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Anesthetic Management for Correction of Patent Fourth Aortic Arch (PAAD) in a Dog: Case Report

Anesthetic Management for the Correction of Persistent Right Aortic Arch (PRAA) in a Dog: A Case Report

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Summary

Persistent right aortic arch (PAAD) is one of the most frequent congenital anomalies of the vascular system in dogs, responsible for the formation of a vascular ring that compresses the esophagus and can lead to the development of megaesophagus and recurrent regurgitation, especially in the post-weaning period. Given the clinical relevance of this condition and the possible associated complications, this study aimed to report the anesthetic and surgical management of a case of PAAD in a pediatric patient, highlighting the necessary care to minimize perioperative risks. The methodology consisted of a case report from the Veterinary Hospital of the Federal Rural University of Pernambuco (UFRPE), involving a four-month-old mixed-breed female dog referred for surgical correction of the anomaly. Preoperative laboratory tests and clinical evaluation were performed, followed by the application of a balanced anesthetic protocol with methadone and midazolam in the pre-anesthetic medication, induction with propofol, and maintenance with inhalational anesthesia associated with continuous infusion of remifentanil and lidocaine. Ultrasound-guided intercostal and serratus plane blocks were performed with bupivacaine and ropivacaine, respectively, and monitoring was maintained throughout the procedure. The intervention lasted approximately two hours and occurred without significant anesthetic complications, maintaining cardiovascular and ventilatory stability. In the immediate postoperative period, the patient showed satisfactory recovery, without episodes of regurgitation. It is concluded that the application of multimodal anesthesia associated with intensive monitoring and adequate airway protection significantly contributes to the safety and success of perioperative management in patients with acute arterial occlusion (AAOP).

Keywords: Locoregional Blocks; Thoracotomy; Pediatric; Ultrasound-Guided

Abstract

Persistent Right Aortic Arch (PRAA) is one of the most frequent congenital vascular system anomalies in dogs, responsible for the formation of a vascular ring that compresses the esophagus and can lead to the development of megaesophagus and recurrent regurgitation, especially during the post-weaning period. Given the clinical relevance of this condition and its potential complications, this study aims to report the anesthetic and surgical management of a PRAA case in a pediatric patient, highlighting the necessary care to minimize perioperative risks. The methodology consists of a case report from the Veterinary Hospital of the Federal Rural University of Pernambuco (UFRPE), involving a four-month-old mixed-breed female dog referred for surgical correction of the anomaly.

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Preoperative laboratory tests and clinical evaluation were performed, followed by a balanced anesthetic protocol using methadone and midazolam as pre-anesthetic medication, induction with propofol, and maintenance with inhalation anesthesia associated with a constant rate infusion (CRI) of remifentanil and lidocaine. Ultrasound-guided intercostal and serratus plane blocks were performed with bupivacaine and ropivacaine, respectively, along with continuous monitoring throughout the procedure. The intervention lasted approximately two hours and proceeded without relevant anesthetic complications, maintaining cardiovascular and ventilatory stability. In the immediate postoperative period, the patient showed satisfactory recovery with no episodes of regurgitation. It is concluded that the application of multimodal anesthesia, combined with intensive monitoring and adequate airway protection, significantly contributes to the safety and success of perioperative management in patients with PRAA.

Keywords: Locoregional blocks; Thoracotomy; Pediatrics; Ultrasound-guided.

1. Introduction

During the embryonic development of the vascular system, several factors may arise.
Malformations originating from the aortic arches, including persistence of the fourth right aortic arch.
(PAAD), which is one of the most common, representing up to 95% of cases in dogs (Fossum, 2014). A
The presence of vascular rings may be associated with genetic factors and environmental influences.
becoming a hereditary condition in dogs and, more rarely, in cats (Santos, 2024).

