https://doi.org/10.52973/rcfcv-e35573 Revista Científica, FCV-LUZ / Vol. XXXV

Anesthetic risk analysis with routine preoperative thoracic radiography in dogs and cats

Análisis del riesgo anestésico con radiografía torácica preoperatoria de rutina en perros y gatos

Eylem Bektaş Bilgiç*

Istanbul University–Cerrahpaşa, Faculty of Veterinary Medicine, Department of Surgery. Istanbul, Türkiye.
**Corresponding author: eylembektass@gmail.com*

ABSTRACT

Thoracic radiography is a valuable tool not only for detecting and evaluating intrathoracic diseases but also for diagnosing systemic conditions. Additionally, it aids in determining the most appropriate anesthesia protocol based on a physical status grading system. This study assessed the cardiovascular and respiratory systems of patients undergoing routine thoracic radiography and analyzed anesthesia risks considering factors such as age, planned surgical procedures, and comorbidities. To achieve this, thoracic radiographs taken during the preoperative period of cats and dogs presented to the Istanbul University–Cerrahpaşa Veterinary Faculty, Department of Surgery, Ear Nose Throat (ENT) clinic between 2018 and 2021 for planned ENT surgeries were evaluated. The ASA physical status score of each patient was determined based on physical examination, laboratory results, and radiographic findings. A total of 237 animals—140 cats and 97 dogs—were included in the evaluation. Extrathoracic structures, pleura, pulmonary parenchyma, and the mediastinum were examined separately and categorized as either normal or presenting lesions that could pose an anesthetic risk. In 103 patients, no lesions were observed on thoracic radiography, and these patients were classified as normal. However, lesions that could potentially increase anesthetic risk were identified in the remaining 134 patients. In conclusion, thoracic radiography is a critical diagnostic and risk assessment tool, particularly in animals with upper respiratory tract diseases. This study's findings highlight that airway obstructions and pulmonary pathologies are commonly observed across various age groups, especially in brachycephalic breeds, underscoring the importance of routine thoracic radiography in preoperative evaluations.

Key words: Thoracic radiography; anesthetic risk; Brachycephalic Obstructive Airway Syndrome (BOAS); ASA physical status score

RESUMEN

La radiografía torácica es una herramienta valiosa no solo para detectar y evaluar enfermedades intratorácicas, sino también para diagnosticar afecciones sistémicas. Además, ayuda a determinar el protocolo de anestesia más adecuado según un sistema de clasificación del estado físico. Este estudio evaluó los sistemas cardiovascular y respiratorio de pacientes sometidos a radiografías torácicas de rutina y se analizaron los riesgos de la anestesia, considerando para ello factores como la edad, los procedimientos quirúrgicos planificados y las comorbilidades. Para lograrlo, se evaluaron las radiografías torácicas tomadas durante el período preoperatorio de gatos y perros presentados en la Facultad de Veterinaria de la Universidad de Estambul–Cerrahpaşa, Departamento de Cirugía, Clínica de Otorrinolaringología (ENT) entre 2018 y 2021 para cirugías de Otorrinolaringología planificadas. La puntuación del estado físico ASA de cada paciente se determinó en función del examen físico, los resultados de laboratorio y los hallazgos radiográficos. Se incluyeron en la evaluación un total de 237 animales (140 gatos y 97 perros). Las estructuras extratorácicas, la pleura, el parénquima pulmonar y el mediastino se examinaron por separado y se clasificaron como normales o con lesiones que podrían suponer un riesgo anestésico. En 103 pacientes, no se observaron lesiones en la radiografía torácica y estos pacientes se clasificaron como normales. Sin embargo, se identificaron lesiones que podrían aumentar potencialmente el riesgo anestésico en los 134 pacientes restantes. En conclusión, la radiografía torácica es una herramienta fundamental para el diagnóstico y la evaluación del riesgo, en particular en animales con enfermedades del tracto respiratorio superior. Los hallazgos de este estudio destacan que las obstrucciones de las vías respiratorias y las patologías pulmonares se observan comúnmente en varios grupos de edad, especialmente en razas braquicéfalas, lo que subraya la importancia de la radiografía torácica de rutina en las evaluaciones preoperatorias.

Palabras clave: Radiografía torácica; riesgo anestésico; Síndrome obstructivo de las vías respiratorias braquicefálicas (BOAS); puntuación del estado físico ASA

Received: 18/11/2024 Accepted: 17/01/2025 Published: 01/04/2025

INTRODUCTION

Preoperative evaluation refers to the clinical examinations that an anesthesiologist must perform prior to administering anesthesia [1]. As part of this evaluation, a thorough physical examination should be conducted, and any abnormal findings should be addressed and managed before proceeding with anesthesia [2, 3]. If abnormal sounds are detected during lower respiratory tract auscultation, thoracic radiography is recommended for all such patients [4]. This diagnostic tool is particularly valuable for dogs (*Canis lupus familiaris*) and cats (*Felis catus*) experiencing respiratory distress, as it aids in distinguishing between upper and lower airway obstructions and in diagnosing other respiratory conditions [5].

Thoracic radiography is a valuable diagnostic tool not only for detecting and evaluating intrathoracic diseases but also for identifying systemic conditions [6, 7]. This method offers a rapid, noninvasive assessment of both intrathoracic and extrathoracic structures [8]. It provides critical information on heart size, shape, and borders; vascular structures; lung patterns; pleural changes; and the thoracic musculoskeletal system. Additionally, thoracic radiography aids in screening for cardiopulmonary, metabolic, and systemic diseases by identifying the location, type, and extent of abnormalities in the thoracic region [9].

Thoracic radiography also aids in selecting the most appropriate anesthetic protocol based on the American Society of Anesthesiologists (ASA) physical status grading system. The ASA physical status score is a widely used tool for assessing anesthetic risk by evaluating the severity of a patient's condition. Preoperative evaluation using this classification system is crucial for determining the optimal anesthetic technique [10].

