Slov Vet Res
DOI 10.26873/SVR-2311-2026

Early View

Case Report

Abscessing Pneumonia in a pet rat – a Diagnostic Approach

Key words

abscess;
lung ultrasound;
pneumonia;
rat;
respiratory disease;
Mycoplasma

Anna Piskovská[1,2], Karel Hauptman[1,3], Miša Škorič[4], Vladimír Jekl[1,2]*

[1]Jekl & Hauptman Veterinary Clinic, Mojmirovo namesti 3105/6a, Brno, 612 00, [2]Department of Pharmacology and Pharmacy, Faculty of Veterinary Medicine, VETUNI Brno, Palackeho tr. 1945/1, 61242 Brno, [3]Department of Veterinary Sciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Praha-Suchdol, [4]Department of Pathological Morphology and Parasitology, Faculty of Veterinary Medicine, VETUNI Brno, Palackeho tr. 1945/1, 61242 Brno, Czech Republic

***Corresponding author:** vladimirjekl@gmail.com

Abstract: A two-year-old 235 g female pet rat (Rattus norvegicus) was presented with weight loss and dyspnoea. Clinical findings included cachexia, chromodacryorrhoea, cyanotic mucous membranes, severe dyspnoea and bronchovesicular wheezes. Thoracic radiographs showed a mixed interstitial-alveolar pattern with cardiac displacement. Rat thoracic ultrasound revealed multiple nodular lesions, abnormal curtain signs. Based on the diagnostic imaging the diagnosis was established as abscessing pneumonia. The animal tested seropositive for *Mycoplasma pulmonis*, *Filobacterium rodentium*, rat theilovirus, and *Pneumocystis carinii*, whereas it was seronegative for rat coronavirus (RCV) and Sendai virus. Bacteriological examination of the bronchoalveolar lavage showed the presence of *Bordetella bronchiseptica*, *Staphylococcus aureus* and *Acinetobacter baumanni*, whereas lung tissue culture showed the presence of *Acinetobacter pittii*, and *Staphylococcus aureus*. Due to poor prognosis, euthanasia was elected. Necropsy, histopathology and bacteriology confirmed chronic interstitial lung abscessation and pyogranulomatous bronchopneumonia. In the presented case, the final diagnosis was chronic interstitial pneumonia and pyogranulomatous bronchopneumonia caused by *M. pulmonis*, *P. carinii, S. aureus,* and *A. pittii.* The recommended optimal diagnostic work-up for respiratory disease includes clinical examination, lung ultrasound, thoracic radiography, haematological analysis and bronchoalveolar lavage. In this case, lung ultrasound, particularly due to the small body size of the animal, proved to be a quick diagnostic method and compared with radiography, a tool with better diagnostic and prognostic outcomes. Therefore, lung ultrasonography should be part of the diagnostic work-up for thoracic pathologies, especially when high-resolution computed tomography imaging is not possible. Pathogen identification should include bacteriology as well as PCR testing. Precise pathogen analysis, together with antibiotic sensitivity testing, helps the practitioner choose the optimal antibiotic and supportive care, following guidelines for the prevention of antimicrobial resistance.

Received: 29 September 2025
Accepted: 20 January 2026

Introduction

Infectious respiratory diseases are one of the most common reasons for medical examination in pet rats (1-3). Factors predisposing animals to respiratory diseases are typically related to husbandry and diet, including overcrowding, inadequate ventilation, suboptimal nutrition, fragrant or dusty bedding, elevated ammonia levels in enclosures, humidity, abrupt temperature fluctuations, and chronic illness. Under conditions of stress, airway irritation, or immunosuppression, the respiratory microbial flora may become pathogenic.[1] *Mycoplasma pulmonis* (MPUL), *Streptococcus pneumoniae* and *Corynebacterium kutscheri* are the three main pathogens causing respiratory disease. Other pathogens such as Sendai virus (paramyxovirus), pneumonia virus of mice (PVM, paramyxovirus), *Pneumocystis carinii* (PCAR), *Fillobacterium rodentium* (cillia-associated respiratory bacillus, CARB), and

Haemophilus spp. are usually considered minor pathogens and rarely cause disease as a single pathogen (1-5). Abscessing pneumonia is typically recognized as an end-stage of the disease (1-3). The main diagnostic approach in rat respiratory disease involves a combination of clinical signs, thoracic auscultation, imaging methods and pathogen identification (1-8).

