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Hypertension in Harmony: Investigating the Common Pathways Between Human and Pet Cardiovascular Health

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ABSTRACT

Hypertension is a common cardiovascular disorder, and its pathophysiology differs between humans and pets. This review examines the standard mechanisms by which genetic and environmental risk factors contribute to the development of hypertension in both humans and animals. This study highlights key biological processes, including dysregulation of the renin–angiotensin–aldosterone system (RAAS), endothelial injury, oxidative stress, and vascular remodeling. The role of environmental stressors: poor diet, lack of physical activity, and exposure to pollutants, on cardiovascular health in humans and pet animals. This study underscores the global importance of hypertension in both human and animal health and makes a compelling case for a 'One Health' approach to cardiovascular health. The study's results highlight the necessity of an integrated, two-species health intervention strategy and reveal a comprehensive, two-way mechanism underlying human-pet health. This study also highlights the importance of common biomarkers (e.g., cortisol and C-reactive protein, or CRP) and diagnostic tools (ambulatory blood pressure monitoring) that can be applied across species to improve hypertension care. This study reveals a novel field of species-specific research that may change the way hypertension is diagnosed, prevented, treated, and managed. Furthermore, additional research will be necessary to fill scientific knowledge gaps and develop advanced medical solutions for treating hypertension, particularly with the investigative potential of comparative genomics and environmental medicine. An interdisciplinary approach in human and veterinary medicine is also necessary to develop efficient, integrated health plans that reduce the risk of cardiovascular disease and to create a more sustainable and effective human-animal model.

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Introduction

Environmental factors influence hypertension development, with pet owners' mood and pets' stress responses affecting each other reciprocally, demonstrating a bidirectional health relationship between humans and their animals. Here, however, some of the evidence is stronger for dogs than for cats. A reduction in owners' stress could result in a decreased hemodynamic response (Barker et al., 2010). In humans, dog tactile interactions can buffer stress and sadness and promote emotional well-being through activities (Gee et al., 2021). In addition, health synchronization between humans and pets, as indicated by coherent corticoid levels, is a stress marker (Takagi et al., 2023). Stressed owners can create stressful environments for pets, potentially worsening their hypertension and other health conditions. Pets reinforce coping mechanisms under stress and are beneficial for the mental health of both human owners and animal pets (Grajfoner et al., 2021). The shared stress responses of the two groups are significant. Pets are a source of emotional support, attenuating stress and its consequences for human health (Krouzecky et al., 2022). While strong pet attachment generally reduces perceived stress, some research suggests it may increase psychological vulnerability during major stressors, such as the COVID-19 pandemic (Bennetts et al., 2022). The emotional health and lifestyle of pet owners directly influence both their own and their pets' risk of hypertension, highlighting the need for stress management and healthy habits like a DASH diet and exercise to prevent cardiovascular disease in both species. (Blumenthal et al., 2010). On the other hand, pet owners on high-salt diets might adopt the same dietary behavior as their pets, thereby increasing sodium consumption and the risk of hypertension, since pets are exposed to conditions similar to those of their owners (High Blood Pressure in Our Pets - Veterinary Partner - VIN, 2025). Pet owners who prioritize their own health typically provide better nutrition and exercise for their pets, while those who neglect their own health often inadvertently increase their pets' risk of obesity and hypertension. (Linder et al., 2021; Morgan et al., 2017). A lack of physical activity and an unhealthy diet are associated with a high risk of developing hypertension in humans, which emphasizes the importance of a healthy lifestyle for the prevention of this disease (Whelton et al., 2018; Zhu & Wang, 2024). Pets in smoking households suffer higher rates of cardiovascular and respiratory problems, including hypertension, while chronic inflammation compromises vascular function in both humans and animals through increased vascular stiffness and endothelial dysfunction (Barrows et al., 2019; Maiuolo et al., 2022).

In addition, owing to cohabitation with owners, pets are frequently exposed to maleficants (e.g., secondhand smoke, indoor PM), which may increase the likelihood of developing hypertension (Barrows et al., 2019; Xu et al., 2020). The connection between pets and people affects health. Pets can detect their owners' distress or illness and may be affected by it, leading to behavioral and health problems, such as hypertension (Wells, 2019). The human-animal bond provides reciprocal benefits: pets reduce owner stress and anxiety while enhancing social support networks, while owner emotions directly impact pet welfare and health outcomes (Arhant-Sudhir et al., 2011; Schreiner, 2016). However, by being sedentary, owners can indirectly help their pets pack on pounds with little exercise, since obesity is a known risk factor for hypertension in people and animals. These relationships have yet to be examined in different populations of social animals (Applebaum et al., 2023; Arhant-Sudhir et al., 2011). The connection between pet ownership and health supervision is highlighted by evidence indicating that pet owners tend to possess stronger antistress defense capacities, which, in turn, could contribute to better control of their own and their pets' health status (Surma et al., 2022). Such preventive health monitoring can significantly help fight hypertension and related diseases.