The systematic evaluation of thoracic radiographs involves dividing the thoracic region into four main compartments: extrathoracic structures, pleura, pulmonary parenchyma, and mediastinum. The extrathoracic structures provide valuable clues for identifying the causes of dyspnea or labored breathing in cats and dogs. In a normal thoracic radiograph, the pleural space should not be visible. Pulmonary parenchymal opacities may be classified as normal or abnormal. In the mediastinum, radiographic findings such as fluid accumulation, air pockets, mass lesions, tracheal lumen changes, esophageal abnormalities, and mediastinal shifts are thoroughly evaluated [8, 11].

In this study, the cardiovascular and respiratory systems were assessed based on radiographic findings from patients who underwent routine thoracic radiography. Anesthesia risks were analyzed by considering factors such as the patient's age, the planned procedure, and any comorbid conditions.

MATERIAL AND METHODS

Identification of sick animals

In this study, routine thoracic radiographs taken during the preoperative period were evaluated for cats and dogs presented to the Istanbul University–Cerrahpaşa Faculty of Veterinary Medicine, Department of Surgery and Otorhinolaryngology (ENT) Clinic, between 2018 and 2021 for planned ENT surgeries. There were no restrictions on the age, breed, or sex of the patients. The planned surgical procedures and the ASA physical status scores, determined based on the patients' age, breed, and disease status, were reviewed retrospectively.

Obtaining radiographic images

Following a physical examination, thoracic radiographs were obtained for each patient in right and left laterolateral, dorsoventral, or ventrodorsal positions. The images were captured using the Ecoray Digital Radiography System (Hasvet Medikal, Türkiye) in the Radiodiagnostic Unit of the Radiology Department at Istanbul University–Cerahpaşa Faculty of Veterinary Medicine. The device automatically adjusted the kV and mA values according to the size of the animals.

Evaluation of radiography images

Radiographic images were systematically evaluated by two specialists and categorized into four compartments: extrathoracic structures, pleura, pulmonary parenchyma, and mediastinum. The vertebral heart score (VHS) for each patient was measured using a standardized method. For patients with VHS values outside the normal range, a consultation with the internal medicine department was requested. When necessary, surgery was postponed to allow for treatment planning.

The ASA score for each patient scheduled for surgery was determined based on findings from the physical examination, laboratory tests, and radiographic assessments. For laboratory examinations, complete blood count (Erythrocyte–RBC, Hemoglobin–HGB, Hematoctitis–HCT, Leukocyte–WBC, Platelet–PLT) and anesthesia protocol biochemistry parameters (Glucose–GLU, Creatinine–CREA, Blood Urea Nitrogen–BUN, BUN/CREA) , Phosphate–PHOS, Calcium–CA, Total Protein–TP, Albumin–ALB, Globulin – GLOB, ALB/GLOB, Alanine aminotransferase–ALT, Aspartate aminotransferase–AST, Alkaline phosphatase–ALKP, Gamma glutamyltransferase–GGT, Total bilirubin–TBİL, Cholesterol–CHOL) were examined. Animals with any abnormal results due to elective surgery were taken into treatment or further examinations were requested by requesting consultation from the relevant department.

The ASA score, along with the patient's information, was recorded, and the patient was referred to the operating room to establish the appropriate anesthesia protocol.

Statistical analysis

The data obtained in this study were analyzed using the licensed SPSS 27 software package. Initially, frequency analyses were conducted to evaluate demographic findings, and the frequency (n) and percentage (%) values of the groups were calculated. To assess differences between groups, an independent samples *t*–test was used for comparisons between two groups, while an ANOVA (analysis of variance) test was applied for comparisons among three or more groups when the variables followed a normal distribution. Relationships between categorical variables were analyzed using the chi–square test. A significance level of 0.05 was used to interpret the results. Accordingly, a *P* value less than of 0.05 was considered statistically significant, indicating a meaningful difference, whereas a *P* value greater than 0.05 was interpreted as not significant.

RESULTS AND DISCUSSION

In this study, thoracic radiographs from 237 animals (140 cats and 97 dogs) were evaluated. Among the cats, 65.5% were female, while 34.95% of the dogs were female. The age distribution of the cats showed that 32.14% were between 0–1 years old, 55.71% were between 1–7 years old, and 12.14% were 7 years or older. For the dogs, 12.37% were between 0–1 years old, 45.36% were between 1–7 years old, and 42.26% were 7 years or older (TABLE I).

TABLE I
Frequency distribution table for demographic characteristics

Variable	Group	n	%
Species	Cat	141	58.76
	Dog	99	41.24
Age (Cat)	0-1 year	45	32.14
	1-7 years	78	55.71
	7 years and over	17	12.14
Age (Dog)	0-1 year	12	12.37
	1-7 years	44	45.36
	7 years and over	41	42.26

The breed distribution of the cats was as follows: domestic mixed–breed cat (n: 91), Scottish Fold (n: 28), British Shorthair (n: 7), Angora (n: 6), Persian (n: 3), and other (n: 3). For dogs, the breeds included Pug (n: 19), Golden Retriever (n: 15), Cocker Spaniel (n: 11), King Charles Spaniel (n: 10), French Bulldog (n: 7), crossbreed (n: 5), Yorkshire Terrier (n: 3), German Shepherd (n: 2), Beagle (n: 2), and other (n: 23).

The ASA does not recommend routine thoracic radiography for human patients, except for those with respiratory disease, chronic obstructive pulmonary disease, or cardiac conditions [12]. In Veterinary practice, however, thoracic radiography is commonly used in patients with symptoms such as coughing, respiratory distress, heart murmurs, or to screen for metastatic diseases [13]. In contrast to these practices in both human [12] and Veterinary Medicine [13], routine preoperative thoracic radiographs were obtained from all patients in this study, regardless of breed, age, known comorbidities, or planned surgical procedure. Bronchial abnormalities are reported in over 85% of dogs with Brachycephalic Obstructive Airway Syndrome (BOAS), though their location and severity can vary [14, 15]. While BOAS represents a significant portion of ear, nose, and throat (ENT) diseases, it is typically treated with surgical intervention. As noted in the literature [14, 15], lesions causing upper airway obstruction in these patients can also lead to secondary effects on the lower airway. Therefore, it is maintained that routine preoperative radiography, offering a non–invasive evaluation of the thorax, is an essential diagnostic tool, especially for patients undergoing ENT procedures.