Although respiratory diseases in laboratory rats are well described and diagnostic protocols are thoroughly standardised (9), exact diagnostic procedures are still rarely performed in routine clinical practice for client-owned pet rats. Consequently, therapeutic management is often based solely on a non-specific diagnosis of "pneumonia", without precise identification of the aetiological agent or underlying pathophysiological mechanism (2, 5). This article describes the recommended step-by-step diagnostic approach and laboratory findings in a pet rat diagnosed with abscessing pneumonia.

Case presentation

A two-year-old, 235 g female rat (Rattus norvegicus) was presented with weight loss, dyspnoea, and episodes of open-mouth breathing accompanied by partial "seizure-like" behaviour, followed by normal feeding. Clinical examination revealed apathy, cachexia (BCS 1.5/5), chromodacryorrhoea, cyanotic mucous membranes, dehydration (skin tenting), dyspnoea with severe abdominal involvement, and bronchovesicular wheezes on auscultation.

After stabilization in an oxygen cage, Lung ultrasound (RATTUS examination) was performed (10), and the findings were evaluated (7). The patient was premedicated with alfaxalone (1 mg/kg IM, Alfaxan multidose, Jurox Limited, Ireland), and anaesthesia was induced by isoflurane in an induction chamber. The general anaesthesia was maintained with isoflurane (2%, Isoflutek 1000 mg/g, Laboratorios Karizoo, S.A., Spain), oxygen flow rate (2 L/min). A blood sample was obtained from the cranial vena cava for haematologiical and serological testing (11). After blood sampling, a radiographic examination (Fig. 1) of the anaesthetised rat was performed in 4 views (left and right lateral view, ventro-dorsal, and dorso-ventral). A CT scan of the upper airways (Fig. 1) was performed immediately after the radiography. Patient was maintained on oxygen until full recovery and the animal received supportive and fluid therapy (Hepagen 0.1 mL/kg IM, Fatro S.p.A., Italy; famotidine 1 mg/kg IM, Quamatel, Gedeon Richter Plc, Hungary; Ringerfundin, B Braun, Germany with Duphalyte, Zoetis, Czech Republic, diluted 1:5, 15 mL/kg SC; Catosal 0.5 mL pro toto SC, Elanco, AG, Germany; B-vitamins 0.1 mL/kg IM, Milgamma, Wörwag Pharma GmbH und Co, Germany).

Haematological analysis showed elevated red blood cell count (12.37 x10^{12}/l, reference value 5.16 ± 1.0 x10^{12}/l) and haematocrite values (0.81 l/l; 0.37 ± 0.1 l/l), reticulocytosis (4%; 2±1), normal total white blood cell count (5.01 x10^{9}/l; 7.73 ± 2.81 x10^{9}/l), and relative neutrophilia (57,9 %; 24.79 ± 8.3 %) and monocytosis (15.8 %; 0.16 ± 0.4%) (12,13).

