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Sokak Köpeklerinde Pulmoner Lezyonlarin ve Pnömoni Tiplerinin Histopatolojik Sınıflandırılması: Şanlıurfa'dan 50 Olguluk Retrospektif Bir Çalışma

Histopathological Classification of Pulmonary Lesions and Pneumonia Types in Stray Dogs: A Retrospective Study of 50 Cases From Şanlıurfa, Türkiye

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ÖZET

Amaç: Solunum hastalıkları köpeklerde yaygın bir morbidite ve mortalite nedenidir; ancak sokak köpeği popülasyonlarında akciğer patolojisine ilişkin histopatolojik veriler, özellikle bölgesel düzeyde, sınırlıdır. Bu çalışmada Şanlıurfa'daki (Türkiye) sokak köpeklerinde pulmoner lezyonların histopatolojik olarak karakterize edilmesi ve sınıflandırılması amaçlanmıştır.

Materyal ve Metot: Harran Üniversitesi veteriner fakültesi patoloji anabilim dalına gönderilen 50 sokak köpeği kadavrasına ait akciğer dokuları incelendi. Nekropsiyi takiben örnekler %10'luk nötral tamponlu formalinde tespit edildi, rutin doku takibinden geçirildi, parafine gömüldü, 5 µm kalınlığında kesildi ve hematoksilen–eozin (H&E) ile boyandı. Dokuz histopatolojik parametre (amfizem, atelektazi, konjesyon/hiperemi, kanama, interstisyel yangı, ödem, nötrofilik yangı, mononükleer/kronik yangı ve bronşitis) yarı-kantitatif olarak (–, +, ++, +++) değerlendirildi ve her olguya morfolojik bir tanı atandı. Veriler tanımlayıcı istatistiklerle analiz edildi.

Bulgular: Popülasyon 23 erkek (%46) ve 27 dişiden (%54) oluşuyordu; 48'i melez, 2'si Kangal ırkındaydı. Kayıt bulunan olgularda (n = 39) yaş 1 ile 8 yıl arasında değişmekteydi (ortalama 4,6). En sık görülen lezyonlar konjesyon/hiperemi (%48), amfizem (%38) ve ödem (%20) idi. Olguların 21/50'sinde (%42) inflamatuvar tanı konuldu: suppuratif pnömoni (%16), kronik pnömoni (%12), bronşitis (%10) ve interstisyel pnömoni (%4). Geriye kalan 29 olguda (%58) yalnızca konjesyon, amfizem, ödem ve kanama gibi non-inflamatuvar değişiklikler saptandı. Genç hayvanlarda daha çok akut/suppuratif paternler görülürken, kronik lezyonlar ileri yaştaki bireylerde daha sık izlendi.

Tartışma ve Sonuç: Bu bölgesel sokak köpeği popülasyonunda non-inflamatuvar pulmoner değişiklikler baskındı; gerçek inflamatuvar tanılar arasında en sık suppuratif pnömoni görüldü. Bulgular, bölgedeki sokak köpekleri için temel histopatolojik veri sağlamaktadır. Etiyolojinin aydınlatılması için immunohistokimyasal ve moleküler çalışmalara gereksinim vardır.

Anahtar Kelimeler: Akciğer, Histopatoloji, Pnömoni, Sokak hayvanları

ABSTRACT

Objective: Respiratory disease is a common cause of morbidity and mortality in dogs, yet histopathological data on pulmonary pathology in stray dog populations remain limited. This study aimed to histopathologically characterise pulmonary lesions and classify pneumonia types in stray dogs from Şanlıurfa.

Material and Methods: Lung tissues from 50 stray dog cadavers submitted to a veterinary faculty pathology department were examined. After necropsy, samples were fixed in 10% neutral buffered formalin, paraffin-embedded, sectioned at 5 µm and stained with haematoxylin–eosin (H&E). Nine histopathological parameters (emphysema, atelectasis, congestion/hyperaemia, haemorrhage, interstitial inflammation, oedema, neutrophilic inflammation, mononuclear/chronic inflammation and bronchitis) were assessed semiquantitatively (–, +, ++, +++), and a morphological diagnosis was assigned to each case. Data were analysed descriptively.