Advancing age in cats and dogs is associated with an increased risk of anesthesia–related mortality, regardless of the animal's physical condition [16, 17]. Anatomical, physiological, and functional changes that occur with age also affect anesthetic protocols [10]. In neonatal and geriatric patients, physiological functions differ from normal, and anesthesia can further impair these functions [2]. Previous studies have highlighted the importance of age–related effects on anesthesia [2, 16, 17, 18]. In this study, kittens and young animals were categorized as 0–1 years, adult animals as 1–7 years, and senior and geriatric animals as 7 years and older. The majority of patients in both the cat and dog groups were between 1–7 years of age.

Factors such as breed differences, airway obstruction, and individual genetic variations can increase the risk of anesthesia–related morbidity and mortality due to heightened sensitivity to anesthetic drugs [19, 20]. Although various cat and dog breeds were included in this retrospective study, nearly a quarter of the patients were brachycephalic breeds, which were found to have airway obstruction, as noted in the literature [19, 20]. It is therefore considered essential to adopt a breed–specific approach in anesthesia, starting with the preoperative period. This includes selecting the appropriate anesthetic protocol and considering additional diagnostic tests for breeds known to have a genetic predisposition to certain diseases.

Extrathoracic structures, pleura, pulmonary parenchyma, and mediastinum were evaluated separately and categorized as either normal or presenting lesions that could pose an anesthetic risk. Among the 237 patients studied, thoracic radiography revealed no lesions in 103 patients, who were therefore classified as normal. In the remaining 134 patients, lesions that could increase anesthetic risk were identified.

The most common lesions were found in the pulmonary parenchyma (n: 94). These included pulmonary edema (n: 57), pneumonia (n: 29), and mineralization of the bronchi, bronchioles, and alveoli (n: 56). Mediastinal lesions (n: 19) included mediastinal masses (n: 6), tracheal deviation (n: 6), tracheal collapse (n: 3), tracheal dilatation (n: 1), megaesophagus (n: 2), and hiatal hernia (n: 1).

In the extrathoracic structures (n: 17), the identified lesions included costochondral calcification (n: 13), sternal fracture (n: 2), lordosis (n: 1), and pectus excavatum (n: 2). Additionally, lesions in cranial abdominal structures were observed in 24 patients. These consisted of hepatomegaly (n: 1) and severe aerophagia (n: 23) (TABLE II, FIG. 1).

In this study, thoracic structures were evaluated using a systematic checklist based on methods described in the existing literature [8]. This approach aimed to minimize the risk of misreadings and incomplete evaluations. While the majority of

TABLE II
Distribution of lesions encountered on radiography

Variable	n
Normal	103
Lesion in the pulmonary parenchyma	94
Lesion in the mediastinum	19
Lesion in extrathoracic structures	18
Lesions in cranial abdominal structures	24

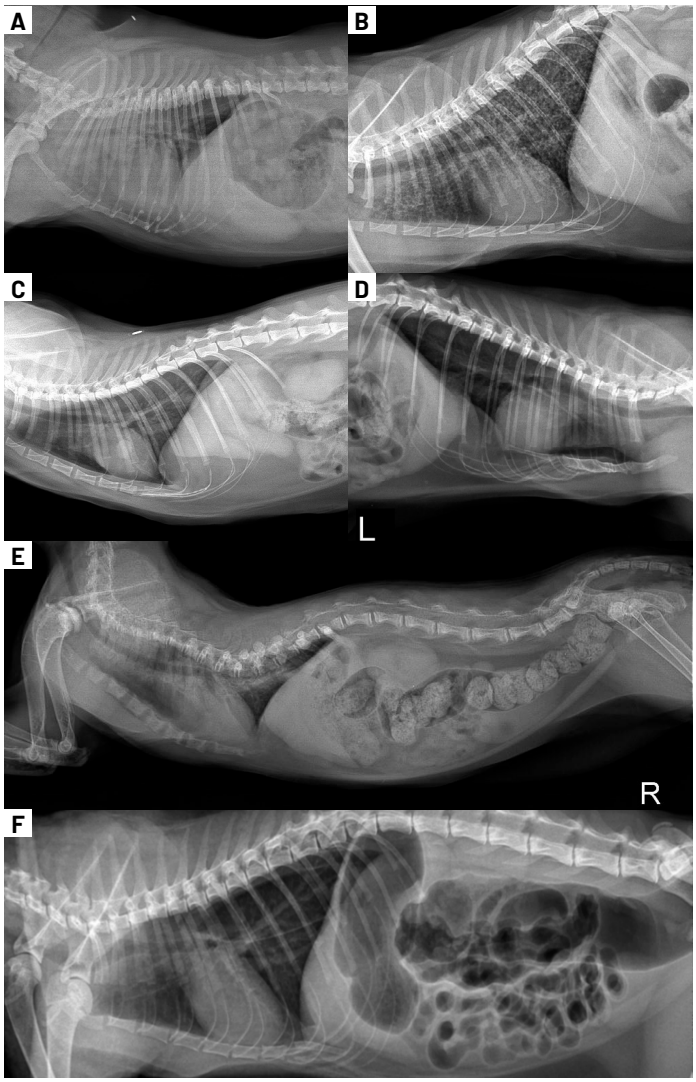

FIGURE 1. A) Right laterolateral thoracic radiograph of a 4-year–old male pug dog. Diffuse pulmonary edema, cardiomegaly, costochondral calcification and severe aerophagia. B) Right laterolateral radiograph of a 2-year–old male domestic mixed–breed cat. Severe pneumonia pattern. C) Right laterolateral thoracic radiograph of a 3-year–old male domestic mixed–breed cat. A nodular lesion (mediastinal mass) was detected in the mediastinum. D) Hiatal hernia and dorsal deviation of the trachea observed in the left laterolateral thoracic radiograph of a 1-year–old female Scottish Fold cat. E) Right laterolateral radiograph of an 11-month–old male domestic mixed–breed cat. Megaesophagus, intestinal meteorismus due to severe aerophagia. F) Lordosis observed in the right laterolateral thoracic radiograph of a 3-year–old female domestic mixed–breed cat