The aortic arch is a structure that connects the descending aorta to the ascending aorta and, in most cases...
In some animals, it disappears during embryonic development, leaving only the aorta.
descending and ascending aorta. In dogs, the main changes occur between the 3rd and 4th weeks of life.
alterations in the development of the aortic arches, totaling six pairs of aortic arches, and, upon
As development progresses, its degeneration occurs (Kyles, 2012). However, during the
During embryonic development, failures can occur, and the fetal aortic arch may persist.
characterizing the persistence of the fourth aortic arch. Due to this malformation, the esophagus becomes...
trapped within a vascular ring composed of the pulmonary artery, the right aortic arch, and the
base of the heart ventrally and by the ligament of arteries dorsally to the left (Sebastiani, 2013;
Konig, 2016; Silva, 2023).

The compression caused by this vascular ring causes dilation of the esophagus cranially, to
As food accumulates, it is retained and subsequently regurgitated.
Esophageal obstruction leads to a condition called megaesophagus, in which the organ becomes dilated and
presents a decrease in its motility, which generates a primary or secondary dysfunction (Konig,
2016; Santos, 2024). The main clinical manifestations of PAAD are due to constriction
Esophageal. In the first weeks of life, beginning between the 3rd and 4th weeks of age and ending
Between the 7th and 8th weeks of age, the main clinical sign is postprandial regurgitation of food.
undigested. Furthermore, another associated clinical sign is poor development of the animal, if
Compared to other animals from the same litter, accompanied by a high appetite. During the period of
During weaning, PAAD (Peripheral Adrenal Gain) becomes a clinical suspicion with the regurgitation of liquid and solid foods.

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accompanied by poor growth and signs related to pneumonia, such as difficulty breathing,
Coughing and lethargy are symptoms, and in some cases of aspiration of food contents, coughing is present.
(Santos, 2023).

The diagnosis of PAAD (Peripheral Adrenal Acute Diarrhea) usually occurs between 2 and 6 months of age and is based on...
Association between clinical findings and complementary examinations. The anomaly can be identified
through physical examination and imaging tests, such as plain radiography, contrast radiography, angiography,
esophagoscopy, fluoroscopy, magnetic resonance imaging and computed tomography (Santos, 2023).
During the evaluation, the animals may present with dehydration and a body condition score below the recommended level.
for their age. On pulmonary auscultation, they may present with lung sounds, dyspnea, and tachypnea, the
which may suggest a case of pneumonia. In some animals, it is possible to palpate the esophagus.
increased in the ventral cervical region (Radlinsky; Fossum, 2014).

Treatment for PAAD can be clinical, but it is palliative in nature and not recommended.
as a definitive treatment approach. The course of action consists of offering a pureed food in
small portions in an upright position, keeping the animal's head erect to facilitate the
To prevent food from passing into the esophagus and avoid aspiration, surgical treatment is the most common solution.
Recommended due to its definitive nature, it can be performed via thoracoscopy or thoracotomy, where
Ligation and transection of the ligamentum arteriosum are performed. Survival cases resulting from...
Surgical interventions occur in up to 80% of cases, and the faster the diagnosis and treatment are performed, the more successful the intervention will be.
Surgical treatment of the malformation results in higher success rates. Despite the favorable prognosis
After surgical correction, some animals may experience residual regurgitation, even if in
lower frequency (Radlinsky; Fossum, 2014).

The anesthetic approach in patients with persistent right fourth aortic arch.
(PAAD) must be understood within the pathophysiological context of secondary megaesophagus, of
high risk of bronchoaspiration and the particularities of thoracic surgery in pediatric patients.
Unlike the embryological and clinical discussion, the anesthetic approach focuses on
risk stratification, airway protection, hemodynamic stability, and analgesia
Intensive multimodal therapy, key elements for perioperative prognosis (Ellison, 2010;
Grimm *et* al., 2015), decisive factors for the choice of protocol and anesthetic planning from the
start of the procedure.

Patients affected by PAAD are mostly puppies in the post-weaning period, phase
in which cardiovascular and respiratory physiology still exhibits functional immaturity, such as
reported patient. According to Grimm *et al.* (2015), pediatric animals exhibit less reserve.
cardiovascular disease, greater predisposition to hypothermia, and an increased risk of hypoglycemia are factors that...
These factors should be considered in anesthetic planning. Furthermore, chronic regurgitation and difficulty...