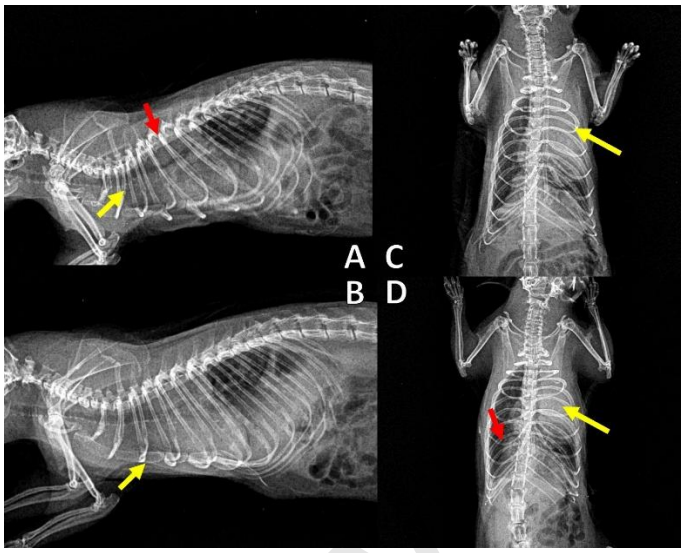

Figure 1: Thoracic radiograph of a rat with abscessing pneumonia. Left latero-lateral (A), right latero-lateral (B), dorso-ventral (C), and ventro-dorsal (D) views. An alveolar pattern was observed in the cranioventral part of the radiograph (yellow arrow). An interstitial to alveolar pattern was seen in the dorsal region (red arrow). The cardiac silhouette cannot be demarcated due to the surrounding soft tissue opacities

The animal tested seropositive for MPUL, *Filobacterium rodentium*, rat theilovirus, and PCAR, whereas it was seronegative for rat coronavirus (RCV) and Sendai virus.

Lung ultrasound examination showed the absence of lung sliding. In the right axillary line, the multiple nodule sign with static air and fluid bronchogram was observed. Multiple B-lines were observed in the left axillary region suggesting interstitial involvement or oedema and bamboo sign. The substernal approach showed left cardiac displacement. As the shift was to the opposite side to the multinodular sign, the cardiac shift was thought to be caused by a mass. The symmetry of the lung distension could not be assessed due to the fragmented pleural line as a result of the lung injury. In the right scapular region, the main finding was an abnormal (or asynchronous) curtain sign and a very pronounced bamboo sign, but this could have been caused by the animal's poor body condition. In the left scapular region, an abnormal curtain sign, C-lines and possibly an Am-line were also noted. In human medical literature, the Am line indicates fibrotic changes (8). The cranial mediastinum showed multiple cavitary lesions, and a subjectively enlarged cardiac silhouette suppressed by nodular signs (suspected abscesses originating from the right lung lobes).

On lateral thoracic radiographs, an alveolar pattern was observed in the cranioventral and caudoventral part of the left lung. A mixed interstitial–alveolar pattern was present in the caudodorsal region. The border of the cardiac silhouette could not be assessed due to the surrounding soft tissue opacities (enlarged cranial mediastinum and soft tissue opacities in the caudal mediastinum). On the dorso-ventral radiograph, alveolar to multiple miliary nodular changes with cardiac displacement were however, assessment was limited by suboptimal positioning. Proper superimposition of the spine and sternum could not be

achieved due to the animal's severely compromised condition and the pronounced wedge-shaped conformation of the thorax, which made correct positioning challenging. The differential diagnosis of the presence of the alveolar lung pattern includes pneumonia, cardiogenic pulmonary oedema, pulmonary haemorrhage, atelectasis, pulmonary contusion, and pulmonary thromboembolism. Nodular lung patterns may be associated with metastatic neoplasia, lymphoma, fungal or bacterial pneumonia, abscesses/granulomas or disseminated intravascular coagulation.[8] A CT examination of the nasal cavity and middle ear cavity revealed no pathological alterations. A presumptive diagnosis of abscessing pneumonia was made.

Bronchoalveolar lavage (BAL) was performed using a sterile urinary catheter (Sterile cat catheter 1.0x110 mm, Polnet, Poland) under otoscopic control. A total of 0.2 ml of pre-warmed sterile saline was instilled into the trachea, followed by 0.2 ml of air, and the fluid was then withdrawn with gentle suction. This procedure was repeated twice. During the procedure, isoflurane anaesthesia was discontinued and at the end of BAL, the rats were awakened to facilitate coughing up the remaining saline. In the recovery phase after BAL, post oxygenation was performed until complete recovery. The BAL sample was placed in a sterile tube and sent to an accredited laboratory for microbiological examination.