cases were classified as normal, lesions were most commonly identified in the pulmonary parenchyma. Previous studies report that the most frequent causes of pulmonary parenchymal lesions in dogs include bacterial pneumonia, fungal infections, and metastatic neoplasms [21]. However, in this study, pulmonary edema was also observed, alongside the pneumonia–related causes highlighted in the literature [21]. Pulmonary edema can be either cardiogenic or noncardiogenic [22]. In dogs, noncardiogenic pulmonary edema is often associated with conditions such as laryngeal paralysis, nasopharyngeal polyps, neoplasms, and brachycephalic obstructive airway syndrome (BOAS), and is classified as postobstructive pulmonary edema [22]. As noted in the literature [22], pulmonary edema may occur in both cats and dogs due to a variety of causes. In this study, the presence of patients with ENT (ear, nose, and throat) conditions further supported the likelihood of postobstructive pulmonary edema. Additionally, cases of cardiogenic pulmonary edema were also identified. Therefore, it is recommended that a cardiovascular system examination be performed on every patient with pulmonary edema, regardless of its potential cardiogenic origin. Previous literature frequently highlights that mediastinal masses (n: 6) can arise from various causes, ranging from benign or malignant tumors to lymph node enlargement. These masses may lead to respiratory distress by compressing adjacent structures [23, 24, 25, 26]. Similarly, tracheal deviation (n: 6) has been reported as a consequence of conditions such as cardiomegaly, myocardial or mediastinal tumors, and atrial dilation [27].

In this study, mediastinal masses and tracheal deviation were observed in equal numbers. Both conditions can cause significant respiratory distress, increase the risks associated with anesthesia, and pose life–threatening complications that may necessitate postponing elective surgery. Tracheal dilatation, on the other hand, is exceedingly rare. In human cases, it has been associated with cuff pressure from tracheostomy [28] or endotracheal intubation tubes [29]. In this study, a single case (Case No: 234) exhibited tracheal dilatation. Although the patient had no history of tracheostomy or prior endotracheal intubation, detailed evaluation using thoracic computed tomography revealed that the condition was caused by tracheomalacia (FIG. 2). Additionally, primary BOAS (brachycephalic obstructive airway syndrome) lesions can lead to secondary conditions, such as tracheal collapse [30]. Tracheal collapse is typically observed in middle–aged small–breed dogs [27].

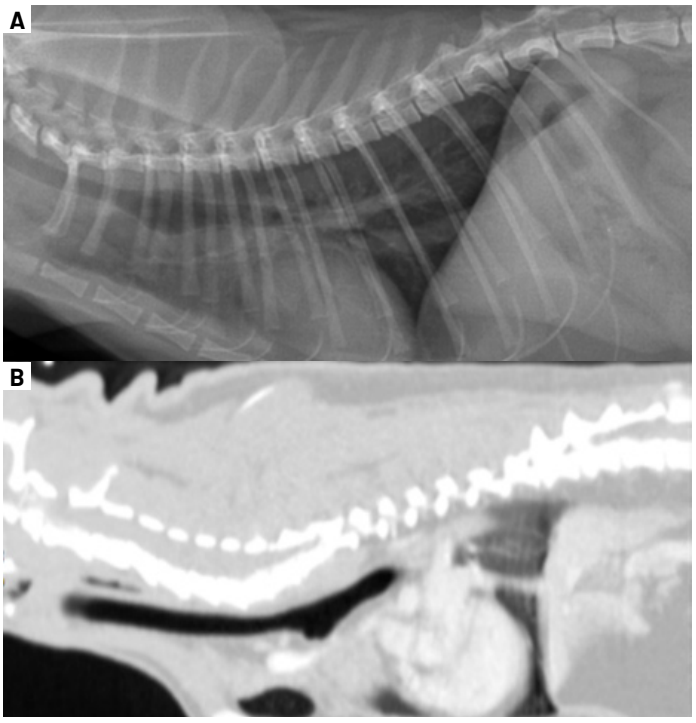

FIGURE 2. A) Tracheal dilatation observed in the right laterolateral radiograph of a 2-year–old male domestic mixed–breed cat. B) Tracheomalacia observed in the sagittal section of the computed tomography image of the same patient

The findings of this study, which included ENT patients, align with the existing literature [27, 30]. Cases of tracheal collapse were observed in middle–aged small–breed dogs, and it is believed that this condition is a secondary lesion associated with BOAS. Upper airway obstruction has been reported to cause simultaneous megaesophagus and hiatal hernia [31, 32, 33]. In this study, one case of hiatal hernia was incidentally detected on routine thoracic radiography during preoperative preparation for arytenoid lateralization in a patient with bilateral laryngeal paralysis. Similarly, megaesophagus was identified in two cases involving patients with nasopharyngeal polyps and severe upper respiratory tract obstruction. These findings are consistent with previously reported cases in the literature [31, 32, 33]. This underscores the importance of routine thoracic radiography, particularly in patients with upper airway obstruction. In such cases, additional diagnostic tests, such as positive contrast radiography or computed tomography, may be warranted. Extrapulmonary and thoracic wall diseases, such as spinal cord and costal deformities, can increase respiratory effort and may lead to respiratory muscle fatigue. Consequently, these patients might require ventilatory support during anesthesia or sedation [34]. The extrathoracic lesions observed in this study align with previously reported findings [34] and included costochondral calcification (n: 13), sternal fractures (n: 2), lordosis (n: 1), and pectus excavatum (n: 2). Costochondral calcification, in particular, has been reported in large–breed dogs as an age–related degenerative change [27].

In this study, costochondral calcification was observed in dogs aged 6 to 14 years, consistent with the literature. However, unlike previous reports, costochondral calcification was also identified in small–breed dogs. Pectus excavatum, a secondary lesion associated with BOAS, has been reported to develop in brachycephalic dogs due to airway obstruction [35, 36]. In this study, two cases of pectus excavatum were identified in cats: one in a 10–month–old Scottish Fold and the other in a 1-year–old domestic mixed–breed cat. The case involving the Scottish Fold aligned with findings in the literature [35, 36] and was thought to be associated with BOAS. Conversely, the domestic mixed–breed cat presented with bilateral inflammatory middle ear polyps, chronic purulent rhinitis, and sinusitis, suggesting an indirect connection between pectus excavatum and obstructive upper respiratory tract conditions. Most patients with scoliosis or lordosis present with dysphagia. However, it has also been reported that these conditions can lead to dysphagia caused by esophageal compression, right ventricular hypertrophy, and pulmonary artery hypertension [37].