Pathophysiological parameters

Neurohormonal regulation (e.g., the renin-angiotensin-aldosterone system)

The similarities in the mechanisms of hypertension between human and veterinary diseases are concentrated in the renin–angiotensin–aldosterone system (RAAS) (Figure1) (Ames et al., 2019; Te Riet et al., 2015).The activation of the RAAS increases angiotensin II levels, which in turn leads to vasoconstriction and fluid retention, resulting in increased BP (Patel et al., 2017). Studies in SHR have demonstrated that renal artery stenosis stimulates the RAAS, with many parallels with human hypertension. (Goldblatt, 1947; Jing et al., 2019). This activation then leads to a series of events, including increased renin release and consequent elevation in the levels of angiotensin II, which are necessary in the pathogenesis of hypertension (Alawi et al., 2021). In humans and animal models, aldosterone is implicated in the pathogenesis of hypertension through its effects on sodium reabsorption, vascular remodeling, and inflammation. (Fernández-Argüeso et al., 2021; Otsuka et al., 2023). This study revealed that hyperaldosteronism increased the risk of CKD, which is a common complication of hypertension in both humans and companion animals (Fernández-Argüeso et al., 2021; Javadi et al., 2005). Studies in animals have demonstrated that 24 h of aldosterone release, which is equivalent to human release, is conserved in the regulation of hormone release (Castagna et al., 2015; Mochel et al., 2013). Oxidative stress is also involved in hypertension, which leads to endothelial dysfunction and vascular aging (Maruyama et al., 2022). Oxidative stress has been identified as a pivotal factor in both environmental perturbations, such as salt loading and hypertension, and interventions directed against oxidative pathways reduce BP in animals. (Shirakura et al., 2016). These findings improve not only the broad base of knowledge regarding hypertension but also the basis for future therapeutic interventions that may be useful in both human and veterinary medicine.

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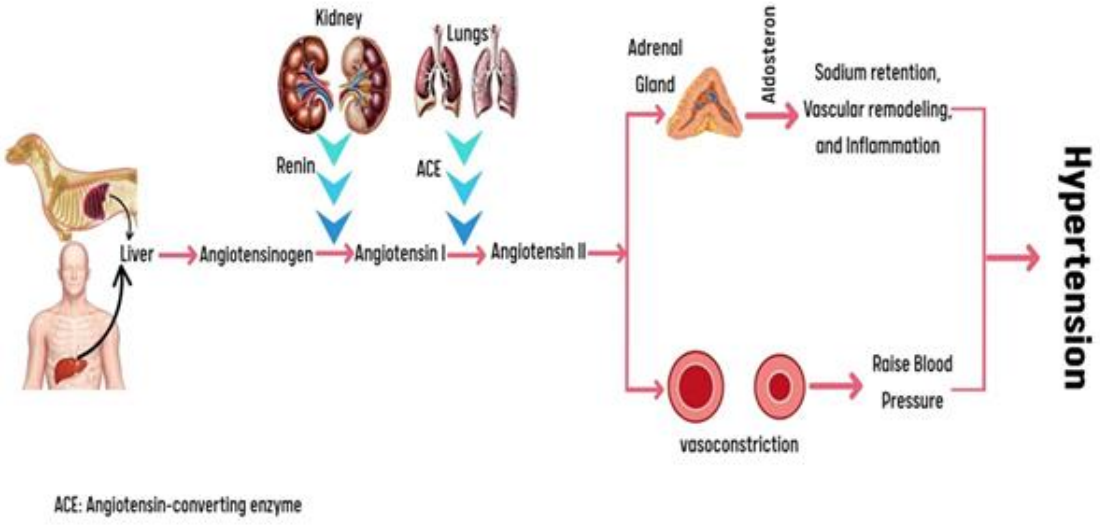

