Male	Red Angus	Concórdia	2017
2	1-year-old	Female	Dairy mixed breed	Concórdia	2014
3	2-year-old	Female	Holstein-Friesian	Concórdia	2017
4	3-year-old	Female	Jersey	Curitibanos	2022
5	5-year-old	Female	Holstein-Friesian and Jersey mixed breed	Curitibanos	2018
6	7.5-year-old	Female	Nelore	São Cristóvão do Sul	2020
7	Adult*	Female	Brown Swiss	Concórdia	2016
8	10-year-old	Female	Holstein-Friesian	Curitibanos	2025

* Age not provided.

Table 2. Clinical signs and duration of the clinical course for each case of death due to aspirations of *Araucaria angustifolia* branches in cattle

Case	Clinical signs	Clinical course
1	Found dead without previous clinical signs	Peracute (found dead)
2	Dyspnea, anorexia, putrid halitosis, cough, jugular vein distention, emaciation	Subacute (4 days)
3	Apathy, dyspnea, anorexia, hyperthermia, putrid halitosis, pulmonary rales on auscultation, recumbence	Subacute (7 days)
4	Anorexia, cough, hyperthermia. Bloody nasal discharge one day before death	Chronic (4 months)
5	Anorexia, apathy, dyspnea, emaciation, chest edema	Chronic (4 months)
6	Bloody nasal discharge, tachypnea	Chronic (2 months)
7	Apathy, agalactia, hyperthermia, cardiac rales on auscultation	Chronic (5 months)
8	Apathy, anorexia, dyspnea, and emaciation	Chronic (6 months)

Fig. 1-2. *Araucaria angustifolia* specimens. (**1**) Trees of *A. angustifolia* are identifiable in the center of the image. (**2**) Branches of *A. angustifolia* on the ground in a paddock of one of the affected farms.

Subacute

Cases 2 and 3 were classified as subacute, with clinical courses lasting four and seven days, respectively. Both animals displayed dyspnea, anorexia, and halitosis. Additionally, Case 2 presented with cough, jugular vein distention, and emaciation, while Case 3 showed apathy, hyperthermia, pulmonary rales on auscultation, and recumbency.

At autopsy, both animals were in poor body condition. Case 2 showed pale mucous membranes and vulvar petechiae, whereas Case 3 had congested mucous membranes. The main macroscopic lesions in both cases were consistent with marked cavitary pneumonia, with Case 3 also displaying septic emboli in other organs. Pulmonary lesions were primarily located in the left cranial and caudal lobes, which appeared firm on palpation (Fig. 5). On cut surface, marked coalescing cavitary necrotic areas ranging from 0.5 cm to 6 cm in diameter were observed, filled with moderate fetid and brown purulent exudate. Fragments of *A. angustifolia* branches, up to 10 cm in length, were frequently seen inside the bronchial lumen, either associated with the purulent content or within the cavitary lesions in both animals (Fig. 6). In addition, Case 2 had marked pleuritis affecting the same lung lobes, characterized by intense fibrin deposition.

Histologically, amidst the pulmonary parenchyma and inside some bronchi, there was an accumulation of cellular debris and fibrin deposition, associated with marked inflammatory infiltration of neutrophils, cocci bacterial myriads, and occasional granular dark-brown material (consistent with fragments of *A. angustifolia* leaves) (Fig. 7). The adjacent parenchyma revealed moderate alveolar edema. Additionally, the pleura of Case 2 exhibited moderate fibrin deposition, neutrophilic infiltration, and numerous coccoid bacteria.

The embolic lesions observed in Case 3 included marked deposition of fibrin on the visceral pericardium (fibrinous pericarditis) and abdominal cavity (fibrinous peritonitis). In the myocardium, multiple encapsulated yellow nodules varying from 1 mm to 3 mm (abscesses) were seen (Fig. 8). The kidneys contained a severe accumulation of dark-brown and fetid liquid between the fibrous renal capsule and the parenchyma (Fig. 9). On cut surface, focally extensive infarctions and small abscesses were evident. Histologically, moderate, multifocal areas of accumulation of cellular debris and coccoid bacterial colonies, surrounded by mild to moderate inflammatory infiltrate of necrotic neutrophils, macrophages and lymphocytes, were found in the myocardium, kidneys (Fig. 10), cerebellum, and spinal cord (septic emboli). In the cerebellum and spinal cord, the embolic foci were surrounded by moderate, multifocal infiltration of Gitter cells. Brown-Hopps Gram staining of the pulmonary lesions in both cases, as well as the embolic lesions in Case 3, revealed a moderate amount of Gram-positive coccoid bacteria.