In this study, thoracic lordosis and spinal deformity were incidentally detected in a cat with a nasal tumor. The findings of scoliosis and spinal deformity are consistent with previous reports [37] and are associated with upper respiratory tract diseases, which exacerbate the severity of the primary condition. These deformities may increase the risk of anesthesia complications by narrowing the rib cage and worsening dysphagia. Given the multifactorial etiology of lordosis, it is essential to identify the primary cause and address the underlying condition as part of the treatment plan. Aerophagia, often associated with BOAS, has been reported in cases of upper airway obstruction, such as nasal masses and laryngeal paralysis, and is known to increase the risk of pulmonary aspiration [38]. In this study, aerophagia was the most frequently observed pathological lesion in cranial abdominal structures on radiographs. This is likely due to the study population, which consisted predominantly of ENT patients, making upper respiratory tract diseases like BOAS relatively common. These findings are consistent with previous literature [38].

Body Condition Score (BCS) measurements indicated that 51.05% of the patients were within normal limits, while 48.95% were outside normal limits. For patients with BCS values outside normal limits, cardiology consultations identified the following conditions: mild left atrial dilatation (n: 2), mitral valve insufficiency (n: 10), tricuspid valve insufficiency (n: 2), pulmonary valve insufficiency (n: 2), dilated cardiomyopathy (n: 2), and myocardial hypertrophy (n: 2).

The mean BCS values were 7.84 ± 0.65 for cats and 10.68 ± 1.09 for dogs. According to the results of an independent samples *t*–test, a statistically significant difference was found between the mean BCS values of cats and dogs (t = -23.035, P=0.001) (TABLE III).

TABLE III
Differentiation of BCS by species

Variables	Category	Species		t test	
		Mean	SD	*t*	P
BCS	Cat	7.84	0.65	-23.035	0.001*
	Dog	10.68	1.09		

*P<0.05; t= Independent Samples t test

Radiographic examination is a commonly used supplementary method for evaluating cardiac pathologies in small animals, as it minimizes observer variability. Among these methods, the vertebral heart score (VHS) is particularly significant [39]. In this study, initial evaluations for cardiac diseases were conducted using routine VHS measurements. It was found that 48.95% of patients had VHS values outside normal limits, and 20 dogs were diagnosed with cardiovascular disease following further cardiogenic assessments. Consistent with the literature [39]. VHS assessment remains an important tool in preanesthetic evaluations. It provides valuable preliminary information for identifying potential cardiac issues and is simple to perform. However, for patients with VHS values outside normal limits, referral for further cardiogenic examination is strongly recommended. Factors such as breed and chest cage depth should also be considered during the assessment.

The planned surgeries were categorized as ear, nose, and throat (ENT) procedures in terms of anesthetic risk (TABLE IV).

When extrathoracic structures were evaluated in cats, lesions were observed in 2 cats (66.67%) in the 0–1 year age group and 1 cat (33.33%) in the 1–7 year age group, while no lesions were detected in cats aged 7 years and older. In the cranial abdominal structures, lesions were identified in 2 cats (28.57%) in the 0–1 year age group and 5 cats (71.43%) in the 1–7 year age group, with no lesions observed in the 7 years and older group. In the mediastinum, lesions were found in 3 cats (37.50%) in the 0–1 year age group, 4 cats (50.00%) in the 1–7 year age group, and 1 cat (12.50%) in the 7 years and older group. Among cats without any lesions, 28 cats (31.82%) were in the 0–1 year age group, 50 cats (56.82%) were in the 1–7 year age group, and 10 cats (11.36%) were in the 7 years and

TABLE IV
Operation Area, planned operation and number of patients

Area	Operation	Frequency
Ear	LKDR	21
	VBO	55
	Auriculoplasty	1
	Aural Tumor	1
	Auricular Hematoma	3
	Outer Ear Duct Aspiration	5
Nose	Dorsal Rhinotomy	38
	Rhinoplasty	47
	Nasal Planectomy	2
	Nasal Aspiration	3
Throat	Staphylectomy	45
	Tonsillectomy	28
	Sacculectomy	8
	Epiglottopexy	9
	Faringeal Tumor Resection	4

older group. Pulmonary parenchymal lesions were identified in 10 cats (29.41%) in the 0–1 year age group, 18 cats (52.94%) in the 1–7 year age group, and 6 cats (17.65%) in the 7 years and older group. There was no statistically significant difference in the distribution of lesions across age groups (z = 4.094, *P*=0.849) (TABLE V).

When extrathoracic structures were evaluated in dogs, lesions were observed in 1 dog (12.50%) in the 0–1 year age group and 7 dogs (87.50%) in the 7 years and older group, while no lesions were detected in the 1–7 year age group. In the cranial abdominal structures, lesions were found in 1 dog (33.33%) in the 0–1 year age group and 2 dogs (66.67%) in the 1–7 year age group, with no lesions observed in the 7 years and older group. In the mediastinum, lesions were identified in 5 dogs (45.45%) in the 0–1 year age group, 2 dogs (18.18%) in the 1–7 year age group, and 4 dogs (36.36%) in the 7 years and older group. Among the dogs with normal radiographs, none were in the 0–1 year age group, 2 dogs (66.67%) were in the 1–7 year age group, and 5 dogs (33.33%) were in the 7 years and older group. Pulmonary parenchymal lesions were recorded in 5 dogs (8.33%) in the 0–1 year age group, 30 dogs (50.00%) in the 1–7 year age group, and 25 dogs (41.67%) in the 7 years and older group. There was no statistically significant difference in the distribution of lesions across age groups (z = 26.471, *P*=0.001) (TABLE VI).

A modified version of the ASA physical condition classification system was used to assess the health status of the animals [40, 41]. However, the ASA House of Delegates recommends that this system should not be used alone to determine anesthetic risk and mortality [42]. Additionally, it has been reported that brachycephalic breeds, which were included in the study, have a higher risk of perioperative complications compared to non–brachycephalic breeds [43]. Although anesthetic risks were evaluated using the ASA physical status classification to ensure standardization in this study, the literature [42] agrees that this classification alone is insufficient.