Figure 1. Effects of the RAAS on Human and Pet Hypertension

Endothelial dysfunction and vascular remodeling

Hypertension progresses through similar pathophysiologic mechanisms in humans and animals, including endothelial dysfunction and vascular. Reduced nitric oxide bioavailability from endothelial dysfunction increases vascular resistance and inflammation, accelerating cardiovascular disease. (Gallo et al., 2022). ED is derived from, but also contributes to, HT by inducing vascular remodeling through enhanced smooth muscle cell (SMC) growth and migration. (Brown et al., 2018; Gallo et al., 2022). In an animal model, lower eNOS activity leading to endothelial dysfunction has also been demonstrated, suggesting that the mechanisms involved are similar between species (Nuyt, 2008). Vascular remodeling, characterized by extracellular matrix (ECM) remodeling, SMC proliferation, and increased collagen and elastin deposition, is a hallmark of hypertension in humans and companion animals (Leong et al., 2015). Dysregulation of reactive oxygen species (ROS) production and antioxidant defenses leads to increased endothelial dysfunction and vascular remodeling in both species, indicating a shared pathophysiological mechanism (Brown et al., 2018; Gallo et al., 2022; Huang et al., 2021). Insight into these common mechanisms can help develop strategies to prevent or treat hypertension and improve cardiovascular health among different species.

Genetic Insights: This study highlights genetic predispositions and polymorphisms in humans and pets

Genetic discoveries

Genomic similarities between humans and animals reveal shared cardiovascular predispositions, with RAAS-related gene polymorphisms particularly the ACE I/D variant influencing blood pressure regulation, where the I allele reduces hypertension risk. (Hamilton et al., 2013). MicroRNA polymorphisms, particularly in miR-499 and premiR-499, disrupt miRNA maturation, altering apoptosis and inflammation pathways that increase the risk of myocardial infarction and heart failure (Ding et al., 2018). Certain dog breeds have genetic predispositions to cardiovascular diseases like dilated cardiomyopathy, which can lead to secondary hypertension (Mubanga et al., 2017). The markers identified in this research are similar to those identified in humans (in dogs, the same genetic markers and polymorphisms detected in humans were detected), which indicates a similar genetic basis of cardiovascular health between species (Mubanga et al., 2017). Canine genetic diversity aids cardiovascular disease research benefiting both species, while epigenetic modifications from early environmental exposures shape cardiovascular phenotypes and hypertension development across humans and animals (Meister et al., 2016). Shared genetic polymorphisms and environmental factors drive hypertension in both humans and pets, with epigenetic signatures offering promising targets for integrated One Health cardiovascular research.

Environmental and Lifestyle Influences

Urban environmental stressors particularly noise pollution, sedentary lifestyles, and chronic urbanization pressures significantly increase hypertension and cardiovascular disease risk in both humans and companion animals, demonstrating shared physiological vulnerability across species. (Floud et al., 2013). Similarly, traffic noise is associated with hypertension; thus, noise and air pollution should both be taken into account when cardiovascular risks are evaluated (Babisch et al., 2014). Urban environments and sedentary lifestyles increase hypertension risk in both humans and pets, with insufficient exercise directly linked to elevated blood pressure and increased body mass across species (Takeuchi et al., 2023). Household pets, especially dogs, can be similarly obese from a lack of exercise and develop similarly dangerous heart problems (Chandler, 2016). Environmental and lifestyle factors create complex interactions that produce similar hypertension patterns in

humans and pets, with noise exposure increasing stress hormones that directly elevate blood pressure in both species (Schmidt et al., 2013). Noise and air pollution trigger similar physiological stress responses in both humans and animals, chronically elevating blood pressure and compromising cardiovascular health across species (Stansfeld, 2015).

Obesity and diet: the role of poor nutrition and obesity in hypertension, comparing human and pet dietary patterns

Obesity and poor diet significantly drive hypertension development in both humans and dogs, while the DASH diet rich in fruits, vegetables, whole grains, and low-fat dairy effectively reduces blood pressure across species (Wang et al., 2015). On the other hand, a Western type of diet, which is rich in saturated fats, sugars and processed food, is related to a greater risk of developing hypertension (DiNicolantonio et al., 2016). Healthier dietary habits are associated with a lower incidence of hypertension in different populations, including the Chinese population (Wang et al., 2020). Diet quality outweighs quantity for blood pressure control, with obesity-linked hypertension occurring through multiple pathways including altered renal sodium regulation, vascular responses, and hormonal imbalances (D'Elia & Strazzullo, 2018).