Chronic

A chronic clinical form was observed in Cases 4-8, lasting from two to six months. These animals exhibited clinical signs of anorexia (4, 5, and 8); bloody nasal discharge (4 and 6); hyperthermia (4 and 7); apathy (5, 7, and 8); cough (4); dyspnea and emaciation (5 and 8); brisket edema (5); tachypnea (6); agalactia and cardiac rales on auscultation (7).

Pale mucous membranes (Cases 4, 6, and 7) and poor body condition (Cases 5, 7, and 8) were noted during the autopsy. Cases 4, 5, and 8 presented with marked pulmonary abscesses, distributed across the lung lobes and appearing as nodules filled with yellow and fetid exudate. In these areas, fragments of *A. angustifolia* branches were seen surrounded by a firm and white fibrous capsule in the left lung lobes in Cases 4 and 5. Meanwhile, Case 5 exhibited a large abscess measuring 25 × 25 × 20 cm in the cranial left lung lobe (Fig. 11). Upon sectioning, it contained abundant blood (Fig. 12), purulent exudate, and fragments of *A. angustifolia* branches. Microscopically, the abscesses in the three cases were composed of cellular debris, necrotic neutrophils, hemorrhage, and bacterial aggregates, surrounded by a marked inflammatory infiltrate of lymphocytes, plasma cells, macrophages, and occasional foreign body-type giant cells.

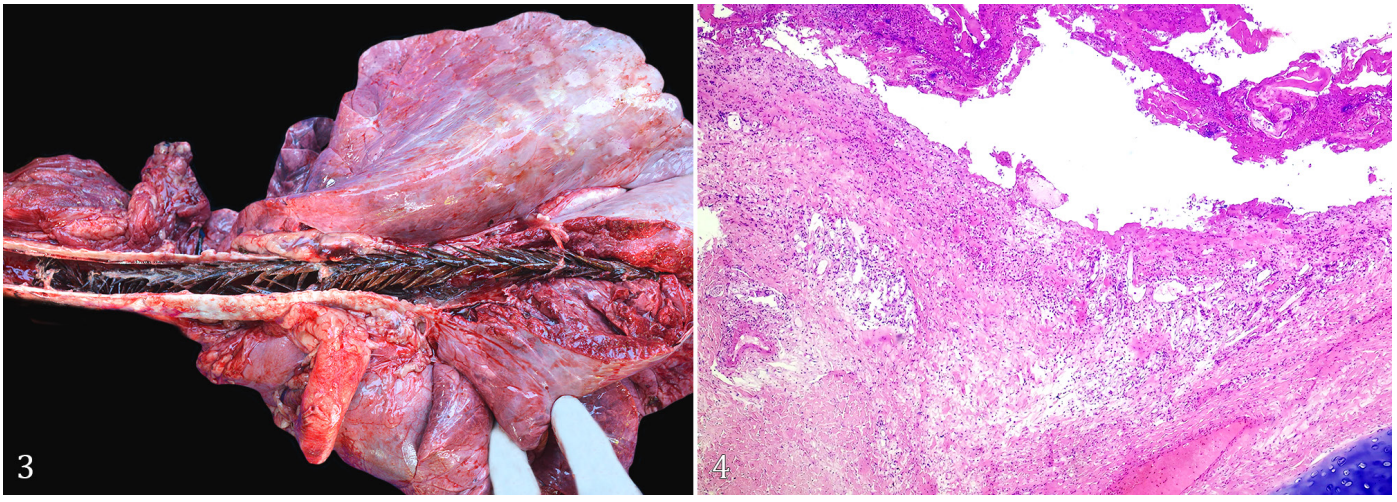

Fig. 3-4. Macroscopic and histopathological findings in a bovine with fatal asphyxia secondary to the aspiration of an *Araucaria angustifolia* branch (peracute form). (**3**) Lung and trachea: a 40 cm-long *A. angustifolia* branch lodged in the tracheal lumen and extending into the left bronchus. Case 1. (**4**) Trachea: focally extensive area of ulceration in the tracheal mucosa, characterized by mucosal discontinuity, fibrin deposition, and neutrophilic infiltration. Case 1. HE, obj. 100x.