Results: The population comprised 23 males (46%) and 27 females (54%); 48 were mixed-breed and 2 were Kangal dogs. Where recorded (n = 39), age ranged from 1 to 8 years (mean 4.6). The most frequent lesions were congestion/hyperaemia (48%), emphysema (38%) and oedema (20%). Inflammatory diagnoses were established in 21/50 cases (42%): suppurative pneumonia (16%), chronic pneumonia (12%), bronchitis (10%) and interstitial pneumonia (4%). The remaining 29 cases (58%) showed only non-inflammatory changes. Younger animals more often showed acute/suppurative patterns, whereas chronic lesions occurred in older individuals.

Discussion and Conclusion: In this regional stray dog population, non-inflammatory pulmonary changes predominated, while suppurative pneumonia was the most common inflammatory diagnosis. The findings provide baseline histopathological data for stray dogs in the region. Immunohistochemical and molecular studies are needed to clarify aetiology.

Keywords: Lung, Histopathology, Pneumonia, Stray animals

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INTRODUCTION

The respiratory system is in continuous direct contact with the external environment and is therefore highly vulnerable to environmental pathogens and noxious agents. In dogs, pulmonary disease is a frequent health problem that may result from both infectious and non-infectious causes, and bacterial pneumonia in particular is a common clinical diagnosis (1). Among these conditions, pneumonia is one of the most commonly encountered. Pneumonia is defined as inflammation of the alveoli and the surrounding lung parenchyma and is usually associated with bacterial, viral, fungal or parasitic agents (2). In young dogs, community-acquired infectious pneumonia is frequently associated with Bordetella bronchiseptica and gram-negative enteric bacteria (3), whereas aspiration and secondary bacterial infection are important contributors in other age groups (4).

Histopathologically, pneumonias are classified according to the nature and distribution of the inflammatory process. Recognised categories include suppurative, fibrinous, serous, haemorrhagic, interstitial, embolic and granulomatous pneumonia. For example, cases dominated by neutrophilic infiltration are classified as suppurative pneumonia, whereas those with marked erythrocyte extravasation are diagnosed as haemorrhagic pneumonia (5). When inflammation is confined to the interstitium it is termed interstitial pneumonia, while inflammation involving the bronchi and bronchioles is described as bronchopneumonia (6, 7). Histopathological examination therefore remains the reference method for defining lesion type and distribution, independent of clinical presentation.

Despite the diagnostic importance of these lesions, histopathological data on pulmonary pathology in stray dog populations are limited, and regional data for Türkiye are scarce. Post-mortem surveys that classify canine pneumonia histopathologically have been reported from other regions (8, 9), but comparable data are lacking for stray dogs in south-eastern Türkiye. Stray dogs are continuously exposed to environmental agents and receive little or no preventive veterinary care, which may result in a distinctive spectrum of pulmonary lesions. Characterising this spectrum has relevance not only for veterinary pathology but also for regional animal and public health surveillance.

The aim of this study was to histopathologically examine lung tissues from 50 stray dogs from Şanlıurfa and the surrounding area, to determine the frequency of individual pulmonary lesions, and to classify the pneumonia types and non-inflammatory changes present.

MATERIALS AND METHODS

Animals and study design

This retrospective, descriptive study included 50 stray dog cadavers routinely collected by municipal teams from Şanlıurfa and the surrounding area and submitted to the Department of Pathology, Faculty of Veterinary Medicine. All animals were submitted already dead; no animal was killed for the purposes of this study. All had lived on the street, and the majority were mixed-breed. Age was estimated from information provided by the officials delivering the cadavers and was therefore recorded as an approximate value. Cause of death was neither determined nor part of the analysis.