Due to the poor prognosis (the entire observed lung surface was pathologically altered), the owner elected euthanasia. As the client owned more rats, postmortem examination, bacteriological analysis and PCR pathogen identification were performed. Necropsy revealed multiple irregularly nodular lesions (size of 0.3 to 1.5 cm in diameter) of yellow colour filled with pus in the right lung and adhesions of the left lung to the thoracic wall. Enlarged tracheobronchial lymph nodes were observed in the cranial mediastinum. The heart chambers were enlarged (Fig. 2). Other organs showed no macroscopic changes. Samples were fixed in buffered 10% neutral formalin, dehydrated, embedded in paraffin wax, sectioned on a microtome at a thickness of 4 µm, and stained with haematoxylin and eosin (H&E). Histopathological examination revealed multiple foci of marked chronic active inflammatory reaction in all lung samples (Figure 4). Presence of multiple confluent foci of chronic purulent inflammatory reaction with formation of abscesses and in some areas with progression into pyogranulomas were detected. In addition, focal thickening of interalveolar septa was noted, characterized mainly by lymphoplasmacytic and, in some areas, mixed inflammatory infiltrates (lymphocytes, neutrophils, macrophages). Certain alveoli were filled with eosinophilic-staining clear fluid, consistent with pulmonary oedema. Bronchiole-associated lymphoid tissue (BALT) hyperplasia was detected. Marked bronchiectasis was present in some regions, with accumulation of mucus and inflammatory cells within the lumina of dilated bronchi and bronchioles. The lymph nodes from the cranial mediastinum showed reactive hyperplasia. Histopathological diagnosis of chronic active bronchointerstitial pneumonia with formation of abscesses and pyogranulomas was made. Bacteriological examination of the BAL showed the presence of *Bordetella bronchiseptica*, *Staphylococcus aureus* and *Acinetobacter baumanni*, whereas lung tissue culture showed the presence of *Acinetobacter pittii, a*nd *Staphylococcus aureus*. PCR analysis revealed the presence of MPUL and PCAR. The final diagnosis of chronic interstitial pneumonia, pyogranulomatous bronchopneumonia caused by MPUL, *S. aureus* and *Acinetobacter pittii* was made.

Discussion

Upper respiratory tract disease, mammary gland tumours and ectoparasitic infections were reported as the most common clinical disorders seen in veterinary practices (2). Respiratory symptoms may originate from the upper and/or lower respiratory tract. Other causes of dyspnoea may be associated with cardiovascular diseases, neoplasia, pneumothorax, and trauma (1, 3, 14, 15). The main imaging diagnostic method used in clinical practice of rats is reported to be radiography (2). Lung ultrasonography has the potential to provide information that assists in diagnosis, narrows differential diagnoses, and helps guide clinical therapy (6,7). In small mammals, lung ultrasonography can provide information that aids diagnosis and refines differential diagnoses (6,7, 10). In the presented case, the radiographic changes were not pathognomonic for abscessing pneumonia, but the formation of multiple abscesses was confirmed by lung ultrasonography. When comparing intravital diagnostics and post-mortem changes, the abnormal curtain sign in the left scapular region was caused by fibrous adhesions of the left lung, while the right curtain sign was altered by a large abscess formation. Multiple B-lines demonstrated regions of pulmonary oedema, and fragmented pleura with Am-line changes indicated fibrotic changes in the pathologically altered lungs. Other signs, such as consolidations with C-lines, supported the diagnosis of abscessing pneumonia. The lymph node enlargement, as seen by RATTUS, was also indicative of antigen stimulation. Computed tomography of the head can rule out upper respiratory tract disease, as was performed in the presented case.