Objective evidence has demonstrated that obesity enhances susceptibility to developing hypertension, which suggests the importance of weight reduction for prevention (Hall et al., 2021). Sedentary domesticated pets increasingly face obesity-related hypertension, mirroring the cardiovascular disease patterns observed in their human counterparts (Chandler et al., 2017). Heavily processed commercial pet foods high in fats and fillers contribute to pet obesity, hypertension, and heart problems, reflecting how owner dietary choices directly impact animal cardiovascular health (Chandler et al., 2017). Healthy eating is crucial for both humans and pets; high salt and processed foods raise hypertension risk, while antioxidant-rich diets help lower blood pressure in both species (Jideani et al., 2021), suggesting that the same type of dietary intervention might also be beneficial for pets.

Physical Activity: Address the role of exercise in managing blood pressure, and how human-pet interactions (e.g., walking dogs) benefit both.

Regular exercise reduces blood pressure through improved vascular function in both humans and pets, with the human-animal bond creating mutual motivation for physical activity that enhances cardiovascular health across species (Pal et al., 2013). In addition to lowering mortality rates from all causes, healthy lifestyles, i.e., exercise, include medical management of chronic illnesses such as hypertension (Ford et al., 2012). The American Heart Association recommends 150 minutes of moderate exercise weekly for heart health, as regular activity helps control weight—a key factor in preventing hypertension. Exercise performs similar functions in hypertension control in animals (Poole et al., 2020). Dog ownership creates a mutually beneficial exercise relationship, with daily walks increasing physical activity for both species and improving cardiovascular outcomes compared to non-dog owners (Ford et al., 2012). Exercising with pets provides psychological motivation that increases exercise adherence, creating sustainable cardiovascular benefits through the emotional bond between humans and animals (Potter & Sartore-Baldwin, 2019). The relevance of this is stipulated in the fact that at-risk populations are hurt by hypertension, and the combination of mental health with physical activity accounts for it.

Therapeutic Interactions: the stress-buffering effects of therapy animals and their potential to reduce blood pressure in humans.

Environmental and lifestyle factors strongly impact cardiovascular health. Interactions with animals, especially for children, can buffer stress and positively influence blood pressure and heart health (Janssens et al., 2021). For example, a sampling study revealed that human–animal interactions (HAIs) can protect against stress, resulting in preserved positive affect (PA) in the face of stress (Janssens et al., 2021). Animal interactions buffer stress-induced hypertension through oxytocin release during human-animal bonding, providing a natural physiological mechanism for cardiovascular protection (Smith & Wang, 2014). These oxytocin excursions during social interaction might help reduce the increase in blood pressure induced by stress (Smith & Wang, 2014). Furthermore, animal therapy can improve therapeutic alliance in a clinical environment accompanied by stress reduction (Goldblatt, 1947). Through the use of a therapy involving a dog with treatment for substance dependence, the therapeutic alliance was strengthened (Williams et al., 2020). Pets could serve as a social buffer, especially for children with ASD, by altering the level of physiological arousal to social stimuli (O'Haire et al., 2015). Dog-assisted interventions reduce stress and anxiety while improving physical health parameters, directly supporting blood pressure management in clinical settings (Lundqvist et al., 2017). Animal-assisted therapy (AAT) produces measurable cardiovascular benefits, with significant decreases in both systolic and diastolic blood pressure observed in cardiac patients interacting with therapy dogs (Barker et al., 2010). This evidence further supports the concept that companion animals may be part of the medical therapy of patients with stress-related health problems, including hypertension.

Comparative diagnostics and biomarkers

Shared biomarkers: Highlight biomarkers (e.g., cortisol and C-reactive protein) when diagnosing hypertension in people and in pets (Shaker & Almahdawi, 2021; Venco et al., 2014). One specific interest is common biomarkers, including cortisol and C-reactive protein (CRP), which are used to diagnose hypertension and reflect stress and inflammation in both species (Venco et al., 2014). Hormonal, copeptin, cortisol and acute phase protein C in males and females with hypertension and in hypertensive patients (Annals of the Romanian Society for Cell Biology)