Sampling and tissue processing

Necropsy was performed on all cadavers, and lung tissue samples were obtained from each animal. Samples designated for histopathological examination were fixed in 10% neutral buffered formalin, processed by routine tissue-processing methods and embedded in paraffin. Sections of 5 µm thickness were cut, mounted on slides and stained with haematoxylin–eosin (H&E).

Histopathological evaluation

Each section was evaluated under light microscopy. Nine histopathological parameters were assessed: emphysema, atelectasis, congestion/hyperaemia, haemorrhage, interstitial inflammation, oedema, neutrophilic (acute) inflammation, mononuclear/histiocytic–lymphocytic (chronic) inflammation, and bronchitis. Each parameter was graded semiquantitatively as absent (–), mild (+), moderate (++) or marked (+++).

Based on the combination of lesions, a specific morphological diagnosis was assigned to each animal with reference to established veterinary pulmonary pathology classifications — for example suppurative pneumonia, chronic pneumonia, interstitial pneumonia and bronchitis for inflammatory conditions, and pulmonary emphysema, congestion and oedema for non-inflammatory changes (5, 6). Diagnoses were based solely on microscopic findings; whether pneumonia was the cause of death was not evaluated. For analysis, closely related descriptors were consolidated into the diagnostic categories reported in Table 2.

Data analysis

Sex, breed, estimated age, individual lesion grades and the final morphological diagnosis were recorded for each animal in a structured dataset (full case-level data in Supplementary Table S1). Data were summarised using descriptive statistics (counts and percentages).

RESULTS

Of the 50 animals, 23 (46%) were male and 27 (54%) were female. Forty-eight (96%) were mixed-breed and two (4%) were Kangal dogs. Estimated age was available for 39 animals and ranged from 1 to 8 years (mean 4.6 years; median 5 years); age was not recorded for 11 animals. The frequency of each histopathological parameter (present at any grade) is shown in Table 1. Congestion/hyperaemia was the most common finding (24/50; 48%), followed by emphysema (19/50; 38%) and oedema (10/50; 20%). Neutrophilic inflammation was present in 9 animals (18%), haemorrhage and chronic (mononuclear) inflammation in 6 each (12%), bronchitis in 5 (10%), interstitial inflammation in 3 (6%) and atelectasis in 2 (4%). Lesions occurred alone or in combination, which accounted for the diversity of final diagnoses.

Table 1. Frequency of individual pulmonary lesions (n = 50).

Lesion	Cases (n)	%
Congestion / hyperaemia	24	48
Emphysema	19	38
Oedema	10	20
Neutrophilic (acute) inflammation	9	18
Haemorrhage	6	12
Mononuclear (chronic) inflammation	6	12
Bronchitis	5	10
Interstitial inflammation	3	6
Atelectasis	2	4

Inflammatory (pneumonic) diagnoses were established in 21 of 50 animals (42%). Suppurative pneumonia was the most frequent inflammatory diagnosis (8/50; 16%), followed by chronic pneumonia (6/50; 12%), bronchitis (5/50; 10%) and interstitial pneumonia (2/50; 4%). The remaining 29 animals (58%) showed only non-inflammatory changes — most commonly pulmonary congestion, emphysema, oedema and haemorrhage, alone or in combination (Table 2).

Table 2. Distribution of morphological diagnoses (n = 50).

Diagnostic category	Cases (n)	%
Non-inflammatory changes (congestion, emphysema, oedema, haemorrhage, atelectasis)	29	58
Suppurative pneumonia	8	16
Chronic pneumonia	6	12
Bronchitis	5	10
Interstitial pneumonia	2	4
Total inflammatory diagnoses	21	42

Pneumonia types were observed at similar frequencies in both sexes, with no marked difference between males and females. With respect to age, younger animals more frequently showed suppurative and acute-type patterns, whereas older individuals more often showed chronic lesions (e.g. fibrosis, chronic bronchitis). This observation is consistent with the influence of age on immune response and with the cumulative effect of environmental exposure over time (10).