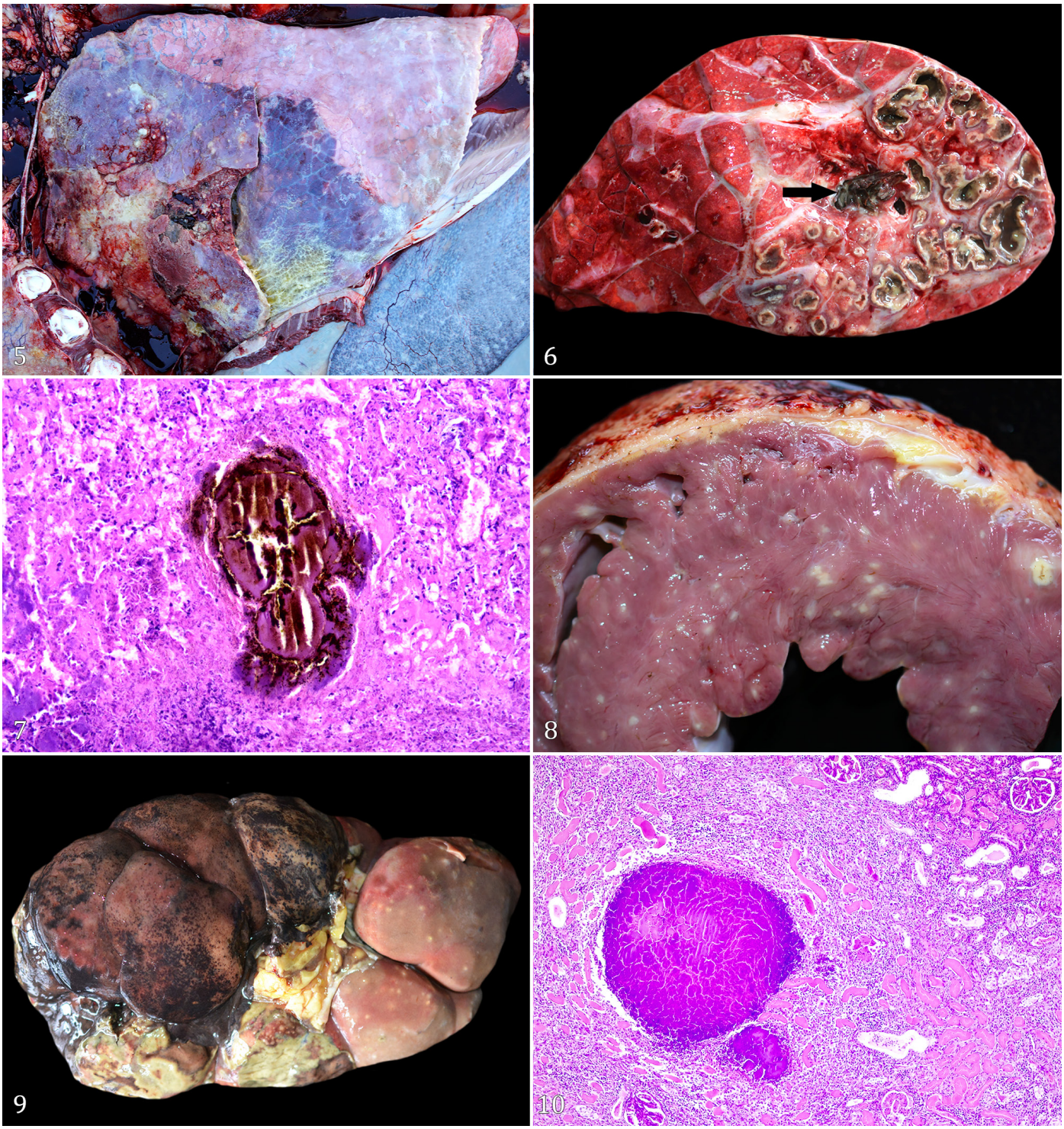

Fig. 5-10. Macroscopic and histological findings in cattle with the subacute form of the disease induced by the aspiration of *Araucaria angustifolia* branches. (**5**) Lung: cranioventral lung lobes are markedly dark red with fibrin deposition on the pleural surface in a case with cavitary bronchopneumonia. Case 2. (**6**) Lung: in the cut surface of a lung with the cavitary bronchopneumonia pattern seen in subacute cases, there are multiple cavitary areas, filled with yellow to brownish fetid material. Some cavitations show fragments of *A. angustifolia* branches amidst the exudate (arrow). Case 3. (**7**) Lung: a granular dark material (compatible with fragments of *A. angustifolia*) is present inside the airways, associated with marked deposition of cellular debris, fibrin deposition, necrotic neutrophils and coccoid bacterial myriads. Case 3. HE, obj. 200x. (**8**) Heart: thickening of the visceral pericardium due to fibrin deposition, with small yellow abscesses scattered throughout the myocardium in a case of cavitary bronchopneumonia with secondary embolic lesions. Case 3. (**9**) Kidney: accumulation of a dark exudate on the renal surface. The parenchyma shows multiple small abscesses in a case of cavitary bronchopneumonia with secondary embolic lesions. Case 3. (**10**) Kidney: in the renal cortex, there is an area of accumulation of cellular debris and bacterial colonies, which is surrounded by necrotic neutrophils, macrophages and lymphocytes. Case 3. HE, obj. 100x.

