CASE REPORT

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The first autochthonous case of *Dirofilaria immitis* infection in a dog in eastern Poland – confirmed by post-mortem examination

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Abstract

Dirofilaria immitis is an emerging parasitic threat in Central Europe with veterinary and zoonotic relevance. The case is described of a fatal autochthonous case in a seven-year-old Cavalier King Charles Spaniel from south-eastern Poland, with no travel history. The dog presented with dyspnea, ascites, cough, syncope, and cyanosis; echocardiography revealed right heart enlargement, tricuspid regurgitation, pulmonary hypertension, and left ventricular diastolic collapse. Euthanasia was performed due to poor prognosis. Necropsy identified six pre-adult worms in the right atrium, ventricle, and pulmonary outflow tract, with pulmonary congestion and oedema. This prepatent infection confirms local transmission of *D. immitis* in Poland and highlights the growing risk of autochthonous dirofilariosis in Central Europe, driven by climate change, vector spread, and animal movement. Vigilance is warranted given the public health implications and potential for misdiagnosis of human pulmonary lesions.

Key words

Poland, dog, zoonosis, Dirofilaria immitis, autochthonous case, necropsy

INTRODUCTION

Cardiopulmonary dirofilariosis is a globally significant parasitic infection caused by the nematode *Dirofilaria immitis*. The typical definitive hosts are dogs and other members of the Canidae family, which serve as a reservoir for the infection. Atypical hosts include cats and ferrets, in which the developmental cycle is prolonged and microfilaremia rarely occurs [1, 2]. The parasite also has zoonotic potential, closely reflecting the One Health concept, linking the health of humans, animals, and ecosystems. In humans, it causes atypical pulmonary nodular lesions, associated with respiratory insufficiency. Humans represent a biological dead-end host, and such infections may lead to diagnostic confusion with neoplastic or tuberculous lesions [3, 2]. The intermediate hosts of *D. immitis* are mosquitoes; therefore, the infection often shows regional and seasonal patterns. Environmental and climate changes, both natural and anthropogenic, as well as animal movements, contribute progressively to the increase in reported cases of *D. immitis* infection. In Europe, a steady north-eastern expansion of the parasite's distribution has been observed. Until the end of the 20th century, endemic foci were almost exclusively limited to southern regions, such as Spain, Italy, Portugal, and Greece. In the first decades of the 21st century, however, a clear trend of expansion towards the north-east of the continent has been documented. Southern Europe still has the highest prevalence rates, exceeding 40% in some areas of Italy and Spain. In Central Europe, autochthonous cases have already been documented in Austria, Hungary, Germany, and Poland [4, 5, 6]. These areas are referred to as pre-endemic zones, as local transmission has been confirmed, although the spread of the infection remains limited. In northern European countries, most cases are imported. Still, reports of *D. immitis* DNA detection in mosquitoes (e.g., in Germany and Denmark) suggest that conditions for development of the parasite are gradually being established, raising the risk of further northward expansion [7].

The life cycle of *D. immitis*, as well as the persistence of infection in a given area, depends largely on climatic conditions. Temperature and humidity determine both mosquito population dynamics as intermediate hosts, and the speed of microfilariae development into the infective L3 stage. Under optimal conditions (27 °C, 80% relative humidity), this process takes 10–14 days. A decrease in temperature significantly prolongs development, and below 14 °C it ceases completely [2, 3]. In recent decades, climate change has had a growing impact on the spread of the infection, extending the activity season of vectors and allowing the parasite to develop in new geographical areas. Additional factors include globalisation and increased movement of companion animals, which can transfer the infection from endemic regions into previously unaffected areas. The appearance of

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invasive mosquito species, such as *Aedes albopictus* and *Aedes japonicus*, also plays an important role. These species have longer life cycles, higher transmission efficiency, and strong adaptability to urban environments, exploiting small water reservoirs and benefiting from the elevated temperatures of urban heat islands. Wild canid populations, including foxes, wolves, and jackals, also serve as reservoirs of the parasite, facilitating maintenance of the cycle in the natural environment.

In recent years, the increased migration of people and animals from eastern and south-eastern Europe, caused by political (e.g., armed conflict in Ukraine), economic, and climatic factors, has further contributed to the spread of infection northward across the continent [1, 5, 6].