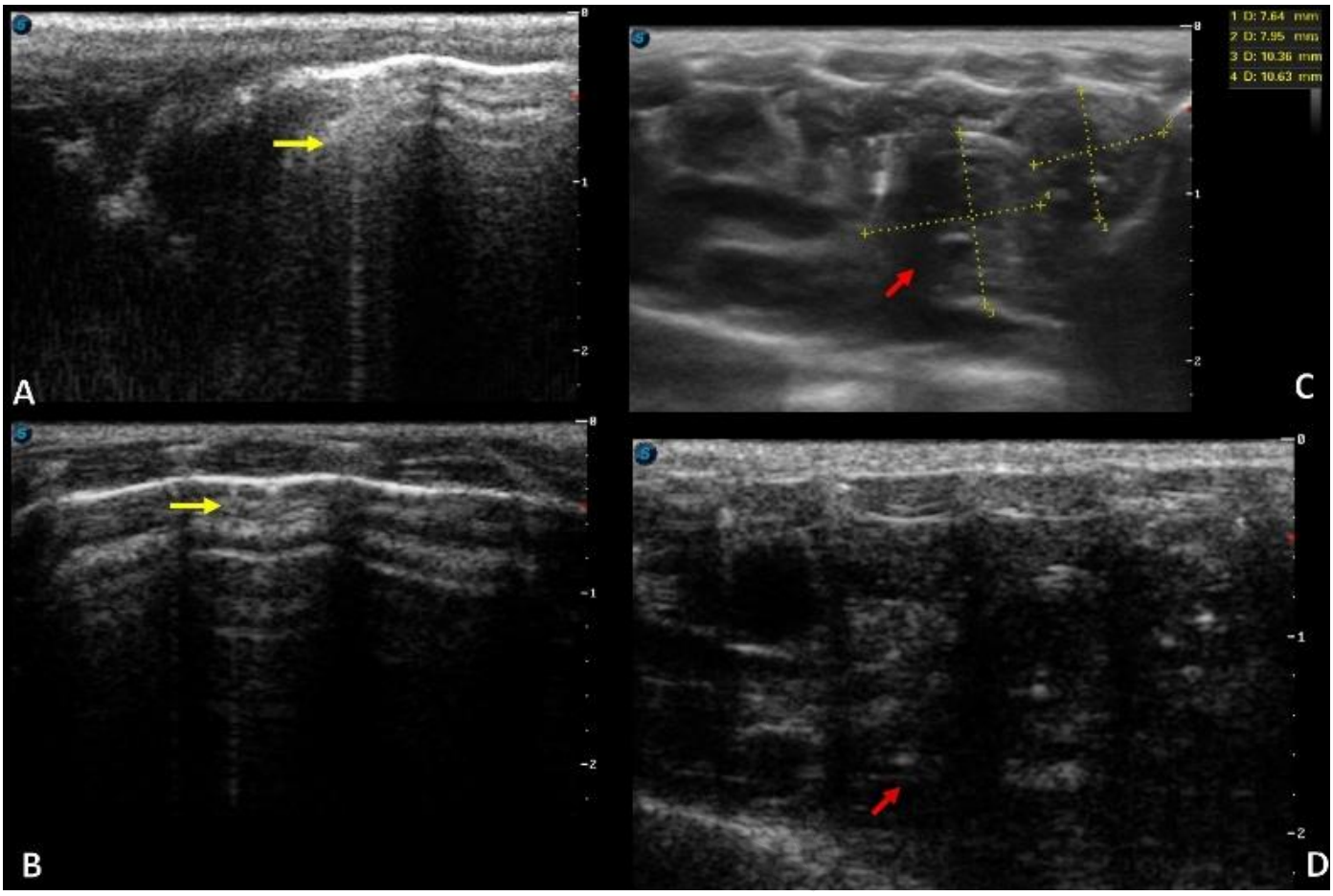

Figure 2: The RATTUS (Rat Thoracic Ultrasound) examination of the pet rat: left axillary region, lung preset (A); left scapular region, lung preset (B); right axillary region, thyroid preset (C); right scapular region, lung preset (D). Fragmented pleura with vertical artefacts (yellow arrow), multimodule sign, heteroechoic, smooth hyperechoic margins, and air and fluid bronchogram (red arrow) were observed. An abnormal curtain sign was noted in the right line, and substernally, the heart was displaced to the left by nodules in the right lung