These areas were delimited by the proliferation of fibrous connective tissue.

Additionally, in the left cranial lobe of Case 8, the parenchyma was atelectatic, with extensive green to black discoloration, occasionally draining a green, purulent and fetid material (Fig. 13). Within one bronchus, a 5-cm fragment of an *A. angustifolia* branch was found, covered by dark-green and yellowish material. Multifocal areas of marked fibrin deposition, associated with severe hemorrhage on both the parietal and visceral pleura, were also seen. In the heart, there was a moderate, diffuse deposition of a pale-yellow filamentous material on the visceral pericardium. On the right atrioventricular valve, there was a focal area of moderate endocarditis, characterized by friable, yellow to red material adhering to the endocardium. Microscopically in the lungs (Fig. 14), mainly in the left cranial lung lobe, there was extensive deposition of cellular debris, bacterial aggregates, and a dense inflammatory infiltrate composed predominantly of neutrophils, along with macrophages, lymphocytes, plasma cells, and occasional multinucleated giant cells (foreign-body type), within bronchioles and alveoli. Surrounding these areas, there was occasional mild proliferation of fibrous connective tissue. In the heart, from the pericardium and extending into the myocardium, there were large amounts of cellular debris, coccoid bacteria, neutrophils, macrophages, lymphocytes, and plasma cells, along with extensive areas of fibrosis (pericarditis).

At the autopsy, Case 6 had a 7 x 2 cm *A. angustifolia* branch lodged in the left caudal lung lobe, associated with the accumulation of tissue debris. Histological changes in Case 6 included bronchi dilated and filled with cellular debris and necrotic neutrophils. The bronchial walls were thickened by a marked inflammatory infiltrate of macrophages, including epithelioid macrophages and foreign body-type multinucleated giant cells. Additionally, abscesses were observed in the hepatic and renal parenchyma of this case.

Case 7 had marked areas of pulmonary atelectasis, and a 15 cm-long *A. angustifolia* branch was found in the bronchial lumen of the left lung lobe, associated with moderate accumulation of purulent liquid. Histological evaluation revealed bronchi markedly dilated and filled by mucous and cellular debris, surrounded by severe inflammatory infiltrate of lymphocytes, plasma cells, and macrophages. There was also marked proliferation of fibrous connective tissue around the bronchi (bronchiectasis) (Fig. 15), highlighted by the Masson's trichrome stain (Fig. 16). Additionally, this animal presented with marked right-sided atrioventricular valvar endocarditis, characterized histologically by adherence of cellular debris, necrotic neutrophils, and coccoid bacterial colonies to the valve surface. Severe chronic pericarditis was also observed, with marked proliferation of fibrous connective tissue and neovascularization of the visceral pericardium. Moderate, chronic hepatic congestion was noted as well.

Bacterial isolation from Cases 5 and 6 resulted in the growth of *Corynebacterium* sp. and *Trueperella pyogenes*, respectively.

DISCUSSION

Diagnosis of death due to *aspiration of Araucaria angustifolia* branches in all cases was suspected according to the epidemiological data and clinical signs, and confirmed with the autopsy. *A. angustifolia* occurs in the Southeast and South regions of Brazil, which is part of the Atlantic Rainforest biome (Lorenzi 2008), as well as the municipalities where the cases were diagnosed. In the mountainous region of Santa Catarina state, the aspiration of pine branches of *A. angustifolia* by cattle was reported causing sudden death due to the obstruction of the airways and due to acute bronchopneumonia (Evangelista et al. 2014). However, these reports are restricted to conference proceedings, with limited epidemiological, signalment, and lesions data.

A noteworthy finding in our study is the occurrence of cases across a wide age range, from a 4-month-old calf to 10-year-old cows, affecting both dairy and beef breeds. All affected animals were kept on pastures where *A. angustifolia* trees were present, reinforcing the association between exposure to the plant and the condition, regardless of age or breed. These findings are consistent with those of a previous study, in which cattle of different ages and breeds were similarly affected in the mountainous region of Santa Catarina state (Evangelista et al. 2014).

Araucaria angustifolia has branches covered with pointed leaves oriented in the same direction (Lorenzi 2008), which facilitates their inhalation and penetration into the lower respiratory tract. This makes it extremely difficult for the animal to expel the branch, as the leaves tend to anchor to the mucosa during attempted removal. The leaves can cause deep penetration and strong adhesion to the respiratory tract mucosa, leading to bleeding and edema that worsen with removal efforts (Tokarnia et al. 2012, Barussi et al. 2020). In fact, the calf of our study that died suddenly due to asphyxia by the pine branch lodged in the trachea showed tracheal and pulmonary hemorrhage and edema, corroborating the pathogenesis described.