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The inherent nutritional deficiency associated with the disease leads to malnutrition and possible hypoproteinemia, altering the pharmacokinetics of drugs highly bound to plasma proteins, which may present in High concentrations in the blood can predispose individuals to poisoning and overdoses (Scarparo *et al.,* 2020);

Due to the high pain potential of thoracotomy, the implementation of protocols Safe and effective analgesics are essential to ensure patient well-being. In this context, Otero and Portela (2018) highlight intercostal block as an efficient strategy in the management of pain and discomfort resulting from lateral thoracotomy. Serrated plane block, by promoting Effective analgesia in hemilateral extension of the thorax involving the muscle layers, if it presents as an effective addition to pain management during surgical procedures and in the postoperative period. (Campoy, 2024)

2 Case Report

She was treated at the Veterinary Hospital of the Federal Rural University of Pernambuco (UFRPE). a female mixed-breed dog, 4 months old and weighing... Weighing approximately 1.4 kg, she was referred for surgical correction of a persistent fourth aortic arch. right (PAAD). The patient had a history consistent with recurrent regurgitation during the period post-weaning, having been previously evaluated by the small animal medical clinic sector and She underwent radiographic examination to confirm the clinical suspicion and subsequent tests. laboratory tests for preoperative evaluation.

Figure 1: Radiographic image confirming the presence of megaesophagus.



Source: Author (2026)

Laboratory tests showed a hematocrit of 35% and total plasma proteins of 5.6 g/dL, platelet count of 640,000/µL, urea of 22.3 mg/dL, creatinine of 0.58 mg/dL, ALT of 67.24 U/L, AST of 57.6 U/L, alkaline phosphatase of 149.3 U/L and glucose of 112.7 mg/dL. So In general, the parameters were within acceptable limits for the species and age group, without

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evidence of significant renal impairment or relevant hepatic changes that contradicts
They indicated the anesthetic-surgical procedure.

On the day of surgery, the patient was received and underwent a pre-anesthetic evaluation. Physical examination revealed a heart rate of 124 bpm and a respiratory rate of 40 breaths per minute. per minute, normal-colored mucous membranes, capillary refill time of two seconds, hydration appropriate and alert behavior. Considering that the patient is a pediatric patient, solid food fasting and The watering was carried out for only 2 hours, according to protocol for pups, in order to minimize risk. of hypoglycemia. The overall assessment indicated clinical stability for the proposed procedure, being Classified as ASA II, considering the correctable congenital condition and absence of alterations. severe systemic conditions.

Pre-anesthetic medication was administered intramuscularly at 9:10 AM, using Methadone at a dose of 0.2 mg/kg combined with midazolam at a dose of 0.05 mg/kg. The protocol promoted adequate sedation and preemptive analgesia, allowing for safe manipulation and establishment of Peripheral venous access.

Anesthesia was induced at 9:53 AM with intravenous propofol at a dose of approximate dose of 8 mg/kg (total volume of 1.2 mL), enabling safe orotracheal intubation and Rapid airway protection. An endotracheal tube suitable for the patient's size was used. with the cuff properly inflated.

Anesthetic maintenance was performed using inhalation anesthesia in a non-rebreathing circuit. (Baraka), appropriate to body weight, associated with a balanced technique with continuous infusion of Intravenous analgesics. A continuous infusion of remifentanil was started at a rate of 0.15 µg/kg/min. aiming for potent intraoperative analgesia and reduced need for inhaled anesthetic. In addition In addition, intravenous lidocaine infusion was used, with an initial bolus dose followed by a rate continuous adjustment to body weight, with the aim of enhancing analgesia and contributing to the cardiovascular stability.

Then, ultrasound-guided locoregional blocks were performed, both unilaterally, according to the surgical plan. Initially, a block was performed. intercostal, in the surgical area to be incised and in two cranial and caudal spaces, using a solution of 0.25% bupivacaine; immediately afterwards, the ultrasound probe was positioned to Performing a serratus plane block with 0.5% ropivacaine at a volume of 0.5 ml/kg.

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Figure 2: Performing the ultrasound-guided serratus plane blocking.