TABLE V
Distribution of lesions in cats by age groups

Variable	Category	Age						Chi–square test	
		0-1 Year		1-7 Years		7 Years +			
		n	%	n	%	n	%	z	*P*
Radiography Lesion Distribution	Lesion of extrathoracic structures	2	66.67	1	33.33	0	0.00	4.094	0.849
	Lesion of cranial abdominal structures	2	28.57	5	71.43	0	0.00		
	Lesion in the mediastinum	3	37.50	4	50.00	1	12.50		
	Normal	28	31.82	50	56.82	10	11.36		
	Lesion in the pulmonary parenchyma	10	29.41	18	52.94	6	17.65		

Species = Cat; *$P<0.05$; z = Chi-Square Test

TABLE VI
Distribution of lesions in dogs by age groups

Variable	Category	Age						Chi–square test	
		0-1 Year		1-7 Years		7 Years +			
		n	%	n	%	n	%	z	*P*
Radiography Lesion Distribution	Lesion of extrathoracic structures	1	12.50	0	0.00	7	87.50	26.471	0.001*
	Lesion of cranial abdominal structures	1	33.33	2	66.67	0	0.00		
	Lesion in the mediastinum	5	45.45	2	18.18	4	36.36		
	Normal	0	0.00	10	66.67	5	33.33		
	Lesion in the pulmonary parenchyma	3	8.33	30	50.00	25	41.67		

Species = Dog; *$P<0.05$; z = Chi-Square Test

It is also recognized that complications related to the operation can affect mortality and morbidity. Therefore, it is suggested that additional evaluations or scales should be used to better assess the risk. One study reported that respiratory complications occurred at a rate of 0.54% in canine anesthesia and 0.34% in feline anesthesia. These complications included respiratory depression, apnea, respiratory distress, and intubation difficulties [44]. Another study found that brachycephalic breeds had a higher risk of complications during the perioperative period compared to non–brachycephalic breeds [43]. In this study, the planned operations were categorized as ear, nose, and throat procedures. Given that these regions—particularly the nose and throat—directly involve the airway, the risk of respiratory complications, as reported in the literature [44], is higher. Additionally, anesthesia, perioperative, and postoperative complications are expected to be more prevalent. It was also considered that pre–existing comorbid airway diseases, such as brachycephalic syndrome [43], could contribute to higher ASA scores in these patients. It has been reported that lesions associated with brachycephalic obstructive airway syndrome (BOAS), such as epiglottic retroversion, soft palate hyperplasia, and laryngeal saccule eversion, can lead to difficult intubation [45]. Based on the literature [44, 45], it was observed that brachycephalic patients in this study had a higher anesthetic risk for nose and throat operations.

Although the effects of aging on respiratory health in humans are well characterized, information on these effects in small animals is limited. In humans, aging leads to a decrease in lung elasticity, respiratory muscle strength, and chest wall compliance [46]. These age–related changes in the respiratory system increase the risk of anesthesia in patients undergoing elective surgery. Therefore, in this study, age and thoracic radiographic lesions were evaluated separately for cats and dogs. In one study, radiographic patterns and airway reactivity were compared between young (1-2 years) and old (12-13 years) clinically healthy cats. It was reported that bronchointerstitial patterns were commonly observed in the radiographs of older cats. The presence of these patterns in elderly feline patients was interpreted as a normal aging change [46]. In contrast to these findings, although thoracic lesions were observed with increasing age in this study, there was no statistically significant difference in the frequency of lesions among the 0-1 year, 1-7 years, and over 7 years patient groups. This suggests that thoracic lesions can occur in any age group and reinforces the importance of routine thoracic radiography for all patients in the preoperative period.

CONCLUSION

In this study, routine thoracic radiographs of dogs and cats, regardless of breed and age, were evaluated preoperatively. In conclusion, thoracic radiography is an important diagnostic and risk assessment tool, particularly in animals with upper respiratory tract disease. The findings of this study revealed that airway obstruction and pulmonary pathologies were frequently encountered across various age groups, especially in brachycephalic breeds, further supporting the necessity of routine thoracic radiography. Additionally, we believe that the changing dynamics of the respiratory system with age may increase the risk of complications during and after anesthesia. Based on these considerations, we conclude that routine thoracic radiography should be widely implemented in clinical practice for pre–anesthetic risk assessment.

Availability of data and materials

The data that support the findings of this study are available on request from the corresponding author.

Conflict interests statement

The authors declare that they have no conflicting interests.

Financial Support

This study was conducted without any financial support.

Ethical Approval

All methods and procedures used in this study comply with the guidelines of the Türkiye and EU directive (Directive 2010/63/EU) on the protection of animals used for scientific purposes. During the meeting of the Istanbul University–Cerrahpaşa Animal Experiments Local Ethics Committee on March 29, 2024, it was determined that Ethics Committee Approval was not required. This decision was made in accordance with Article 8, Section 8-k2, of the "Regulation on the Working Procedures and Principles of Animal Experiments Ethics Committees," published in the Official Gazette in February 2014 (No. 28914). Specifically, clinical applications for diagnostic and therapeutic purposes are not subject to HADYEK approval (Decision No. 2024/22).

BIBLIOGRAPHIC REFERENCES

[1] Lafli Tunay D. Preoperatif değerlendirme konusunda birinci basamakta çalişan hekimlerin bilgi ve tutumlarinin değerlendirilmesi [Evaluation of the knowledge and attitudes of primary care physicians in preoperative evaluation]. J. Cukurova Anesth. Surg. Sci. [Internet]. 2019; 2(2):150–168. doi: https://doi.org/n99t

[2] Kushnir Y, McKune C. Anesthetic process. In: Shelby AM, McKune CM, editors. Small Animal Anesthesia Techniques. 2nd ed. [Internet]. Chennai (India): John Wiley & Sons, Inc; 2023. p. 3–27. Available in: https://doi.org/n99w

[3] Posner LP. Pre–anaesthetic assessment and preparation. In: Duke–Novakovski T, Vries M, Seymour C**,** editors. BSAVA Manual of canine and feline anaesthesia and analgesia. 3rd ed. [Internet]. Aberystwyth (United Kingdom): British Small Animal Veterinary Association. 2016; p. 6–12. doi: https://doi.org/n99x