Different clinical courses were observed, including peracute, subacute, and chronic forms. In the peracute case, the calf died suddenly without any clinical signs observed by the farmer. It is worth mentioning that the animal was observed well the previous night, and then it was found dead early in the morning. In a previous report, among 10 cattle that died from this condition, two exhibited a presentation similar to the peracute form described in our study. Although these animals showed clinical signs, including hemorrhagic nasal discharge, both had long pine branches measuring 30 to 34 cm that obstructed the tracheal and/or bronchial lumen. Moreover, necropsies revealed petechial hemorrhages in the mucosa of the larynx, trachea, and bronchi (Evangelista et al. 2014). Similarly, in our case, the affected bovine had a 40 cm-long pine branch completely obstructing the trachea and left bronchus, likely leading to acute respiratory insufficiency due to asphyxiation. Moreover, *post mortem* and histological examinations revealed predominantly hemodynamic and erosive changes, attributed to the mechanical trauma, without evidence of secondary bacterial infection.

Subacute cases were observed in two animals, with clinical courses ranging from four to seven days. The disease was characterized by respiratory and systemic clinical signs. Cavitary bronchopneumonia with accumulation of dark and fetid material was the most prominent autopsy finding. In animals with septic aspiration pneumonia, the inhaled material induces extensive necrosis and liquefaction of the lung tissue (Caswell & Williams 2016), as observed in our cases and previous reports of pine branch aspiration in cattle