This review summarizes evidence from different reports to identify these common biomarkers and the consequences of hypertension in human and animal models. Cortisol, which is a glucocorticoid hormone produced by the adrenal glands, is an important factor in the response of the human body to stress (Sitorus & Silitonga, 2025). High levels of cortisol can actually cause hypertension in humans because long-term stress can increase blood pressure (Zhu, 2023). Furthermore, dogs also produce more cortisol when exposed to stressors, which may have similar repercussions on health, such as hypertension (Mârza et al., 2024). This finding indicates that recording cortisol levels in humans as well as in pets might offer an understanding of their comorbidity. C-reactive protein (CRP) is also a marker of inflammation and a biomarker correlated with cardiovascular diseases such as hypertension (Hage, 2014). A high level of CRP is an indicator of systemic inflammation, and systemic inflammation is a risk factor for human hypertension (Zhu, 2023). In addition, in recent years, interest in the role of the microbiome in health has increased, including evidence that the gut microbiota can modulate inflammation and stress reactivity, which has been reported in both humans and companion animals (Dinan & Cryan, 2012; Patel et al., 2024). Microbial communities in common household pets have been shown to resemble the microbes in their human counterparts, with potential implications for health and disease, including cardiovascular health (Jha et al., 2020). Gut flora influences immune responses and inflammation, affecting biomarkers like CRP and cortisol, and highlighting how environment and lifestyle shape health in both humans and pets.

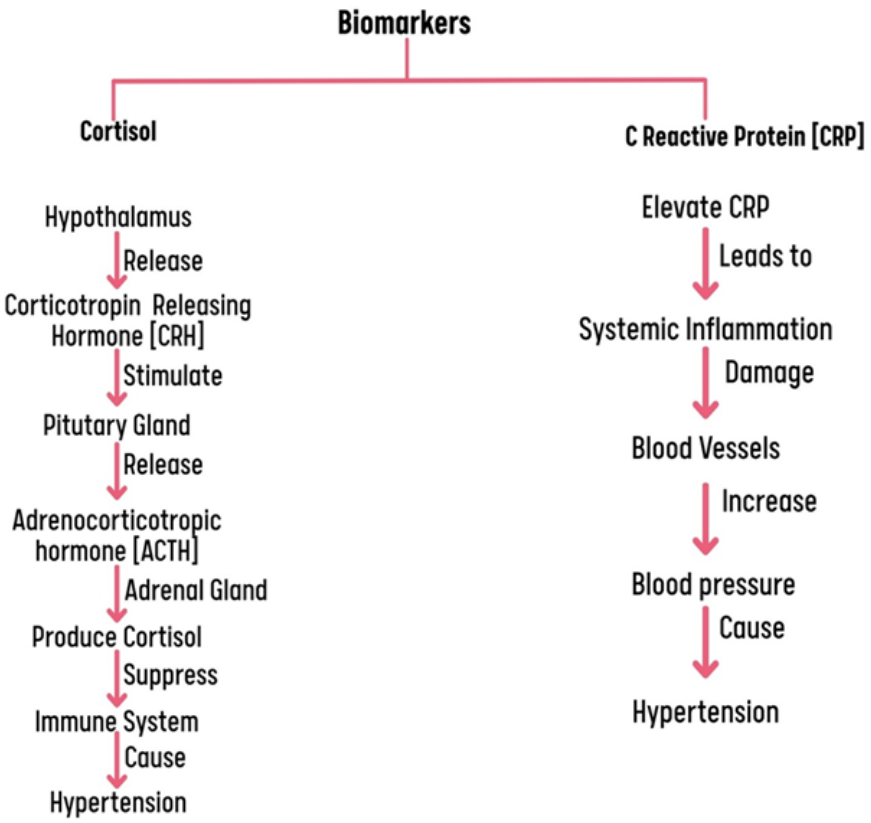

Figure 2. Effects of biomarkers on human and pet hypertension

Advances in diagnostics: Compare diagnostic tools such as ambulatory blood pressure monitoring and noninvasive methods for pets

Advanced hypertension diagnostics, particularly ambulatory blood pressure monitoring (ABPM), serve as gold standards for both human and veterinary medicine, enabling comparative insights into species-specific cardiovascular physiology and treatment responses (Hermida et al., 2015). It gives a 24-hour day-in, day-out, measurement of blood pressure reflecting variations that would be missed either at single clinic visits. Studies have demonstrated that ABPM is superior to routine office blood pressure (BP) measurements in detecting WCH and MH disorders (Nasothimiou et al., 2012; Viera et al., 2021). Another advantage of ABPM regarding HBPM is the ability to perform a broader analysis of the blood pressure pattern, which is essential for the success of hypertension treatment (Nasothimiou et al., 2012). The implementation of ABPM in veterinary medicine is relatively new. However, conventional procedures such as oscillometric and Doppler methods are often utilized (Valentin et al., 2025). Both ABPM and home monitoring techniques effectively diagnose hypertension across species, allowing assessment of blood pressure variations outside clinical settings and revealing how lifestyle factors affect cardiovascular parameters in humans and companion animals (Groenland et al., 2022). There was moderate agreement between smartphone-supported Home Blood Pressure Monitoring (HBPM) and ABPM in diagnosing sustained and masked hypertension (Groenland et al., 2022). HBPM is a good alternative for patients or animals anxious in clinical settings. In veterinary practice, oscillometry is commonly used for noninvasive blood pressure measurement, though its accuracy can be affected by pet size and cooperation (Wang et al., 2013). Hence, although noninvasive studies have had advantages, in some cases, the complete data that ABPM offers cannot be established.