The histopathological features of the cases are described below according to their morphological diagnosis (Table 2). Gross (macroscopic) findings were not systematically recorded and are therefore not reported. Representative findings are illustrated in Figure 1.

Suppurative pneumonia

Eight animals (16%) were diagnosed with suppurative pneumonia. Histopathologically, these cases were characterised by dense infiltration of the alveolar spaces by neutrophils (Figure 1D, G), which at higher magnification appeared as neutrophils accumulated within the alveolar lumina (Figure 1E). Alveolar and capillary congestion frequently accompanied the inflammatory infiltrate, and intra-alveolar oedema fluid was present in some cases.

Chronic pneumonia

Six animals (12%) were diagnosed with chronic pneumonia. These cases showed infiltration of the alveolar walls and interstitium by mononuclear inflammatory cells (lymphocytes and macrophages), with thickening of the alveolar septa (Figure 1I). Emphysema and haemorrhage were observed in association with the chronic inflammatory changes in individual cases.

Interstitial pneumonia

Two animals (4%) were diagnosed with interstitial pneumonia, characterised by thickening of the alveolar septa due to inflammatory cell infiltration confined to the interstitium, accompanied by congestion and, in one case, emphysema.

Bronchitis

Five animals (10%) were diagnosed with bronchitis. In these cases the bronchial epithelium was hyperplastic and the bronchial lumen was infiltrated by neutrophils, macrophages and lymphocytes (Figure 1A); the surrounding alveolar parenchyma was largely unaffected.

Non-inflammatory changes

The remaining 29 animals (58%) showed only non-inflammatory changes, occurring alone or in combination. Congestion/hyperaemia was seen as dilatation of the alveolar capillaries (Figure 1B), and pulmonary oedema as accumulation of eosinophilic fluid within the alveolar spaces (Figure 1B, F). Pulmonary haemorrhage appeared as extravasated erythrocytes filling the alveolar spaces (Figure 1C), and in several animals congestion, oedema and haemorrhage

were present together in the same section (Figure 1F). Emphysema was characterised by enlargement of the air spaces resulting from rupture of the alveolar septa (Figure 1H), and atelectasis by collapse of the alveolar spaces.

