

# ARCHIVES

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### Cardiac Autonomic Modulation and the Occurrence of Arrhythmic Events in Brachycephalic Dogs: A Scoping Review

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### Cardiac Autonomic Modulation and the Occurrence of Arrhythmic Events in Brachycephalic Dogs: A Scoping Review

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**Abstract:** Brachycephalic obstructive airway syndrome (BOAS) is a condition characterized by anatomical obstructions of the upper airways that impair airflow and lead to ventilatory dysfunction in dogs with broad and short skulls. This condition may also contribute to the occurrence of arrhythmias associated with increased vagal tone, such as sinus pauses or atrioventricular blocks. In advanced stages, pulmonary hypertension and cardiac remodeling may occur, predisposing affected dogs to more complex arrhythmias, including atrial fibrillation. This study aimed to map the available scientific evidence regarding autonomic cardiac activity and the presence of arrhythmias in brachycephalic dogs. This scoping review was conducted according to the standards of the Joanna Briggs Institute (JBI) and adhered to the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews methodological guidance (PRISMA-ScR). The databases CABI, BVS, Embase, MEDLINE/PubMed, SciELO, Scopus, and Web of Science were used to search for scientific evidence published to date. The search strategy included the terms: "airway obstruction", "brachycephalic dogs", "heart rate variability", "parasympathetic nervous system", and "respiratory sinus arrhythmia". The research identified 769 articles, of which 11 met the criteria and were included in the analysis. Each article was analyzed, and its information was characterized according to four domains of interest: general study information, methodological design of the studies, variables analyzed and diagnostic strategies applied, and main findings and conclusions. This scoping review emphasizes the increasing scientific interest in the relationship between brachycephalic breed morphology and cardiac autonomic modulation in dogs. Although there are a limited number of studies with methodological diversity, the evidence suggests that vagal overstimulation resulting from chronic upper airway obstruction in these breeds significantly influences heart rate and rhythm modulation. Future research should focus on achieving methodological standardization, detailed morphometric evaluations, and utilizing long-term monitoring techniques to improve diagnostic accuracy and clinical relevance.

**Keywords:** autonomic nervous system; brachycephaly; brachycephalic obstructive airway syndrome; bulldog; pug.

#### 1. Introduction

The brachycephalic condition in dogs refers to a series of anatomical conformations characterized by a broad and shortened skull, which include an elongated soft palate, stenotic nares, everted laryngeal sacculs, tracheal hypoplasia, and laryngeal collapse. Over time, these alterations lead to changes in ventilatory dynamics due to increased resistance to airflow through the upper airways (Dupré and Heidenreich, 2016; Liu et al., 2017; Junior et al., 2021). There are reports that these anatomical abnormalities may influence various cardiocirculatory conditions, including the presence of sinus pauses (Noszczyk-Nowak et al., 2017) and sinus arrhythmias (Dias et al., 2016; Canola et al., 2018). Likewise, it has been demonstrated that brachycephalic dogs exhibit higher values of the vasovagal tone index (VVTI), a marker of heart rate variability (HRV), compared to non-brachycephalic breeds. These differences suggest a predominance of parasympathetic tone in these dogs, likely as a result of enhanced vagal stimulation associated with more pronounced respiratory sinus arrhythmia (SRA) (Doxey and Boswood, 2004; Dias et al., 2016; Canola et al., 2018). On the other hand, it has also been reported that such increased parasympathetic activity may be exacerbated, leading to marked bradycardia and even transient atrioventricular block following sympathetic activation events (Santilli et al., 2019).

Several mechanisms may explain the altered autonomic modulation observed in brachycephalic dogs. Fernandes et al. (2024) noted that the prolonged inspiratory phase and increased respiratory effort, characteristic features of brachycephalic syndrome, influence autonomic nervous system activity, promoting greater heart rate variability and higher VVTI values. However, when multiple brachycephalic breeds were compared, the differences were not significant, which may suggest that although a general pattern of vagal hyperstimulation exists, other morphological or physiological factors may modulate this response depending on the breed or individual. Additionally, chronic respiratory compromise caused by upper airway obstructions can lead to significant hemodynamic consequences. Canola et al. (2018) observed that dogs with brachycephalic syndrome exhibit elevated pulmonary pressures, likely secondary to chronic hypoventilation and hypoxemia, which may result in right-sided cardiac remodeling (*cor pulmonale*) and eventually in congestive heart failure. These structural and functional alterations of the cardiovascular system reflect the close interrelationship between brachycephalic morphology, respiratory physiology, and cardiac rhythm regulation.