CASE REPORT

In the second half of January 2024, a 7-year-old male Cavalier King Charles Spaniel weighing 16 kg was presented to the Department of Epizootiology and Clinic of Infectious Diseases at the Faculty of Veterinary Medicine in Lublin, eastern Poland. The primary reasons for the visit were ascites diagnosed in another clinic, dyspnea even after short walks, apathy, cough, reluctance to play, and episodes of syncope. Clinical symptoms were very advanced. The referring veterinarian reported abnormal cardiac and pulmonary murmurs. The dog had normal body conformation and weight and regularly vaccinated. According to history, the dog had lived in the Lublin region since birth and had never travelled abroad. Clinical examination revealed markedly cyanotic mucous membranes. Capillary refill time was 4 seconds, body temperature elevated to 38.8 °C, and respiratory rate – 40/min. Cardiac auscultation revealed a grade III/VI murmur on the right side of the thorax. Palpation of peripheral lymph nodes revealed no abnormalities. The dog remained conscious but showed reduced response to external stimuli. Complete haematological and biochemical blood tests showed no significant abnormalities (Tab. 1). Echocardiographic examination was performed in right lateral recumbency using an Esaote Mylab Class C ultrasound device with a PA 240 sector probe (1–4 MHz). In the right parasternal long-axis view, a markedly enlarged right heart silhouette was observed. Both the right atrium and right ventricle showed dilatative features of volume overload (Fig. 1). Colour Doppler evaluation revealed tricuspid regurgitation with

Table 1. Hematological and biochemical parameters of the examined dog

Tested Parameter	Result	Reference Values
Leukocytes	16.7×10^9/l	$6–17 \times 10^9$/l
Erythrocytes	8×10^{12}/l	$5.5–8.5 \times 10^{12}$/l
Haematocrit	32%	37–55%
Haemoglobin	14.1 g/dl	12–18 g/dl
Platelets	240×10^9/l	$200–500 \times 10^9$/l
ALT	51 U/l	3–51 U/l
AST	43 U/l	1–37 U/l
Urea	54 mg/dl	20–50 mg/dl
Creatinine	1.22 mg/dl	1–1.7 mg/dl
Glucose	89 mg/dl	70–120 mg/dl
GGT	17 U/l	5–20 U/l

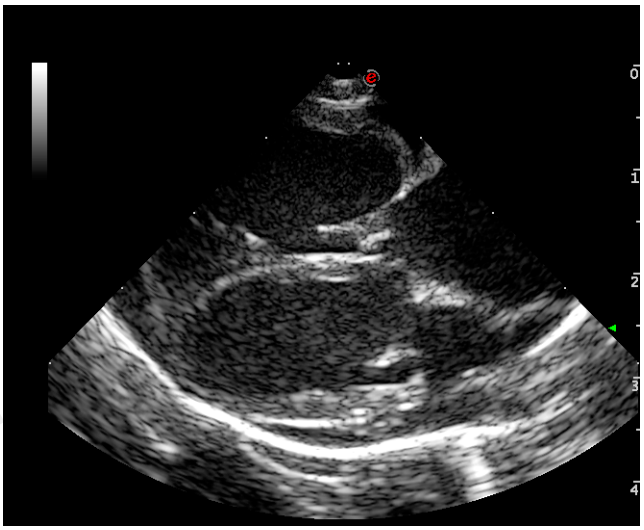

Figure 1. Echocardiogram – right parasternal long-axis view. Markedly enlarged right heart silhouette

a velocity of approximately 3 m/s. Pulmonary artery flow was turbulent at 1.71 m/s, but no stenosis of the pulmonary trunk was detected. Aortic flow was normal at 1.44 m/s. The left atrial diameter was 26.7 mm, aortic diameter was 22.6 mm, with an LA/Ao ratio of 1.18. M-mode evaluation showed left ventricular internal diameter in diastole (LVDd) at 19.5 mm and in systole (LVDs) at 11 mm. Interventricular septal thickness in diastole (IVSd) was 10.6 mm, and in systole (IVSs) – 10.8 mm. Fractional shortening was 43%, and ejection fraction 78%. In the right parasternal short-axis view, collapse of the left ventricular lumen during diastole was observed. Heart rate was 78 bpm, with no apparent arrhythmias. A small amount of pericardial effusion was present without signs of cardiac tamponade. Due to the poor prognosis, the owners opted for euthanasia and gave consent for necropsy.

Necropsy findings. Necropsy was performed at the Department of Pathomorphology and Forensic Veterinary Medicine, University of Life Sciences in Lublin. In the abdominal cavity, an increased volume of clear, reddish-tinged fluid (50 ml) was present. The liver was slightly enlarged, yellowish in colour, with rounded edges (liver steatosis), the kidneys were of normal size and shape, while the spleen was markedly enlarged with rounded edges, dark red in colour, with poorly visible reticular structure and soft consistency. The thoracic cavity contained approximately 20 ml of reddish-tinged fluid. Abundant blood-tinged foamy fluid was observed in the tracheal bifurcation and on cut surfaces of the lungs. An additional 10 ml of reddish fluid was found in the pericardial sac, which appeared smooth, shiny, and translucent. The heart was rounded with the myocardium red and fleshy in consistency. The epicardium was smooth and shiny. The left ventricle contained a small amount of semi-fluid blood. The bicuspid valve exhibited nodular thickening of the edges (corresponding to clinical stage Myxomatous Mitral Valve Disease – Stage B2 – MMVD-B2). The right atrium and ventricle contained a small amount of clotted blood. Within the lumen of the right ventricle and atrium, threadlike nematodes measuring 12–18 cm were detected, with 6 individuals partly located near the pulmonary artery outflow tract. The isolated nematodes

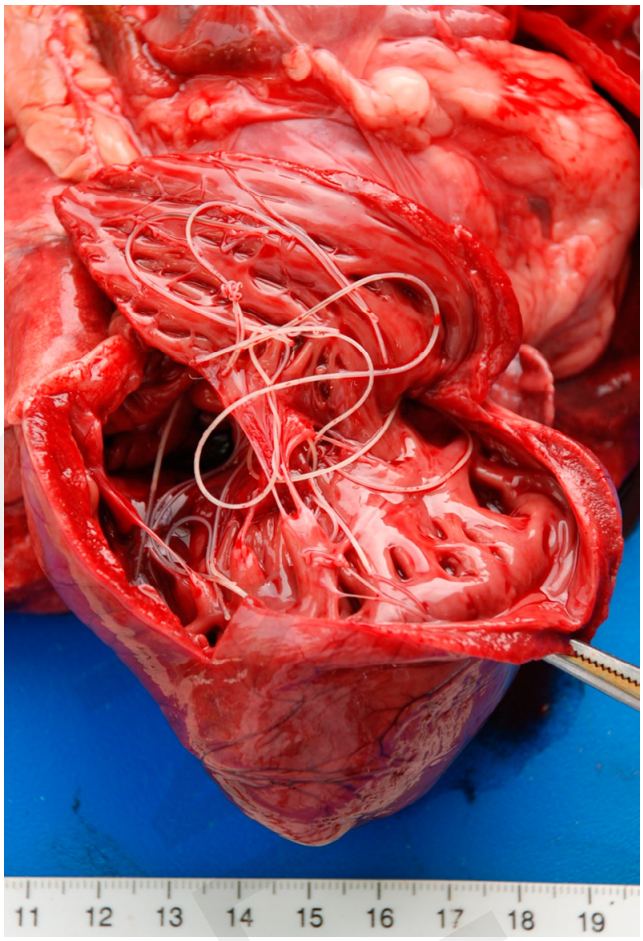

Figure 2. Pre-adult stages in the heart of the necropsied dog

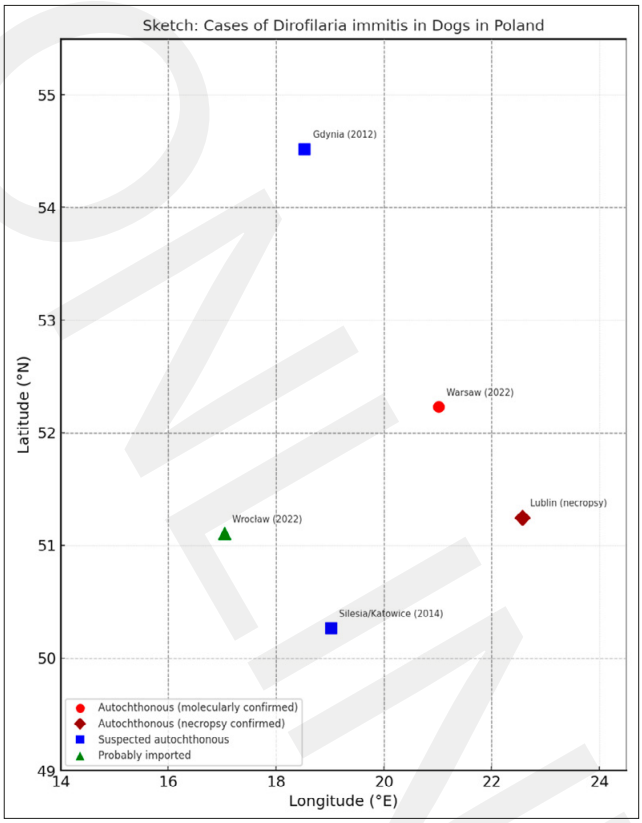

Figure 3. Summary of Published Cases of Dirofilaria immitis Infections in Dogs in Poland

were cylindrical, grayish-white, and transversely striated, with males smaller and coiled posteriorly, while females were larger with straight, rounded tails.

Key morphological features included a rounded cephalic end without lips, cuticular longitudinal annulations, unequal spicules, and characteristic pre- and post-cloacal papillae confirmed *Dirofilaria immitis* invasion (Fig. 2). Moreover, the obtained morphometric and morphological data were compatible with previous descriptions of *Dirofilaria immitis*. Microscopic examination of the reproductive organs of all isolated nematodes showed no sexual maturity, consistent with the absence of microfilariae in peripheral blood. The infection was thus prepatent, with pre-adult stages. Given that the prepatent period lasts approximately 6 months, infection likely occurred in August or September 2024. Ultimately, congestion and oedema of the lungs, liver steatosis and pulmonary embolism caused by heartworm disease were diagnosed microscopically.

DISCUSSION

In Poland, cases of *D. immitis* infection in dogs are rare, and include both autochthonous and sporadic imported infections. The first indigenous case was reported in 2012 in Gdynia, based on a SNAP test detecting antigens of adult females. Although autochthonous, this case lacked post-mortem confirmation [8]. The second case, confirmed post-mortem, was recorded in 2014 in Silesia, with adult parasites found during necropsy [9]. The third case, described in 2022 in Warsaw, involved a dog that never left Poland, co-infected with *D. repens* and *D. immitis*, confirmed by PCR – the first molecularly confirmed autochthonous case in Poland (Fig. 4) [10]. Additionally, veterinarians sporadically diagnose imported cases in dogs returning from endemic areas, particularly southern Europe. In the Baltic states, sporadic imported cases have been described (Lithuania), while Latvia and Estonia lack reports of autochthonous cases, though transmission risk increases with high prevalence of *D. repens* in sled dog kennels. Slovakia is endemic for *D. immitis*, with a recent rise in co-infections with *D. repens*. Between 2017 – 2021, co-infections accounted for 22.5% of canine cases, and in 2022, an autochthonous human case was confirmed. In the Czech Republic, all reported cases were imported. In Germany, numerous infections have been detected, most linked to travel or import, although *D. immitis* DNA has been found in mosquitoes, suggesting pre-endemic status. On Belarusian territory, entomological studies confirmed the presence of parasite DNA in mosquitoes, but no clinical cases in dogs have been reported. Ukraine is endemic for both *D. repens* and *D. immitis*, especially in the south, with documented human cases confirming active transmission. Taken together, these data indicate that Poland, partly surrounded by endemic and pre-endemic areas, lies in a zone of elevated risk for new autochthonous cases [4, 5, 6, 7].

Infected dogs often exhibit chronic, asymptomatic courses. Initial symptoms usually include coughing, dyspnea, syncope, and signs of pulmonary hypertension. Imaging reveals changes in lungs and heart, while laboratory findings (leukocytosis, eosinophilia, anaemia, proteinuria) occur mainly in advanced stages. Heavy infections may lead to

caval syndrome, causing acute circulatory failure and death. All confirmed Polish autochthonous cases to date have been fatal, despite relatively low parasite burdens (Fig. 3). An important immunopathological aspect is the exaggerated immune response of dogs from non-endemic regions upon first exposure, leading to severe damage. Adult *D. immitis* localises in pulmonary arteries and the right heart, inducing chronic endarteritis. Immune activation leads to vascular fibrosis, pulmonary hypertension, right ventricular hypertrophy, and heart failure. Wolbachia endosymbionts exacerbate inflammation, justifying antibiotic therapy with doxycycline. Parasite death, natural or after treatment, triggers strong hypersensitivity reactions, pulmonary inflammation, and embolism. The presented case indicated unfavourable outcomes, despite a short exposure (6 months) and a low parasite load (6 worms) [2, 3].

CONCLUSIONS

This report confirms the direct threat posed by zoonotic *Dirofilaria immitis* to animals and humans in south-eastern Poland. It highlights the presence of reservoir hosts and competent mosquito populations in the region. In eastern Poland, approximately 50 mosquito species have been recorded, with the most common belonging to the genera *Culex* (especially *Culex pipiens*), *Aedes* (including *Aedes vexans*), and *Anopheles* (mainly *Anopheles maculipennis* complex). All of these mosquito species may serve as potential intermediate hosts for *Dirofilaria immitis* as this parasite is not host-specific with respect to its mosquito vectors. These findings should alert medical doctors, particularly pulmonologists, to consider parasitic aetiology of pulmonary nodules in patients with no history of travel to endemic regions.

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