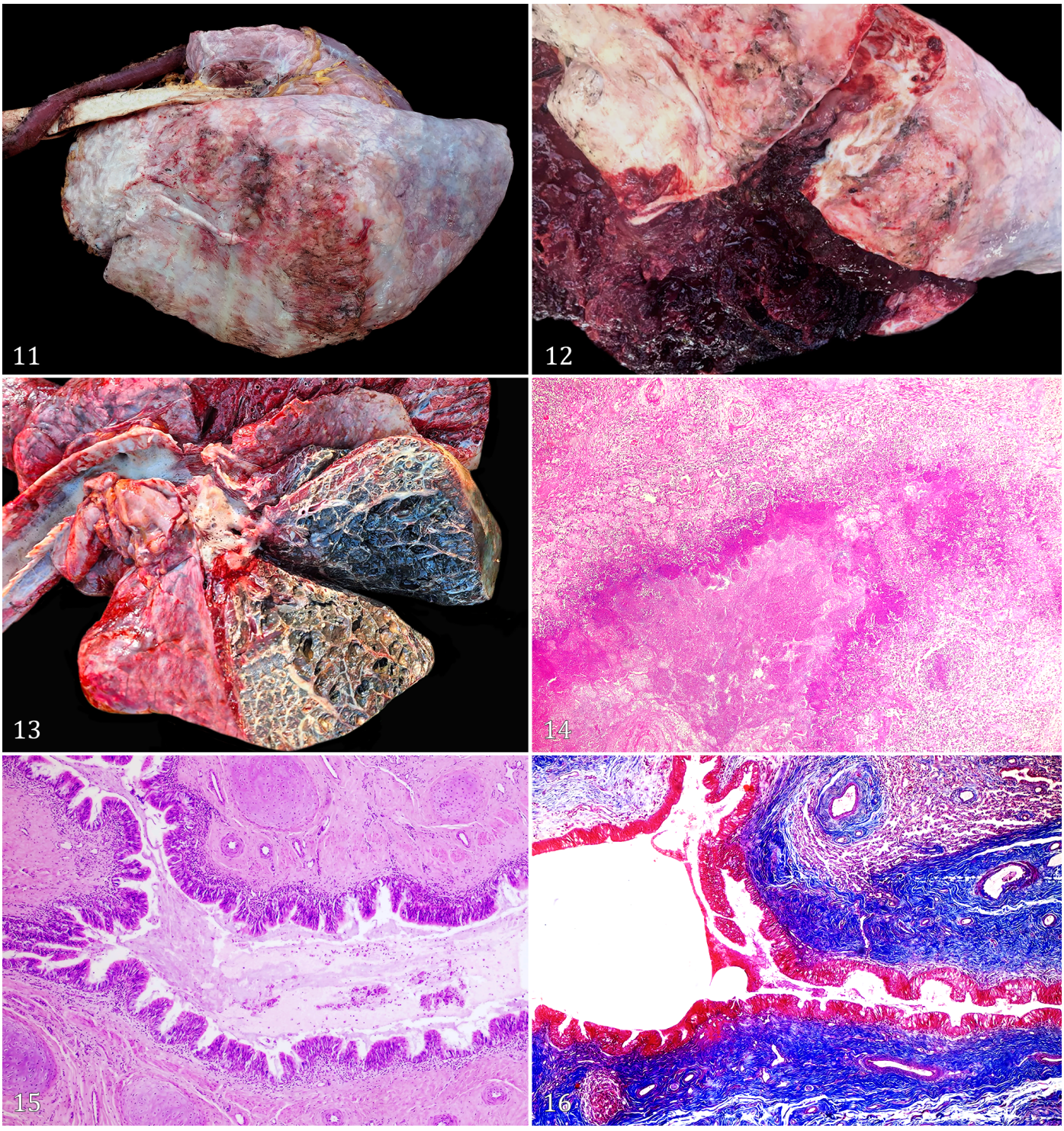

Fig. 11-16. Macroscopic and histological findings in cattle with the chronic form of disease caused by the aspiration of *Araucaria angustifolia* branches. (**11**) Lung: affecting the cranial left lung lobe, there is a large abscess, measuring approximately 25 x 25 x 20 cm. Thickened pleura caused by the proliferation of fibrous connective tissue. Case 5. (**12**) Lung: abscess section with a marked amount of blood clots. Case 5. (**13**) Lung: the caudal left lobe is severely and focally extensive atelectatic with green to black discoloration. Case 8. (**14**) Lung: focally extensive area of necrosis of the parenchyma, with accumulation of cellular debris, deposition of fibrin, and surrounded by inflammatory infiltration of neutrophils. More externally, there is mild proliferation of fibrous connective tissue. HE, obj. 40x. (**15**) Lung: the bronchus is markedly dilated and filled with mucous and cellular debris. It is surrounded by a prominent proliferation of fibrous connective tissue (bronchiectasis) and mild inflammatory infiltration of lymphocytes, plasma cells, and macrophages. Case 7. HE, obj. 100x. (**16**) Lung: the proliferation of fibrous connective tissue associated with bronchiectasis is highlighted by Masson's trichrome stain. Case 7. Masson's trichrome, obj. 100x.

(Evangelista et al. 2014) and in one horse (Molossi et al. 2022). While Caswell & Williams (2016) noted that plant fragments are often absent in lung gross examinations of herbivores, we observed a contrasting pattern, with *A. angustifolia* debris present in every case. This is most likely due to the large size of branches and was also seen in the aforementioned studies (Evangelista et al. 2014, Molossi et al. 2022). Additionally, bovine of Case 3 developed embolic lesions in the kidneys, heart, and nervous system. Pyogenic bacteria can enter the bloodstream and establish new infection sites in other organs (Werner 2011), thereby worsening the clinical condition.

Most cases described in our study were chronic, with cattle presenting respiratory and systemic clinical signs for up to six months. Cases 4, 5, and 8 developed bronchopneumonia associated with abscess formation, similar to what was reported by Evangelista et al. (2014), where this lesion pattern was observed in half of the cases. However, the duration of the clinical course was not specified in that study. These lesions may be characterized as areas of sequestrum, which consist of necrotic lung parenchyma, often separated from viable tissue by purulent exudate and encapsulated by a fibrous capsule, serving as a source of persistent bacterial infection (Caswell & Williams 2016). In fact, histological examination of the lungs from these cases revealed areas of necrosis with bacterial aggregates, surrounded by proliferation of fibrous connective tissue. The prolonged clinical course in these cases likely contributed to the development of this chronic lesion pattern, whereas subacute cases exhibited cavitary pneumonia without fibrous encapsulation. Additionally, Case 5 had an abscess filled with marked hemorrhage, an aspect not previously described. The hemorrhage was presumed to be the result of traumatic injury to the pulmonary parenchyma caused by the pine branches.

Case 7, which had a clinical course of five months, developed the most chronic lesion pattern observed among all cases, with the formation of bronchiectasis. Bronchiectasis is a complication of chronic bronchopneumonia and persistent exudate accumulation, leading to permanent dilation of the bronchi, weakening of the bronchial wall, and failure of mucociliary clearance. Proliferation of fibrous connective tissue may also form and extend into the adjacent pulmonary parenchyma (Caswell & Williams 2016), as observed in our case and enhanced by Masson's trichrome staining. These changes were likely secondary to the accumulation of inflammatory exudate triggered by the pine branch within the bronchi. Bronchiectasis is relatively common in cattle due to their complete lobular septation and lack of collateral ventilation, which impairs the resolution of bronchopneumonia (Caswell & Williams 2016).