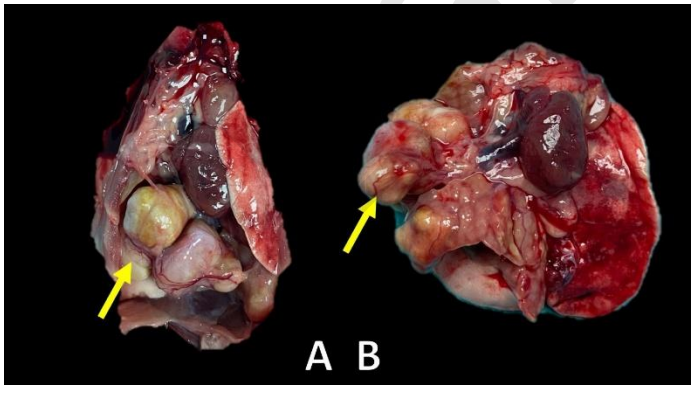

Figure 3: Gross post-mortem images of the lung and thoracic cavity of a rat (A), and the ventrodorsal view of the isolated lower airways (B). The right lung is particularly affected by abscess formation (yellow arrow)

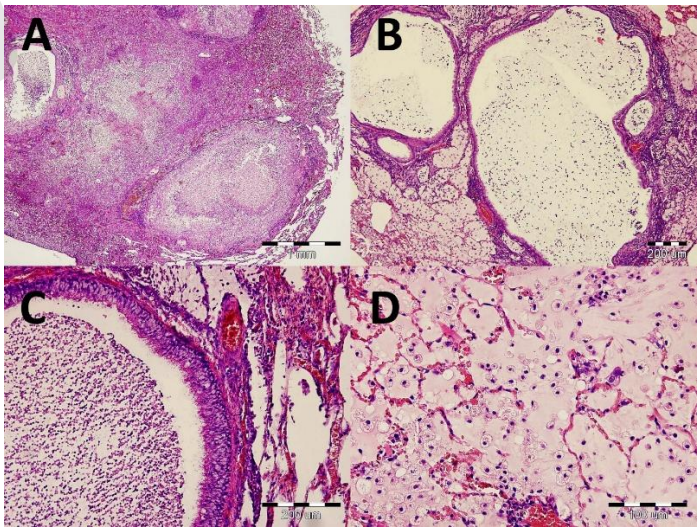

Figure 4: Histopathological images of a rat lung (A-D). A, Severe alteration of the architecture of lung parenchyma. Presence of multiple confluent foci of chronic purulent inflammatory reaction with formation of abscesses and pyogranulomas. HE stain, 40x; B, Marked bronchiectasis with presence of condensed mucus and inflammatory cells in the lumen. HE stain, 100x; C, Detail of dilated bronchiole with purulent exudate in the lumen. HE stain, 200x; D, Oedema with numerous activated alveolar macrophages. HE stain, 400x

Pathogen identification may be challenging, and some authors recommend focusing on obtaining information to assess disease severity and concurrent or underlying problems to establish a prognosis. By some authors, it is considered impractical for practitioners to attempt to establish the exact aetiological diagnosis of respiratory disease in rats, especially in cases of mycoplasmosis (5). As other pathogens than mycoplasma may be identified in cases of pneumonia, exact pathogen identification and antibiotic sensitivity testing should ideally be performed in all cases, as antimicrobial resistance is now a significant global public health concern (16). In the presented case, *A. baumannii* and *A. pittii* were isolated, but both Gram-negative species belong to the *Acinetobacter calcoaceticus-baumannii* complex (17). *Acinetobacter* species are commonly found in the environment but can also cause infections of the skin, urinary tract, and lungs in human patients, and are also classified as nosocomial multidrug-resistant pathogens (18). Staphylococcal infections in rodents are not as common as in rabbits; however, they may also cause respiratory tract infections in different rodent species (19). In the presented case, bacteriological analyses of the BAL and lung tissue specimens revealed similar results. Therefore, BAL should also be included in the diagnostic workup of lower respiratory disease in rats. The results of haematological examination indicating mostly chronic infection, as was seen in the presented cases, but can also reveal other diseases such as lymphoma (20). Reticulocytosis in the absence of anemia may be associated with hemolysis, a recent anemia, or hypoxia (21). Authors suggest that in the presented case it may be associated with hypoxia associated with pneumonia. High hematocrit and red blood cell values were most probably associated with dehydration. Serological testing is especially recommended when eliminating infected animals and preventing reinfection; however, it may be challenging as many rats are serologically positive.[5]. PCR testing may be an option for pathogen identification. Although identification of mycoplasma on conventional cultivation media may be time-consuming, using media such as "Chromagar" appears promising, as mycoplasma can be cultivated within a few days. In the presented case, apart from the detection of MPUL via PCR, PCAR was also identified. *P. carinii* may be transmitted airborne and can cause interstitial pneumonia in rats (22). Viral infections may act as co-pathogens and, especially in cases of active acute or chronic infections, may aggravate the clinical signs.