Therapeutic strategies and challenges

Pharmacological Intervention:

Hypertension treatment spans both human and veterinary medicine, utilizing identical drug classes—diuretics (reducing blood volume through renal excretion), ACE inhibitors and ARBs (inhibiting RAAS to induce vasodilation), calcium channel blockers, and beta blockers—with therapeutic mechanisms conserved across species despite dosing differences (Escobar & Barrios, 2010; Iftikhar et al., 2013). Indeed, the efficacy of these drugs has been clearly established in both human and veterinary medicine and supports the concept of a common pathophysiological basis of hypertension across species (Escobar & Barrios, 2010). Adherence to hypertension treatment is essential for determining treatment outcomes. Medication adherence may differ markedly across antihypertensive classes, with ACE inhibitors and ARBs often showing higher adherence than other classes (Dillon et al., 2019; Zuckerman et al., 2012). This inconsistency could be due to the safety profiles of these drugs, as hypotension, dizziness or renal failure can be associated with reduced adherence (Gebreyohannes et al., 2019). Polypharmacy and the complexity of drug regimens in humans and pets can also challenge adherence, as patients may find it difficult to manage multiple medications (Gebreyohannes et al., 2019; Zuckerman et al., 2012). Furthermore, antihypertensive drugs affect more than blood pressure and can also affect other aspects of health. Some antihypertensive medications have been shown to enhance cognitive function and reduce the progression of neurodegenerative diseases, such as Alzheimer's disease, by targeting vascular-related risk factors (Affleck et al., 2020). Effective hypertension management requires cross-species thinking, with combination therapy commonly needed in both humans and animals as single medications rarely achieve target blood pressure goals despite pharmacological similarities across species (Escobar & Barrios, 2010). This need underscores the need to plan treatment individually, taking into account, first, the pharmacological profiles of medications and, second, individuals, whether human or veterinary (Escobar & Barrios, 2010). In addition, continued patient and pet owner education, support for adherence, and attention to side-effect management are essential to achieving better health outcomes (AlGhurair et al., 2012).

Comparative studies

Despite growing evidence for cardiovascular benefits of pet ownership, current literature lacks rigorous cross-species studies examining shared hypertension mechanisms between humans and companion animals, representing a critical knowledge gap in comparative medicine (Surma et al., 2022). Epidemiological studies examining stress and lifestyle factors across species could identify shared hypertension mechanisms, enabling targeted interventions benefiting both humans and animals, but require unprecedented collaboration between veterinary and human medicine researchers to develop comprehensive understanding (Sikkema & Koopmans, 2016; Wilkes et al., 2019).

Technological innovations

Novel technological advances promised to radically transform hypertension follow-up. Advances in companion animal blood pressure measurement and pathophysiological understanding have been impressive over the last 15 years (Carr et al., 2008). Technological advancements in veterinary medicine enable earlier hypertension detection and better management in animals, mirroring how wearable devices have revolutionized human hypertension care through continuous monitoring and personalized treatment approaches (Hadar, 2024). Joint research leveraging these advances could lead to the establishment of comprehensive monitoring systems, which could be useful for both human and animal health.

Conclusion

This review reveals striking parallels in hypertension pathophysiology between humans and companion animals, including dysregulation of the RAAS, endothelial dysfunction, oxidative stress, and vascular remodeling. Environmental factors and lifestyle choices, including diet quality, exercise patterns, and pollution exposure, similarly affect cardiovascular outcomes across species. The human-animal bond creates a bidirectional health relationship where each partner's welfare directly influences the other's cardiovascular health. Common biomarkers and diagnostic approaches offer opportunities for comparative research and for innovations in treatment. These findings strongly support a "One Health" approach integrating human and veterinary medicine to address hypertension through collaborative research in comparative genomics, environmental medicine, and precision therapeutics, ultimately fostering healthier human-animal relationships that benefit both species and their shared environments.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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