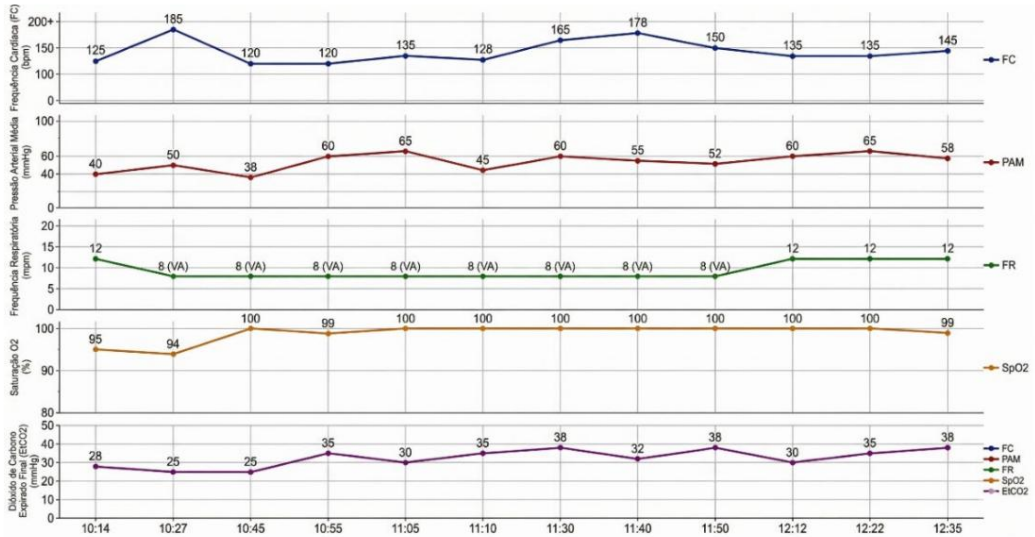


Source: Author (2026)

During the procedure, fluid therapy with Ringer's lactate solution was instituted at a rate of Average of 3 mL/kg/h, adjusted according to hemodynamic parameters.

Anesthetic monitoring was performed using a multiparameter monitor, evaluating... continuously monitors heart rate, blood pressure, respiratory rate, and peripheral oxygen saturation. Oxygen (SpOÿ), capnography (EtCOÿ), and body temperature were measured. The patient remained stable. Cardiovascular function was maintained throughout the procedure, with average blood pressure values within the normal range. physiological for the species. Ventilation was assisted as needed. intraoperatively, establishing 8 breaths per minute as the standard. Body temperature was maintained using active heating methods, and kept between 37.7 and 38.2 ºC during all the handling.

Figure 3: Anesthetic monitoring chart, in the table below, surgical procedure time in minutes.



C: 0	10	15	35	45	55	1h22	1h32	1h45			

Source: Author (2026)

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During the procedure, at the beginning of the surgical procedure (C:0), ephedrine was used. 0.1 mg/kg *bolus,* followed by dobutamine infusion initiated at C10 at 2.5 mcg/kg/min. Adjusted- If the dose is then reduced to 5 mcg/kg/min at C:35. Weaning initiated at C:55 with reduction to 2.5 mcg/kg/min and subsequently decreased to 1 mcg/kg/min at C:1h22. The infusion was stopped at the end of surgery.

The total surgical procedure time was approximately two hours, without Significant anesthetic complications, arrhythmias, or episodes of persistent hypotension were not reported. The need for additional rescue analgesic during the intraoperative period.

At the end of the surgery, the inhaled anesthetic was discontinued, maintaining Oxygen therapy was administered until partial recovery of protective reflexes. Extubation was performed after... Proper return of swallowing and laryngeal reflex.

In the immediate postoperative period, dipyrone (0.042 mL, IM) was administered. meloxicam (0.035 mL, IM) and cefalothin (0.21 mL, IV), comprising a multimodal protocol for analgesia and antimicrobial prophylaxis. Recovery was considered satisfactory, with the parameters Physiological conditions maintained in accordance with the perioperative period, followed by progressive return. of consciousness, maintenance of cardiorespiratory stability, and absence of regurgitation during the period immediate.

3. Discussion

The entire anesthetic procedure was guided by patient safety. The choice of pre-anesthetic medication... The anesthetic team prioritized drugs with minimal cardiovascular depression and adequate analgesia. Preemptive. The combination of ÿ-agonist opioids, such as methadone (which also acts on receptors). NMDA), benzodiazepines, such as midazolam, are widely recommended in young patients. or debilitated (Lamont; Mathews, 2007). Methadone provides effective analgesia and reduces The need for inhaled anesthetics, while midazolam promotes muscle relaxation with minimal hemodynamic and respiratory impact. This combination promotes stable sedation without significantly compromise physiological parameters. (Grimm, 2024).

Anesthetic induction should allow for rapid and safe airway control. Propofol is... frequently indicated in these cases due to its rapid action and short duration, enabling Immediate orotracheal intubation and reduction of aspiration risk (Branson, 2007). The literature emphasizes that, in patients with megaesophagus, early airway protection through intubation with Properly inflated cuff is an essential measure to minimize respiratory complications and maintain optimal patient ventilation (Grimm *et* al., 2015).

During anesthetic maintenance, the use of balanced anesthesia is considered the gold standard. in thoracic surgery. The combination of inhaled anesthetic with continuous opioid infusions and

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Intravenous local anesthetics promote a reduction in the minimum alveolar concentration (MAC) and greater hemodynamic stability (Valverde *et* al., 2004), in addition to the association with pre-medication Anesthetics can further reduce this concentration. Short-acting opioids, such as remifentanil, They offer an advantage in thoracic procedures by allowing precise titration of analgesia and rapid recovery at the end of the infusion (Muir; Hubbell, 2013).

Locoregional blocks are fundamental techniques for intra- and post-surgical analgesia, in addition to They play an important role in reducing the dose of analgesics and anesthetics, corroborating with Essential care in anesthesia for pediatric patients. (Grimm, 2024) Ultrasound-guided blocks They demonstrate greater safety by allowing visualization of anatomical structures and the ideal location for... Injection of local anesthetic. The combination of intercostal and serratus plane blocks has been proposed. to cause analgesia throughout the entire treated chest area, including skin and muscle layers. (Campoy, 2024). Blocks have proven successful in providing analgesia to the area. surgical procedure was successful, as the patient remained stable throughout the entire procedure without major complications. changes that would indicate the presence of nociception.

Intravenous lidocaine infusion has been described as an effective strategy for reducing MAC (measured intravascular coagulation). isoflurane, in addition to contributing to systemic analgesia and control of ventricular arrhythmias during Cardiac manipulation (Valverde *et* al., 2004). Multimodal analgesia, combining opioids, Local anesthetics and non-steroidal anti-inflammatory drugs, when there are no contraindications, are recommended for proper management of post-thoracotomy pain (Hellyer *et* al., 2007).

The main anesthetic complications described in patients with vascular ring anomalies. These include hypoxemia, hypotension, and aspiration pneumonia (Buchanan, 2004; Ellison, 2010). Implementation of balanced protocols, with emphasis on airway protection and ventilation. Assisted therapy and effective analgesia have been associated with a reduction in perioperative morbidity, because The reason is multimodal anesthesia and intensive monitoring with a focus on preventive analgesia. It is characterized as the gold standard.

The dobutamine infusion produced the expected effect, increasing heart rate and blood pressure. Mean arterial pressure primarily due to positive inotropic and chronotropic effects (Grimm, 2024). Once that pediatric patients are less resilient with regard to perianesthetic complications involving Due to a drop in blood pressure, treatment was initiated at a dose of 2.5 mcg/kg/min, but with less effect than desired. thus increasing the dose; from that point, with the normalization of the values, it was possible to gradually reduce it. throughout the surgical procedure, through weaning.

4. Final Considerations

The anesthetic protocol and individualized care for the pediatric patient. They demonstrated effectiveness during the procedure. The choice of pre-anesthetic medication

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demonstrated an effective reassurance response; the local lockdowns implemented were successful.

Regarding the control of intra- and post-operative pain, given the satisfactory recovery of the animal. It concludes-

If, therefore, the anesthetic management was successful in relation to the planned procedure of

Correction of persistence of the fourth aortic arch and may assist in the development of protocols.

Safe anesthetics in veterinary medicine.

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