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TOTAL INTRAVENOUS ANESTHESIA (TIVA) VS. INHALATIONAL ANESTHESIA IN SMALL ANIMALS

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Luana Saibel da Silva[1], Aldo Gomes de Queiroz Junior[2], Vyrginia Stheffany Fernandes dos Santos[3], Mateus Marques Feitosa Silva[4], João Gomes Marinho[5], Ana Beatriz de Oliveira Silva Salles[6], Daniella Cristina Menezes Mota[7], Luiz Carlos Fabio Junior[8], Vinicius Augusto do Carmo Silva[9], Rebeca Paes Barreto Valdez[10], Marcia Cristina Pires Ferrão[11], Maria Aline Leitão Scatambuli[12], Guinnevere Cerda Palacios[13] and Karine dos Santos Souza[14]

[1]Undergraduate student in Veterinary Medicine
Centro de Ensino Superior Riograndense- CESURG/Sarandi-RS
E-mail: luanasaibelsilva@gmail.com
[2]Undergraduate student in Veterinary Medicine
Maurício de Nassau University Center – Teresina
Email: aldo_qjunior@icloud.com
[3]Graduated in Veterinary Medicine; Postgraduate student in Small Animal Medical and Surgical Clinic
United College of Campinas
E-mail: vyrginiafernandesmedvet@gmail.com
[4]Undergraduate student in Veterinary Medicine
Maurício de Nassau University Center – Teresina
Email: mateusmarquesilva@gmail.com
[5]Undergraduate student in Veterinary Medicine
Maurício de Nassau University Center – Teresina
Email: joao.gomez.vet@gmail.com
[6]Undergraduate student in Veterinary Medicine
Instituto Master de Ensino Presidente Antônio Carlos
E-mail: ana.beatriz@aluno.imepac.edu.br
[7]Graduated in Veterinary Medicine
University Center of Patos de Minas
E-mail: daniella.menezesm@gmail.com
[8]Graduated in Veterinary Medicine
University Center of the United Metropolitan Colleges
E-mail: luiz.junior@timefamesp.com.br
[9]Graduated in Veterinary Medicine
University Center of Belo Horizonte (UniBH)
Email: mvviniciusaugusto@gmail.com
[10]Graduated in Veterinary Medicine
Federal Rural University of Pernambuco
E-mail: rebecapaesbarretovaldez@gmail.com
[11]Graduated in Veterinary Medicine; Postgraduate student in Small Animal Medical Clinic
Mauritius University Center of Nassau
E-mail: marciacristinamed01@gmail.com
[12]Undergraduate student in Veterinary Medicine
Federal University of Mato Grosso - Sinop Campus
E-mail: maria-aline-scatambuli@hotmail.com
[13]Undergraduate student in Veterinary Medicine
Federal University of Santa Catarina
E-mail: guinneverecp@outlook.com
[14]Graduated in Veterinary Medicine
Federal Rural University of Pernambuco

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ABSTRACT
Objective: To compare the effects, advantages and disadvantages of total intravenous anesthesia (TIVA) and inhalational anesthesia in small animals, evaluating anesthetic recovery, cardiovascular stability, patient safety, environmental impact and economic viability. General anesthesia is critical in veterinary, with TIVA standing out as a growing option due to precise dose control and lower environmental pollution. On the other hand, inhalational anesthesia is still widely used due to the ease of adjusting the intensity of the anesthetic. This study conducted a literature review of papers published in the last ten years, examining clinical and experimental research that compared these techniques. The findings show that TIVA promotes a more agile and stable anesthetic recovery, particularly in elderly patients or those with liver problems, in addition to reducing environmental hazards. On the other hand, inhalational anesthesia is more recommended for long-term procedures due to the ease of adjustment of anesthesia, even though it is linked to a higher risk of hypotension and respiratory depression. Combined protocols have been adopted to optimize benefits and minimize risks. It is therefore concluded that the choice of technique should consider the patient's clinical status, the type of procedure and the available infrastructure.

Keywords: Environmental impact. Anesthetic recovery. Anesthetic safety. Hemodynamic stability. Clinical viability.

E-mail: karinesouza.kss@gmail.com

INTRODUCTION

General anesthesia is an essential element in the practice of veterinary medicine, making it possible to perform surgical and diagnostic procedures with comfort and protection for patients. Among the main techniques used in small animals, total intravenous anesthesia (TIVA) and inhalational anesthesia stand out, both widely discussed in the veterinary literature (Oliveira *et al*., 2020; Silva & Costa, 2021)

TIVA, which consists of the exclusive application of anesthetics intravenously, has been gaining popularity for its ability to reduce environmental contamination and provide more precise control of the dose applied (Santos *et al*., 2019). However, inhalational anesthesia is still the most used technique in veterinary clinics, thanks to the simplicity in titration of anesthetics and the wide range of equipment for its application (Ferreira *et al*., 2022).

Comparative studies indicate that the decision between these techniques is influenced by several elements, such as the patient's clinical status, the type of surgical intervention, and the existing infrastructure. Although TIVA can offer a faster recovery and a reduced risk of metabolic side effects, inhalational anesthesia allows for rapid changes in anesthetic intensity, being the most suitable option for long-term procedures (Rodrigues *et al*., 2023).