[4] Smith LJ. Patient Evaluation. In: Smith LJ., editor. Questions and answers in small animal anesthesia [Internet]. Ames (USA): John Wiley & Sons; 2015. p. 1-9. Available in: https://doi.org/n99z

[5] Gaschen L. Airway Obstruction on thoracic radiographs [Internet]. In: Proceedings of the 35th World Small Animal Veterinary Association Congress–Annual Congress; 2-5 Jun 2010; Geneva (Switzerland): WSAVA. 2010 [cited 20 Aug. 2024]. p.1-2. Available in: https://goo.su/jcZPBIs

[6] Rudorf H, Taeymans O, Johnson V. Basics of thoracic radiography and radiology. In: Schwarz T, Johnson V, editors. BSAVA Manual of canine and feline thoracic imaging [Internet]. India: British Small Animal Veterinary Association; 2008. p. 1–19. doi: https://doi.org/n995

[7] Boztok Özgermen B, Bumin A. Comparison of computed tomography and thoracic radiography findings for the assessment of pulmonary diseases in dogs. Ankara Üniv. Vet. Fak. Derg. [Internet]. 2016; 63:339–346. doi: https://doi.org/pbbc

[8] Berry RC. Interpreting smal animal thoracic radiographs. NAVC Clinician's Brief; 2010 [cited 10 Aug. 2024]. p. 65–70. Available in: https://goo.su/mx2ziL

[9] Fox PR. Thoracic radiography: The Coughing and Dyspneic Cat; the Dog with Cardiopulmonary Disease [Internet]. In: Proceedings of the 28th World Small Animal Veterinary Association Congress–Annual Congress. Bankok (Thailand): WSAVA; 2005 [cited 10 Aug. 2024]. Available in: https://goo.su/hwrVF

[10] Sigrist N, Mosing M, Iff I, Larenza MP, Lang J, Spreng D. Influence of pre–anaesthetic thoracic radiographs on ASA physical status classification and anaesthetic protocols in traumatized dogs and cats. Schweiz. Arch. Tierheilkd [Internet]. 2008; 150:507–514. doi: https://doi.org/dgpvqg

[11] Diana A, Pivetta M, Cipone M. Imaging evaluation of the small animal mediastinum. Vet. Res. Commun. [Internet]. 2006; 30:145–151. doi: https://doi.org/bx6ghr

[12] Jindal S, Gombar S, Jain K. Is routine preoperative chest X–ray: An underutilized tool in asymptomatic patients! Ann. Card. Anaesth. [Internet]. 2018; 21(4):460-461. doi: https://doi.org/pbh5

[13] Lappin MR., Blondeau J., Boothe D., Breitschwerdt EB., Guardabassi L., Lloyd DH., Papich MG, Rankin SC, Skyes JE, Turnidge J, Weese JS. Antimicrobial use guidelines for treatment of respiratory tract disease in dogs and cats: Antimicrobial guidelines working group of the ınternational society for companion animal ınfectious diseases. J. Vet. Intern. Med. [Internet]. 2017; 31(2):279-294. doi: https://doi.org/ghkh53

[14] Mitze S, Barrs VR, Beatty JA, Hobi S, Bęczkowski PM. Brachycephalic obstructive airway syndrome: much more than a surgical problem. Vet. Q. [Internet]. 2022; 42(1):213–223. doi: https://doi.org/pbh6

[15] De Lorenzi D, Bertoncello D, Drigo M. Bronchial abnormalities found in a consecutive series of 40 brachycephalic dogs. J. Am. Vet. Med. Assoc. [Internet]. 2009; 235(7):835–840. doi: https://doi.org/dpfxv4

[16] Doodnaught G, Steagall P. Handling, restraint and preanesthetic assessment. In: Steagall P, Roberson S, Taylor P. editors. Feline anesthesia and pain management. Ames (USA): John Wiley & Sons; 2017. p. 1–16. doi: https://doi.org/pbh8

[17] Farry T, Goodwin W. Anaesthesia for geriatric patients. Today's Vet. Nurse [Internet]. 2019 [cited 22 Oct. 2024]; 2019:38–49. Available in: https://goo.su/r6GW8zk

[18] Mosing M. General principles of perioperative care. In: Duke–Novakovski T, Vries M, Seymour C, editors. BSAVA Manual of canine and feline anaesthesia and analgesia. 3rd ed. [Internet]. Aberystwyth (United Kingdom): British Small Animal Veterinary Association; 2016. p.13–23. doi: https://doi.org/pbh9

[19] Krein S, Wetmore LA. Breed–specific anesthesia. Clinician's brief. NAVC Clin. Br. [Internet]. 2012 [cited 22 Oct. 2024]. p.17–20. Available in: https://goo.su/iBFoX

[20] Bednarski R, Grimm K, Harvey R, Lukasik VM, Penn WS, Sargent B, Spelts K. AAHA anesthesia guidelines for dogs and cats. J. Am. Anim. Hosp. Assoc. [Internet]. 2011; 47(6):377–385. doi: https://doi.org/fq3kxq

[21] Reinero C. Interstitial lung diseases in dogs and cats part I: The idiopathic interstitial pneumonias. Vet. J. [Internet]. 2019; 243:48–54. doi: https://doi.org/pbjn

[22] Berry CR, Huguet EE, Cole RC. Radiographic diagnosis of pleural effusion and pulmonary edema in dogs and cats. Today´s Vet. Pract. [Internet]. 2023 [cited 02 Nov. 2024]; 2023:44–51. Available in: https://goo.su/fgLRhz

[23] Oura TJ, Hamel PE, Jennings SH, Bain PJ, Jennings DE, Berg J. Radiographic differentiation of cranial mediastinal lymphomas from thymic epithelial tumors in dogs and cats. J. Am. Anim. Hosp. Assoc. [Internet]. 2019; 55(4):187–193. doi: https://doi.org/pbjp

[24] McGrath AM, Salyer SA, Seelmann A, Lundberg AP, Leonard MR, Lorbach JN, Lumbrezer–Johnson S, Hostnik ET, Tremolada G, Lapsley J, Selmic LE. Mediastinal fibrosarcoma in a dog–case report. Front. Vet. Sci. [Internet]. 2022; 9:820956. doi: https://doi.org/pbjq

[25] Ruby J, Secrest S, Sharma A. Radiographic differentiation of mediastinal versus pulmonary masses in dogs and cats can be challenging. Vet. Radiol. Ultrasound [Internet]. 2020; 61(4):385–393. doi: https://doi.org/pbjr

[26] Bernardi S, Martini V, Perfetto S, Cozzi M, Comazzi S. Flow cytometric analysis of mediastinal masses in cats: A retrospective study. Front. Vet. Sci. [Internet]. 2020; 7:444. doi: https://doi.org/pbjs

[27] Muhlbauer MC, Kneller SK. editors. Thorax. In: Radiography of the dog and cat: guide to making and ınterpreting radiographs. 2nd ed. Ames (USA): John Wiley & Sons; 2023. p. 137-269.