Aspiration pneumonia, particularly involving liquids and/or gastric content, in cattle and pigs most commonly affects the right cranial lung lobe (Caswell & Williams 2016). This predisposition is probably related to the tracheal bronchus in these species, which directly supplies the right cranial lobe (Konig & Liebich 2020). In contrast, in seven of the eight cases in our study, the lesions mainly affected the left lung lobes. This distribution can be attributed to the wider lumen of the left principal bronchus, which facilitates the passage of large *A. angustifolia* branches into the pulmonary parenchyma, thus differing from the typical pattern of aspiration pneumonia in these species. Furthermore, whereas plant material is often absent on macroscopic examination of aspiration pneumonia in herbivores (Caswell & Williams 2016), in our cases, the branches were readily identifiable because of their larger size.

Aspiration of *A. angustifolia* branches has also been reported in horses. In a study involving bronchoscopy in Paraná state, also the South region of Brazil, four horses presenting with persistent cough and fetid breath were examined, and a pine branch was identified within the bronchial lumen in all animals. Removal of the branch, either complete or partial, was achieved in three horses (Barussi et al. 2020). Still in horses, this condition was diagnosed as the cause of death in a 1.5-year-old foal in Rio Grande do Sul state. The foal displayed hemoptysis, dyspnea, restlessness, and fever, progressing to death on the same day of the onset of the clinical signs. *Post mortem* examination revealed marked hemothorax, cranioventral pulmonary consolidation, and pleural fibrin deposition. The right primary bronchus was obstructed by a pine branch measuring 18 cm in length. Microscopically, there was diffuse pulmonary necrosis with severe hemorrhage, neutrophilic inflammatory infiltrate, and coccoid bacterial aggregates (Molossi et al. 2022). Despite the peracute clinical course presented by this foal, both the gross and microscopic findings were similar to those observed in the subacute cases in our study.

In cattle, chronic suppurative bronchopneumonia is frequently colonized by secondary pathogens such as *Trueperella pyogenes*. Similarly, in cases of septic aspiration pneumonia, opportunistic bacteria are commonly isolated (Caswell & Williams 2016). In our study, bacterial culture was available in only two cases, resulting in the identification of *T. pyogenes* and *Corynebacterium* sp., both known opportunistic pathogens in cattle. Likewise, in the aforementioned report in a foal, *Streptococcus equi* subsp. *zooepidemicus*, which is also an opportunistic pathogen to horses, was isolated (Molossi et al. 2022).

Araucaria angustifolia cannot be removed from the grazing paddocks because it is a protected species. Cutting down this tree is prohibited by environmental regulations. Therefore, the primary measure to prevent aspiration of *A. angustifolia* branches by cattle is to restrict access to fallen branches. However, this may be difficult to achieve given the wide distribution of this tree species, particularly in southern Brazil. Since branches frequently accumulate in grazing areas, their complete removal is often impractical. Therefore, early clinical examination and diagnosis are crucial, as the branch can still be removed when lodged in the anterior portion of the nasal cavity (Tokarnia et al. 2012).

CONCLUSIONS

This study presents the epidemiological, clinical, and pathological findings of eight cases of *Araucaria angustifolia* branch aspiration as a cause of death in cattle from Santa Catarina state, Brazil. Cattle of different ages, breeds, and production types (beef and dairy) were affected, showing no apparent predisposition. The different clinical courses observed (peracute, subacute, and chronic) correlated with the pathological variations identified in both macroscopic and microscopic examinations. Except for the peracute case, in which no clinical signs were observed, the remaining animals primarily showed respiratory signs. Lesions were predominantly observed in the left lung lobes, although

aspiration pneumonia in ruminants typically affects the right lung lobes.

Aspiration of *A. angustifolia* branches should be considered as a differential diagnosis of cattle with respiratory disease, particularly in prolonged cases, in southern Brazil, where this tree is commonly found. Additionally, necroscopic examination is a key procedure for establishing the diagnosis in animals that progress to death.

Acknowledgments.- This study was supported by the "Instituto Federal Catarinense" (IFC), "Conselho Nacional de Desenvolvimento Científico e Tecnológico" (CNPq), project 307086/2022-4, and partially by "Coordenação de Aperfeiçoamento de Pessoal de Nível Superior" (CAPES), Brasil — Finance code 001.

Conflict of interest statement.- The authors declare that there are no conflicts of interest.