In view of these considerations, this study aims to compare the effects, advantages, and disadvantages of total intravenous anesthesia (TIVA) and inhalational anesthesia in small animals, evaluating anesthetic recovery, cardiovascular stability, patient safety, environmental impact, and economic viability.

METHODOLOGY

This study involved a literature review based on scientific articles published in indexed journals, books, and guidelines on veterinary anesthesia. The search for references in databases such as PubMed, Scielo and Google Scholar was performed in databases such as PubMed, Scielo and Google Scholar.

The inclusion criteria considered publications from the last ten years that dealt with clinical, physiological, and comparative aspects between anesthetic techniques. Experimental studies, clinical trials, and systematic reviews were analyzed to obtain data on anesthetic recovery, cardiovascular stability, patient safety, environmental

impact, and economic feasibility. The collected data were organized and compared for a critical discussion of the findings.

Exclusion criteria included studies without a defined methodology, isolated case reports without relevant statistical support, duplicate articles, and those that dealt only with anesthesia in species that did not fall into the category of small animals, such as large animals or exotic animals. In addition, publications that did not undergo peer review and those whose full access was not accessible were excluded.

RESULTS AND DISCUSSIONS

The comparative analysis between TIVA and inhalational anesthesia in small animals shows notable differences in terms of anesthetic recovery, heart stability, patient safety, and impact on the environment. Research indicates that TIVA favors a more predictable and agile recovery, as it prevents the residual impact of volatile anesthetics on the animal's body (Santos *et al.*, 2019; Almeida *et al.*, 2021). This is due to the metabolization and direct elimination of intravenously administered medications, decreasing the time required for the recovery of consciousness and the restoration of vital functions. This factor is especially advantageous for elderly animals or those with liver diseases, as the metabolization of volatile anesthetics can be impaired in these cases (Martins *et al.*, 2022).

Inhalational anesthesia, on the other hand, is often used for its convenience and ability to quickly modify the intensity of the anesthetic, making it a practical option for long-term procedures (Ferreira *et al.*, 2022). However, its recovery can be longer and more complex, particularly in patients with impaired metabolism, since the excretion of inhalational anesthetics is mostly done by the lungs. This may result in an increased prevalence of respiratory depression and hypothermia in the postoperative period (Rodrigues *et al.*, 2023).

On the other hand, inhalational anesthesia is often employed for its practicality and ability to quickly adjust the depth of the anesthetic, making it a practical option for long-term procedures (Ferreira *et al.*, 2022; Lima & Castro, 2023). However, its recovery can be longer and more complex, particularly in patients with impaired metabolism, since the excretion of inhalational anesthetics is mostly done by the lungs. This can result in an increased prevalence of respiratory depression, hypothermia, and

oxygenation problems in the postoperative period (Rodrigues *et al*., 2023; Nascimento *et al*., 2022).

Another important aspect is the maintenance of cardiovascular stability during anesthesia. TIVA is less likely to cause hypotension and arrhythmias, as it does not cause marked vasodilation as with inhalational anesthetics (Oliveira *et al*., 2020; Barros *et al*., 2021). Maintaining blood pressure at more stable levels may be beneficial for critically ill patients or those with preexisting cardiovascular conditions. On the other hand, inhaled anesthetics such as isoflurane and sevoflurane can cause considerable hypotension, requiring constant interventions to ensure adequate tissue perfusion (Silva & Costa, 2021; Ferreira *et al*., 2023).

In addition to direct clinical effects, the choice between TIVA and inhalational anesthesia must take into account factors such as environmental impact and occupational safety. Inhalational anesthetics are widely recognized for their contribution to environmental pollution, since they are considered greenhouse gases (Santos *et al*., 2019; Moura *et al*., 2022). In addition, occupational exposure to these agents may imply health hazards for veterinarians, emphasizing the importance of appropriate ventilation and protective equipment in surgical centers. The use of TIVA, as it does not release anesthetic agents into the environment, may represent a more ecological and safer option for professionals (Lopes *et al*., 2022).

However, TIVA also brings challenges, particularly related to the cost and requirement of specific equipment, such as controlled infusion pumps and advanced monitors of physiological parameters, among others. In addition, the continuous application of intravenous agents requires appropriate training of the anesthetic team to prevent overdose or underdosage, ensuring a safe and efficient anesthetic plan (Rodrigues *et al*., 2023; Costa & Mendes, 2023).

Taking into account the pros and cons of each method, many veterinarians have chosen combination protocols, combining TIVA with low doses of inhalational anesthetics to maximize the advantages of both strategies. This approach decreases the demand for high doses of intravenous medications, attenuates cardiovascular side effects, and allows for more accurate control of anesthesia (Ferreira *et al*., 2022; Nascimento *et al*., 2023).

FINAL CONSIDERATIONS

The decision between TIVA and inhalational anesthesia in small animals is influenced by several elements, such as the patient's condition, the goals of the procedure, and the availability of resources. The progress of anesthetic methodologies and the improvement of monitoring technology will contribute to an increase in anesthetic safety in veterinary medicine. Combined protocols have shown encouraging results, providing a balanced option to improve the quality of anesthesia and reduce risks.

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