[28] King K, Mandava B, Kamen JM. Tracheal tube cuffs and tracheal dilatation. Chest [Internet]. 1975; 67(4):458–462. doi: https://doi.org/cr8zm4

[29] Jacobsen E, Jensen J. Tracheal Dilatation: A complication of tracheostomy. Acta Anaesthesiol. Scand. [Internet]. 1968; 12(2):95–102. doi: https://doi.org/cg9nkc

[30] Monnet E. Brachycephalic airway syndrome. In: Proceedings of the 29th World Small Animal Veterinary Association Congress–Annual Congress; Rhodos (Greece): WSAVA; 2004 [cited 20 Apr. 2024]. p. 1-2. Available in: https://goo.su/oSI3rAp

[31] Kim K. Concurrent hiatal hernia and megaesophagus secondary to a nasopharyngeal polyp in a 6-month–old cat. Acta Sci. Vet. [Internet]. 2021; 49(Supl1):710. doi: https://doi.org/pbjt

[32] Phillips H, Corrie J, Engel DM, Duffy DJ, Holt DE, Kendall AR, Schmiedt CW, Vetter A, Meren IL, Follette C, Schaeffer DJ, Mayhew PD, Marks SL. Clinical findings, diagnostic test results, and treatment outcome in cats with hiatal hernia: 31 cases (1995–2018). J. Vet. Intern. Med. [Internet]. 2019; 33(5):1970–1976. doi: https://doi.org/pbj2

[33] De Sandre–Robinson DM, Madden SN, Walker JT. Nasopharyngeal stenosis with concurrent hiatal hernia and megaesophagus in an 8-year–old cat. J. Feline Med. Surg. [Internet]. 2011; 13(6):454–459. doi: https://doi.org/fngrw7

[34] Johnson RA, Brunson DB. Respiratory disease. In: Johnson RA, Snyder LBC, Schroeder CA, editors. Canine and feline anesthesia and co–existing disease. 2nd ed. Hoboken (USA): Wiley–Blackwell; 2021. p. 86-110. https://doi.org/pbj3

[35] Özer K, Karabağli M, Akgül Ö, Devecioğlu Y, Demirutku A. Surgical treatment results of young and adult cats with pectus excavatum. Kafkas Üniv. Vet. Fak. Derg. [Internet]. 2017; 23(5):699–705. doi: https://doi.org/pbj6

[36] Yaygingul R, Kibar B, Suner I, Belge A. Pectus excavatum in a cat: a case report. Vet Med (Praha). [Internet]. 2016; 61(7):409–411. doi: https://doi.org/pbj7

[37] Lee MS, Taylor J, Lefbom B. Congenital thoracic lordosis and scoliosis in a cat. J. Feline Med. Surg. [Internet]. 2014; 16(8):703–707. doi: https://doi.org/f6cjxf

[38] Grobman M, Reinero C, Lee–Fowler T, Lever TE. Incidence and characterization of aerophagia in dogs using videofluoroscopic swallow studies. J. Vet. Intern. Med. [Internet]. 2024; 38(3):1449–1457. doi: https://doi.org/pbj8

[39] Bappah MN, Chom ND, Lawal M, Bada AA, Muhammad ST. evaluation of vertebral heart score and cardiac sphericity in apparently normal dogs. Iran. J. Vet. Surg. [Internet]. 2021; 16(1):1–4. doi: https://doi.org/pbj9

[40] Ko J. Preanesthetic medication: drugs and dosages. In: Ko J, editor. Small animal anesthesia and pain management. Hong Kong (China): Manson Publishing; 2018. p. 51–76.

[41] Portier K, Ida KK. The ASA physical status classification: What ıs the evidence for recommending ıts use in veterinary anesthesia?—A systematic review. Front. Vet. Sci. [Internet]. 2018; 5:204. doi: https://doi.org/gfrwgb

[42] Li G, Walco JP, Mueller DA, Wanderer JP, Freundlich RE. Reliability of the ASA physical status classification system in predicting surgical morbidity: A retrospective analysis. J. Med. Syst. [Internet]. 2021; 45:83. doi: https://doi.org/pbkc

[43] Downing F, Robinson R. Anaesthesia for the brachycephalic patient. In: Downing F, Robinson R, editors. Health and welfare of brachycephalic (Flat–faced) companion animals [Internet]. Boca Raton (USA): CRC Press. 2022. p. 353–375. Available in: https://goo.su/6Vkda

[44] Brodbelt DC, Flaherty D, Pettifer GR. Anesthetic risk and informed consent. In: Grimm KA, Lamont LA, Tranquilli WJ, Greene SA, Robertson SA, editors. Veterinary anesthesia and analgesia. 15th ed. Pondicherry (India): Wiley Blackwell; 2015. p. 11–22. doi: https://doi.org/pbkg

[45] Bektaş Bilgiç E. Difficult airway spectrum in cats and dogs – management with alternative intubation methods. Acta Sci. Vet. [Internet]. 2024; 52:1–11. doi: https://doi.org/pbkj

[46] Bellows J, Center S, Daristotle L, Estrada AH, Flickinger EA, Horwitz DF, Lascelles BD, Lepine A, Perea S, Scherk M, Shoveller AK. Aging in cats: Common physical and functional changes. J. Feline Med. Surg. [Internet] . 2016; 18(7):533–550. doi: https://doi.org/bm2k