Credit author statement.- Fernanda F. Perosa, Frederico H.R.S.S. Wiggers, and Jean C.O. Menegatt: Data analysis and article writing. Fernanda F. Perosa, Jean C.O. Menegatt, Manoela M. Piva, Francielli C. Zimermann, Adriano T. Ramos, Ronaldo J. Piccoli, Teane M.A. Gomes, and Ricardo E. Mendes: Performing necropsies and processing samples. Francielli C. Zimermann, Adriano T. Ramos, Teane M.A. Gomes, David Driemeier, and Ricardo E. Mendes: Article review.

Data availability statement.- The data presented in this study are available on request from the corresponding author.

Editor-in-Chief.- Fabiano José Ferreira de Sant'Ana

REFERENCES

Barussi FCM, Bastos FZ, Zenni L, Camargo CE, Michelotto PV. Pine branch of *Araucaria angustifolia* in horse bronchi: a series of four cases. Equine Vet Educ 2020; https://doi.org/10.1111/eve.13080

Braun U, Feige K, Schweizer G, Pospischil A. Clinical findings and treatment of 30 cattle with botulism. Vet Rec 2005; https://doi.org/10.1136/vr.156.14.438

Caswell JL, Williams KJ. Respiratory system. In: Maxie MG. Jubb, Kennedy and Palmer's Pathology of Domestic Animals. 2016; https://doi.org/10.1016/B978-0-7020-5318-4.00011-5

Dhillon KS, Kaur SJ, Gupta M. A case report on aspiration pneumonia in a cow. J Entomol Zool Stud 2020; https://www.entomoljournal.com/archives/2020/vol8issue3/PartC/8-2-337-901.pdf

Divers TJ, Peek SF. Rebhun's Diseases of Dairy Cattle. 2008; https://doi.org/10.1016/B978-1-4160-3137-6.X0001-5

Evangelista CM, Ogliari D, Melchioretto E, Biff CP, Traverso SD, Gava A. "Grimpa" de *Araucaria angustifolia* como causa de morte por insuficiência respiratória em bovinos. VII Encontro Nacional de Diagnóstico Veterinário (ENDIVET) 2014.

Gomez DE, Desrochers A, Francoz D, Nichols S, Babkine M, Fecteau G. Pharyngeal trauma in dairy cattle: 27 cases. J Vet Intern Med 2019; https://doi.org/10.1111/jvim.15510

Kaliappan S, Elumalai V, Subramanian S, Ramasamy R, Premkumar R, Shanmugam K. Clinico-pathological evaluation of aspiration pneumonia in cattle. Indian J Vet Sci Biotechnol 2021; https://journals.acspublisher.com/index.php/ijvsbt/article/view/2350/2275

Konig HE, Liebich H-G. Respiratory system (apparatus respiratorius). In: Konig HE, Liebich H-G. Veterinary Anatomy of Domestic Animals: textbook and colour atlas. 7th ed. Stuttgart: Thieme; 2020.

López A, Martinson SA. Respiratory system, thoracic cavities, mediastinum, and pleurae. In: Zachary JF. Pathologic Basis of Veterinary Disease. 7th ed. St. Louis: Elsevier; 2022.

Lorenzi H. Árvores Brasileiras: manual de identificação e cultivo de plantas arbóreas nativas do Brasil. 5ª ed. Vol. 1. Nova Odessa: Instituto Plantarum; 2008.

Molossi FA, Pont TPD, Echenique JVZ, Almeida BA, Lopes BC, Machado GA, Driemeier D, Pavarini SP. Bronchopneumonia by *Streptococcus equi* subsp. *zooepidemicus* in a horse with inhalation of pine branch of *Araucaria angustifolia*. Ciência Rural 2022; https://doi.org/10.1590/0103-8478cr20210009

Sala G, Boccardo A, Fantinato E, Coppoletta E, Bronzo V, Riccaboni P, Belloli AG, Pravettoni D. Retrospective analysis of iatrogenic diseases in cattle requiring admission to a veterinary hospital. Vet Rec Open 2019; https://doi.org/10.1136/vetreco-2017-000254

Smith JS, Sheley M, Chigerwe M. Aspiration pneumonia in two Tibetan yak bulls (*Bos grunniens*) as a complication of ketamine-xylazine-butorphanol anesthesia for recumbent castration. J Zoo Wildl Med 2018; https://doi.org/10.1638/2016-0205R1.1

Tokarnia CH, Brito MF, Barbosa JD, Peixoto PV, Döbereiner J. Plantas que causam lesões mecânicas/traumáticas, p.471-482. In: Tokarnia CH, Brito MF, Barbosa JD, Peixoto PV, Döbereiner J. Plantas Tóxicas do Brasil: para animais de produção. 2ª ed. Rio de Janeiro: Helianthus; 2012.

Werner PR. Patologia Geral Veterinária Aplicada. São Paulo: Roca; 2011.