One of possible study limitations is that high-frequency ultrasound may fail to detect or accurately characterise very small lesions — especially those below ~0.1-0.2 mm — because of inherent limits in spatial resolution and shallow penetration depth. Diagnostic performance also depends on operator experience, probe frequency and settings, which reduces consistency and may lead to false-negative findings in small or low-contrast lesions (8). Nevertheless, as one of the signs of possible pneumonia is fragmented pleura, which may be caused even by small (1 mm) lesions, which create vertical artefacts, the lung ultrasound is a very sensitive tool for detecting these abnormalities. Standardization of the examination (RATTUS) enhances the final diagnostic outcomes (10). Computed tomography of the thorax was not performed due to client financial limitations.

Conclusions

In the presented case, the final diagnosis was chronic interstitial pneumonia and pyogranulomatous bronchopneumonia caused by MPUL, *S. aureus,* and *A. pittii.* The recommended optimal diagnostic work-up for respiratory disease includes clinical examination, lung ultrasound, haematological analysis and BAL. In this case, lung ultrasound, particularly due to the small body size of the animal, proved to be a quick diagnostic method and compared with radiography, a tool with better diagnostic and prognostic outcomes. Therefore, lung ultrasonography should be part of the diagnostic work-up for thoracic pathologies, especially when high-resolution computed tomography imaging is not possible. As abscessing pneumonia is the end stage of respiratory disease in rats, client discussion and further therapeutical and prognostic options should be discussed. Pathogen identification should include bacteriology as well as PCR testing. Precise pathogen analysis, together with antibiotic sensitivity testing, helps the practitioner choose the optimal antibiotic and supportive care, following guidelines for the prevention of antimicrobial resistance.

Acknowledgements

The study was funded by the project IGA VETUNI 2023 105/2023/FVL (VETUNI, Brno).

Disclosure. The authors have no conflicts of interest in this work.

References

1. Benato L. Respiratory diseases in rats. Comp Anim. 2012;17(4):47–50.

2. Rey F, Bulliot C, Bertin N, et al. Morbidity and disease management in pet rats: a study of 375 cases. Vet Rec 2015;176:385-385.

3. Harkness JE, Turner PV, VandeWoude S, Wheler CL. Clinical signs and differential diagnoses.. In: Harkness JE, Turner PV, VandeWoude S, Wheler CL, eds. Biology and Medicine of Rabbits and Rodents. 5th ed., John Wiley & Sons, Hoboken, 2025:195-248

4. Frohlich J. 2021. Rats and mice. pp 345-367 In: Ferrets, rabbits, and Rodents. Clinical Medicine and Surgery, 4th ed. (Quessenberry K, Orcutt CJ, Mans C, Carpenter JW. eds.), Elsevier Saunders, New York.

5. Graham JE, Schoeb TR. Mycoplasma pulmonis in rats. J Exot Pet Med 2011;20(4):270-276.

6. Boysen S, Gommeren K, Chalhoub S.. The Essentials of Veterinary Point of Care Ultrasound: Pleural Space and Lung. Gruppo Asis Biomedica, S.L., Zaragoza, 2022:182.