Despite the above, the literature addressing the relationship between brachycephaly and electrocardiographic changes is limited. A search for information conducted in May 2025 across the databases CABI, BVS, Embase, MEDLINE/PubMed, SciELO, Scopus, and Web of Science revealed no evidence of syntheses, scoping reviews, or systematic reviews. Additionally, no relevant records were found on the Open Science Framework (OSF), the Database of Systematic Reviews for Animals and Food (SYREAF), the

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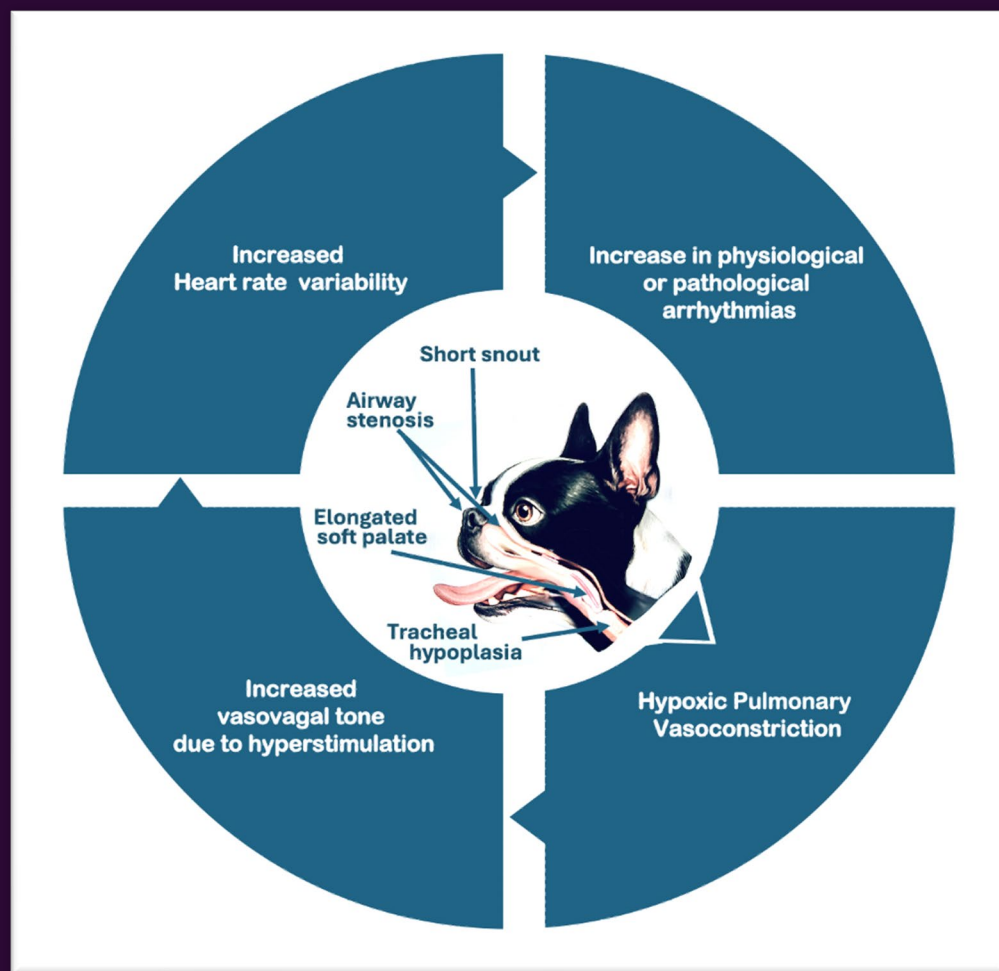
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GRAPHICAL ABSTRACT



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