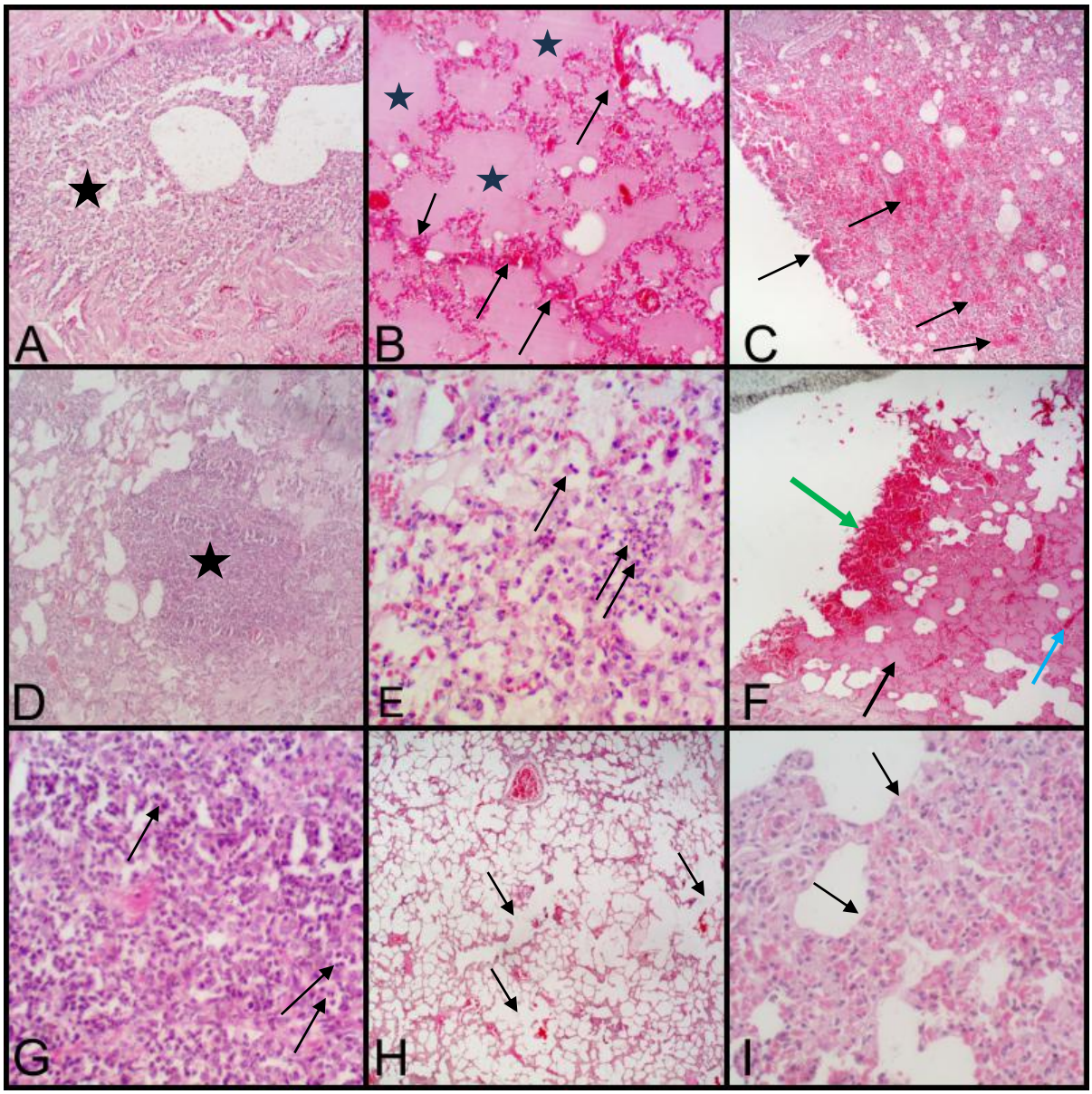

Figure 1. Representative haematoxylin–eosin findings in the lungs of stray dogs. (A) Bronchitis characterised by bronchial epithelial hyperplasia and infiltration of the lumen by neutrophils, macrophages and lymphocytes (star) (10×). (B) Oedema (stars) and hyperaemia (arrows) characterised by fluid accumulation in the alveolar spaces and dilated capillaries around the alveoli (10×). (C) Pulmonary haemorrhage (arrows) (4×). (D) Acute inflammation characterised by dense neutrophilic infiltration filling the alveolar spaces (star) (10×). (E) High-magnification detail of neutrophils accumulated in the alveolar lumina (arrows) (40×). (F) Oedema (black arrow), hyperaemia (blue arrow) and haemorrhage (green arrow) observed together in the same section (4×). (G) Neutrophils (arrows) clustered in the lumen (40×). (H) Pulmonary emphysema (arrows) characterised by enlarged air spaces due to rupture of the alveolar septa (4×). (I) Thickening of the alveolar walls (arrows) due to hyperaemia and inflammatory cell infiltration (40×).

DISCUSSION

In this retrospective histopathological study of 50 stray dogs from Şanlıurfa, non-inflammatory pulmonary changes predominated (58%), while inflammatory diagnoses accounted for 42% of cases. The most common individual findings were congestion, emphysema and oedema, and the most frequent true pneumonia was the suppurative type. These results provide baseline histopathological data on pulmonary pathology in a regional stray dog population, for which published information is limited.