7. Buda N, Piskunowicz M, Porzezińska M, et al. Lung ultrasonography in the evaluation of interstitial lung disease in systemic connective tissue diseases: criteria and severity of pulmonary fibrosis–analysis of 52 patients. UiM/EJU 2016;37.04:379-385.

8. Dennis R, Kirberger RM, Barr F, et al.. Lower Respiratory Tract. In: Dennis R, Kirberger RM, Barr F, Wrigley RH, eds. Handbook of Small Animal Radiology and Ultrasound. Techniques and differential diagnoses. 2nd ed., Elsevier, China 2010:145-174.

9. Buchheister S, Bleich A. Health Monitoring of Laboratory Rodent Colonies-Talking about (R)evolution. Animals (Basel). 2021;11(5):141.

10. Piskovská A, Kraszewska K, Hauptman K, et al. The Rat Thoracic Ultrasound protocol: scanning technique and normal findings. Front Vet Sci 2024;11:1286614.

11. Jekl V, Hauptman K, Jeklová E, et al. Blood sampling from the cranial vena cava in the Norway rat (Rattus norvegicus). Lab Anim 2005;39(2):236-9.

12. Jacob Filho W, Lima CC, Paunksnis MRR, Silva AA, Perilhão MS, Caldeira M, Bocalini D, de Souza RR. Reference database of hematological parameters for growing and aging rats. Aging Male. 2018;21(2):145-148.

13. Delwatta SL, Gunatilake M, Baumans V, Seneviratne MD, Dissanayaka MLB, Batagoda SS, Udagedara AH, Walpola PB. Reference values for selected hematological, biochemical and physiological parameters of Sprague-Dawley rats at the Animal House, Faculty of Medicine, University of Colombo, Sri Lanka. Animal Model Exp Med. 2018;1(4):250-254.

14. Kling MA. A review of respiratory system anatomy, physiology, and disease in the mouse, rat, hamster, and gerbil. Vet Clin North Am Exot Anim Pract 2011;14:287-337.

15. Piskovská A, Kraszewska K, Hauptman K, et al. RATTUS (Rat Thoracic Ultrasound): diagnosis of pneumothorax in pet rats. Front Vet Sci. 2024;11:1394291

16. Monteiro HIG, Silva V, de Sousa T, et al. Antimicrobial Resistance in European Companion Animals Practice: A One Health Approach. Animals (Basel). 2025;15(12):1708

17. Nemec A, Krizova Ly Maixnerova M, et al. Genotypic and phenotypic characterization of the Acinetobacter calcoaceticus–Acinetobacter baumannii complex with the proposal of Acinetobacter pittii sp. nov. (formerly Acinetobacter genomic species 3) and Acinetobacter nosocomialis sp. nov. (formerly Acinetobacter genomic species 13TU). Res Microbiol 2011;162(4):393–404.

18. Ren X, Palmer LD. Acinetobacter Metabolism in Infection and Antimicrobial Resistance. Infect Immun. 2023;91(6):e0043322

19. Ardiaca García M, Montesinos Barceló A, Bonvehí Nadeu C, et al. Respiratory Diseases in Guinea Pigs, Chinchillas and Degus. Vet Clin North Am Exot Anim Pract. 2021;24(2):419-457.

20. Matsushima K, Yamakawa S, Edamoto H, et al. Spontaneous Malignant T-cell Lymphoma in a Young Adult Crl:CD (SD) Rat. J Toxicol Pathol. 2010;23(1):49-52.

21. Mosqueira M, Willmann G, Zeiger U, et al. Expression Profiling Reveals Novel Hypoxic Biomarkers in Peripheral Blood of Adult Mice Exposed to Chronic Hypoxia. PLoS ONE. 2012;7:e37497.

22. Livingston RS, Besch-Williford CL, Myles MH, et al. Pneumocystis carinii infection causes lung lesions historically attributed to rat respiratory virus. Comp Med 2011;61:45–59.

A. Piskovská, K. Hauptman, M. Škorič, V. Jekl

Izvleček:

Ključne besede: