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Multimodal anesthesia associated with regional block in a dog who underwent corrective surgery for persistent right aortic arch: case report

Anestesia multimodal associada a bloqueio loco-regional em cão submetido a cirurgia corretiva para persistência de arco aórtico direito: relato de caso

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ABSTRACT: The persistence of the fourth right aortic arch (PRAA) is a congenital malformation that affects the heart base's main vessels. Surgical treatment is recommended and should be advocated as a matter of urgency. In this context, efficient anesthesia planning is necessary, with satisfactory analgesia, associating multimodal techniques with regional blocks. The present work aims to report the anesthetic procedure during corrective surgery for PRAA in a dog. Neuroleptanalgesia was intramuscularly performed, using acepromazine (0.015 mg.kg-^{1}) and methadone (0.3 mg.kg-^{1}) in pre-anesthetic medication. Ketamine (1 mg.kg^{-1}) and propofol (3 mg.kg^{-1}) were administered at induction, both intravenously, followed by maintenance using total intravenous anesthesia with propofol (initial rate of 0.4 mg.kg^{-1} .minute) and remifentanil, (0.2 mcg.kg.$^{-1}$.minute). In addition, ultrasound-guided regional intercostal block was performed, with 5% bupivacaine without vasoconstrictor (0.05ml.kg^{-1}). Ketamine infusion was postoperatively maintained for one hour. The instituted protocol proved to be satisfactory in controlling trans and postoperative pain, maintaining all parameters stable during and after the procedure, without any intercurrence. Thus, the protocol provided quality recovery to the patient.

KEYWORDS: thoracotomy, vascular anomaly, intercostal block, opioids, total intravenous anesthesia

RESUMO: A persistência do quarto arco aórtico direito é uma má formação congênita, afetando os principais vasos da base cardíaca. O tratamento cirúrgico é recomendado e preconiza-se um planejamento anestésico eficiente, associando-se técnicas multimodais a bloqueios regionais. O presente trabalho objetiva relatar a anestesia durante cirurgia corretiva de PDA em cão. Na medicação pré-anestésica, instituiu-se neuroleptonalgesia, utilizando-se acepromazina (0,015 mg.kg^{-1}) e metadona (0,3 mg.kg-^{1}), por via intramuscular. Na indução, foi administrada cetamina (1mg.kg $^{-1}$) e propofol (3 mg.kg-^{1}). Para manutenção, utilizou-se propofol (taxa inicial de 0,4 mg.kg^{-1}.minuto) e remifentanil, (0,2 mcg.kg^{-1}.minuto). Além disso, foi realizado bloqueio regional intercostal guiado por ultrassom com bupivacaína sem vasoconstritor a 5% (0,05ml.kg^{-1}). O paciente permaneceu em infusão analgésica de cetamina por uma hora, no pós operatório. O protocolo estabelecido demonstrou ser satisfatório no controle de dor trans e pós-operatória, mantendo todos os parâmetros estáveis, sem nenhuma intercorrência, proporcionando qualidade de recuperação ao paciente.

PALAVRAS-CHAVE: Toracotomia; anomalia vascular; bloqueio intercostal; opioides; anestesia total intravenosa.

INTRODUCTION

Persistent right aortic arch corresponds to a congenital anomaly that affects the main vessels of the heart base (MEIRA et al., 2020), generating communication between them and diverting blood flow from within the aortic duct to the pulmonary trunk (BINETTI et al., 2020). This condition is known as portosystemic shunt, negatively affecting the hemodynamics of the organism, which can lead to increased preload in the left ventricle and pulmonary hypertension (MILLER; GAL, 2017). The esophagus is secondarily affected due to the occlusion from the ligamentum arteriosum, consequently resulting in pathological enlargement. Clinical signs include stunted growth, regurgitation after the intake of solid diet, and aspiration pneumonia (PLESMAN et al., 2011). Plain and contrast radiography assist in the diagnosis of megaesophagus, associated or not with vascular ring anomalies. (KOZU; SILVA; SANTOS, 2015).

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Anesthesia of dogs with cardiac abnormalities, in general, becomes challenging during the transanesthetic period since it requires greater caution and attention. This is given the difficulty of maintaining the cardiac output of these patients, despite the physiologic compensating mechanisms (ARENILLAS; CARO-VADILLO; De SEGURA, 2019).

In the persistence of the aortic arch, the main complications are tachycardia, bradycardia, hypertension, hypotension, hypothermia, and cardiac arrhythmias (PARISSI et al., 2020). Adequate analgesia in these surgical procedures is indispensable because it accelerates post-surgical recovery. It also contributes to the patient's quality of life and well-being (SOUZA et al., 2018). Analgesic infusions are continuously being explored, and this technique is commonly used in small animal anesthetic practice. Infusions can be isolatedly administered, as remifentanil, for example, or in pharmacological combinations to provide balanced anesthesia (ALVES et al., 2017).

The introduction of regional blocks, with the aid of nerve stimulation or ultrasound, are conferring objectivity and precision to regional analgesia techniques, contributing to a lower requirement of general anesthetics, as well as opioids (PORTELA; VERDIER; OTERO, 2018). Thus, the objective of this work was to report the anesthetic and analgesic protocol used in a case of persistence of the aortic arch in a dog with secondary megaesophagus, submitted to thoracotomy for corrective surgery.

CASE REPORT

The patient was referred to the Veterinary Hospital of the Universidade Federal Rural do Semi-Árido, in the city of Mossoró-RN, for clinical-surgical evaluation. It was a 3-month-old white Swiss shepherd male dog with a bodyweight of 4.6 kg. The complaints were recurrent regurgitations of postprandial undigested solid material, occurring as early as two months of age, hiccups, and respiratory distress. On physical examination, a marked dilation in the sternal region was noted when the patient was slightly agitated. The patient also had a body condition score of 2 on a scale of 1 to 5. Blood samples were collected for hematimetric and serum biochemical tests (urea, creatinine, ALT, AST, alkaline phosphatase, and total protein), which showed no noteworthy changes. In addition, radiography of the esophageal and tracheal region revealed the presence of gaseous content, which was evidenced with moderate dilation of the cervical portion of the esophagus and radiopacity (Figure 1).

2 ml. kg barium sulfate radiographic contrast was administered orally, highlighting the region that presented esophagus dilation. There was an accumulation of contrast material in the cervical neck up to the entrance of the thorax, close to the heart (Figures 2). Such an alteration is suggestive of compressive esophageal stenosis due to vascular ring anomaly. Due to the progressive worsening of the animal's condition, exploratory thoracotomy was indicated to confirm the diagnosis and surgical correction.

Figure 1. Plain radiography - left lateral view showing esophageal dilation.

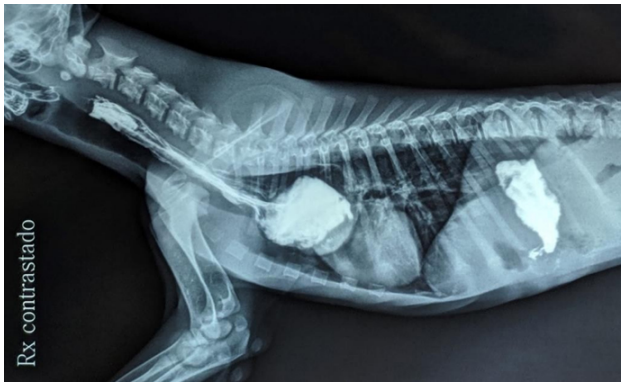

Figure 2. Contrast-enhanced radiography left lateral view with esophageal dilation and contrast accumulation from the cervical portion to the thoracic inlet. Esophageal stenosis is immediately proximal to the heart base.

The patient underwent an 8-hour solid food and water fast. The following parameters were assessed before the anesthetic protocol: Baseline heart rate (HR) of 112 beats per minute, synchronous pulse and respiratory rate *(RR)* of 36 movements per minute, capillary refill time (CRT) less than 2 seconds, systolic arterial pressure (SAP) of 95 mmHg, measured by Doppler, normal colored mucous membranes, skin turgor with a satisfactory degree of hydration and a rectal temperature (RT) of 38.4 C°.

Neuroleptanalgesia was used as pre-anesthetic medication, with acepromazine (0,015 mg.kg-1) and methadone (0,3 mg.kg-1) association administered intramuscularly. Twenty minutes later, anesthetic induction was initiated, using ketamine at a dose of 1 mg.kg-1 as co-inducer. After one minute, propofol was administered at a dose of 3 mg.kg-1 until orotracheal intubation was viable. The intravenous route was used for both ketamine and propofol. An orotracheal tube was also placed, by esophageal route, for occasional megaesophagus regurgitations. Oxygen support was provided, with a flow of 30 mL. kg-1.min, employing the non-reinalatory circuit through the Mapleson D (avalvular) system, with oxygen flow, by assisted manual ventilation. Total intravenous anesthesia with propofol was used to maintain anesthesia, starting at

0,4 mg.kg-1minute and gradually decreasing during the transanesthetic period, remaining stable at the low continuous infusion rate (0.05 mg.kg-1 minute).

For analgesia, the intercostal block was performed with bupivacaine without vasoconstrictor at 0.5 %, at a dose of 0.05 ml. kg per point, using ultrasound with a linear transducer above 10 Mhz. The patient was positioned in the right lateral decubitus position, and the third intercostal space, cranio-dorsal to the incision, was palpated. The transducer was positioned, and the reading depth was adjusted to 3cm. In order to avoid complications of accidental vascular injections, the content was aspirated before injection of the anesthetic. Two more cranial and caudal local applications were made to the first rib with the same technique to block other adjacent sensory nerves successively.

In addition to the block, a remifentanil analgesia infusion at a rate of 0.2 mcg.kg-1 was performed to enhance analgesia. It is worth noting that the surgical incision was made 25 minutes after the block and the opening of the cavity after 30 minutes.

The Ringer's Lactate solution rate was instituted at 3 ml. kg.h-1. The hemodynamic parameters (HR, *RR* °, TR, and IAP - invasive arterial pressure, accessed by the dorsal pedal artery) were assessed, in addition to the oxygen saturation (SpO2), through a multiparameter digital monitor.

The whole procedure lasted three hours and ten minutes. The patient was stable from the beginning to the final third of surgery, except when the vagus nerve was stimulated at the time of the surgery. This stimulation resulted in an abrupt reduction in heart rate (56 beats per minute) and blood pressure (40 mmHg). However, the parameters were quickly and spontaneously reversed without the need for pharmacological intervention. Heart rate varied from 130 to 180 beats per minute, the assisted respiratory rate from 08 to 20 movements per minute, the mean arterial pressure from 60 to 80 mmHg, and the oxygen saturation between 95 and 99%. The rectal temperature varied between 37.9° C and 37°C. The remifentanil infusion was interrupted simultaneously at the end of the surgical procedure, and propofol interruption occurred 10 minutes before. Within 35 minutes of extubation, the patient presented total recovery of consciousness, remaining in sternal decubitus position, with all cardiorespiratory and body temperature parameters within physiological normality, thus allowing discharge from the anesthesia recovery room. The animal was maintained from the immediate postoperative period on an analgesic infusion of ketamine at the rate of (0.6 mg.kg-1.h) for one and a half hours. Meloxicam (0.2 mg.kg) and dipyrone (25 mg.kg) were administered postoperatively, and there was no need to perform any opioid analgesic rescue on the day of the procedure. The next day, the patient started using tramadol 2 mg.kg, every 12 hours, for 07 days.

DISCUSSION

According to the protocol instituted for pre-anesthetic medication, acepromazine was necessary since the patient was young, agitated, and anxious, characteristics that did not allow manipulation. Despite its main adverse effect of hypotension, acepromazine also prevents ventricular arrhythmias and ventricular fibrillation by blocking alpha-1 adrenergic receptors in the myocardium (LEMKE, 2013). Therefore, it is beneficial due to the release of catecholamines brought on by the patient's stress. Phenothiazine has been associated with methadone to provide better sedation, increase analgesia, and minimize the need for other anesthetic agents (SANTOS et al., 2010). Monteiro et al., 2016, described in their study that the association of these drugs considerably decreases the requirement for general anesthetics.

Similarly, the use of opioids such as remifentanil adds to intraoperative antinociception, thus promoting lower anesthetic maintenance requirements (MURAHATA et al., 2018). Monteiro et al., 2010, concluded that dose-dependently remifentanil use significantly reduced the CAM of isoflurane in dogs. In the present report, it was possible to see the decreased propofol requirement in the transoperative period, managing to keep the animal in an adequate anesthetic plan with the minimum maintenance rate, 0.05 mg.kg-1.h.

During the entire procedure, the patient was maintained in manual controlled ventilation since respiratory depression and transient apnea are the most common adverse effects of propofol administration (REVES et al., 2000). As a limitation of the study, the anesthetic equipment did not have a capnograph, the central monitoring element for lung ventilation (HOPPER et al., 2007). The main disadvantage between manual and mechanical ventilation is that, in the latter, there is control of the volume of air offered or pressure exerted, making the process safer and more efficient (CASTELLANA et al., 2003).

According to Assorey et al. (2020), patients undergoing thoracic surgeries may experience severe acute pain due to rib retraction, as well as serratus muscle or intercostal nerve damage. Therefore, inadequate or negligent management of pain control can lead to severe postoperative complications for the patient. Such complications include hypertension that can increase bleeding risks, tachycardia, and arrhythmias, which can compromise cardiac output (ARENILLAS; CARO-VADILLO; DE SEGURA, 2019), in addition to the development of chronic pain (SILVA et al., 2008).

In this case, a regional intercostal block in the transoperative period was carried out. This block has already been mentioned in complex procedures, such as partial resection of the chest wall followed by reconstruction (JULIÃO et al., 2020), mastectomies (SANCHES et al., 2020), or aortic ductal persistence corrective surgery in dogs (VOLKEIS et al., 2020). In all the mentioned procedures, the block has been demonstrated to be efficient and satisfactory. The thoracic

paravertebral acoustic window obtained by the ultrasound during regional anesthesia allows for the visualization of the transverse process cranially and immediately caudal to the rib. The needle is positioned between the intercostal membrane and the parietal pleura, contributing with safety, practicality, and precision in the procedure, minimizing errors (O'RIAIN et al., 2010) and enabling promising perioperative effects in surgeries regarded as extremely painful, such as thoracotomies. This technique also decreases the anesthetic requirement, allowing minimal rates of propofol during the maintenance of anesthesia (PORTELA, D.; VERDIER, N.; OTERO, P., 2018). Regional intercostal block has been applied and described in dogs (PORTELA et al., 2017) and foxes (MANTICEL et al., 2017).

In the transoperative period, remifentanil (0.2 mcg.kg-1.h) was administered as an analgesic, contributing to balanced anesthesia and decreasing the need for drugs for anesthetic maintenance, such as propofol (ALVES et al., 2017). In the immediate postoperative period, infusion of ketamine (0.6 mg.kg-1.h) was administered as the action of the bupivacaine decreased.

According to Reed et al. (2019), ketamine adds to acute analgesia by acting on the N-methyl-D-aspartate (NMDA) receptor and interacting with opioid receptors. Its actions on the NMDA receptor are also attractive due to the secondary hyperalgesia decreasing caused by central awareness. Studies with human subjects show that low-dose ketamine infusion can decrease postoperative opioid consumption (BOENIGK et al., 2019). The reported patient was stable throughout the period, with cardiorespiratory parameters within normal range.

Despite some intercurrences such as tachycardia, bradycardia, cardiac arrhythmia, hypertension, and hypotension, which are expected complications (PARISSI et al., 2020), there were no significant complications or required interventions in this report. After the end of anesthesia, the animal was alert and with appetite, and food was offered after 60 minutes of total anesthetic recovery. A form adapted from the Glasgow pain scale (TRANQUILI et al., 2013) was used for pain assessment. The patient was observed from the immediate postoperative period, every one hour, for 24 hours. According to the assessment, there were no signs of postoperative pain, such as reaction to palpation, vocalizations, or apathy. In addition, after the hospitalization period, the patient was routinely followed up, thus excluding any behavior suggestive of hyperalgesia or allodynia. The reported patient was comfortable at all times after the end of anesthesia, with the presence of appetite and alertness. Subsequently, the animal did not present any suggestive of hyperalgesia or allodynia-like behaviors.

CONCLUSION

The anesthetic and analgesic protocol adopted in this report was satisfactory. The use of the thoracic paravertebral block with ultrasound allowed an assertive and safe approach to the patient, significantly increasing the trans and postoperative analgesia and the infusion of remifentanil, allowing lower rates of propofol requirement for maintenance. Thus, it can be concluded that a well-planned anesthetic protocol, with good techniques, improves the prognosis, minimizes anesthetic complications expected in this type of patient, and provides adequate pain control, favoring the patient's well-being.

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