The high frequency of congestion, oedema and emphysema deserves careful interpretation. In cadaver-based studies, some of these changes may reflect agonal or circulatory events, postmortem change, or respiratory tract trauma rather than primary lung disease, and therefore do not by themselves indicate pneumonia (6). Distinguishing these non-inflammatory changes from genuine inflammatory lesions is one of the strengths of a histopathology-based classification, and in the present series this distinction allowed 29 animals to be separated from the 21 with definite inflammatory disease.

Among the inflammatory diagnoses, suppurative pneumonia was the most common, consistent with the prominent role of bacterial infection in canine pneumonia (1, 2, 5). In young community-acquired cases, Bordetella bronchiseptica and gram-negative enteric organisms are frequently implicated (3), and secondary bacterial infection is common in aspiration-associated disease (4); although the causative agents were not investigated in the present study, these organisms provide a plausible background for the suppurative pattern observed.

Our lesion frequencies are broadly comparable to those of other post-mortem canine series. In a Nigerian study of 70 canine lungs, Alaka et al. (9) reported pulmonary oedema in 20%, atelectasis in 4% and interstitial pneumonia in 10% of cases — figures close to the 20%, 4% and 6% observed here — although their overall proportion of pneumonic (inflammatory) lungs was higher, with bronchointerstitial and interstitial pneumonias predominating. Okusanya et al. (8), in a retrospective post-mortem study, similarly found suppurative bronchopneumonia to be the most frequent pneumonic pattern. Differences between studies most likely reflect the source population: whereas hospital necropsy series are enriched for clinically diseased, often client-owned animals, the present sample consisted of unowned stray dogs collected regardless of cause of death, which may explain the higher proportion of purely non-inflammatory changes in our series.

The tendency for suppurative and acute patterns to occur in younger animals, and for chronic lesions to predominate in older ones, is in line with the reported influence of age on the pulmonary presence of viral and bacterial pathogens and on immune response (10), and may also reflect the cumulative burden of environmental exposure in free-roaming animals.

Beyond the diagnostic findings, the slide archive generated during this study has been retained as a permanent teaching resource for veterinary pathology training, adding educational value to the work.

This study has several limitations. First, ages were estimated from information provided at collection and are therefore approximate, and age was unavailable for 11 animals; age-related comparisons should be interpreted with caution. Second, diagnoses were based solely on H&E morphology, without microbiological, immunohistochemical or molecular confirmation, so specific aetiological agents could not be identified. Third, the cadaveric source and the lack of clinical history mean that cause of death could not be established and that some changes may represent postmortem or agonal artefacts. Fourth, the sample was drawn from a single region and from stray animals only, which limits generalisability. Finally, the analysis was descriptive; formal statistical testing of associations between age or sex and lesion type was not performed. Future work should combine histopathology with immunohistochemical and molecular methods to clarify the aetiology of the lesions identified. Such studies could improve agent identification and support the planning of preventive measures relevant to veterinary and public health.

CONCLUSION

In this regional population of stray dogs, non-inflammatory pulmonary changes predominated, whereas suppurative pneumonia was the most frequent inflammatory diagnosis. Histopathological examination allowed inflammatory pneumonias to be reliably distinguished from structural and circulatory changes. The study provides baseline histopathological data for stray dogs in Şanlıurfa and yielded a permanent educational slide archive. Complementary immunohistochemical and molecular studies are warranted to define the underlying aetiologies.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Ethics Approval and Consent

The Harran University Local Animal Experiments Ethics Committee (HRÜ-HADYEK) determined that the study did not require ethics committee approval, as it was conducted on cadaveric material and thus falls outside the scope of Article 8(k)(2) of the regulation on the

working procedures and principles of animal experiments ethics committees (decision no. 2025/004/12, dated 24.04.2025). All animals were submitted already dead; no animal was killed for the purposes of this study.

Conflict of Interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Author Contributions

O.M.: sampling and necropsy, laboratory processing, histopathological evaluation, writing of the manuscript. K.F.: supervision, study design, histopathological evaluation, sampling and necropsy, writing and critical revision of the manuscript. Both authors read and approved the final manuscript.

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