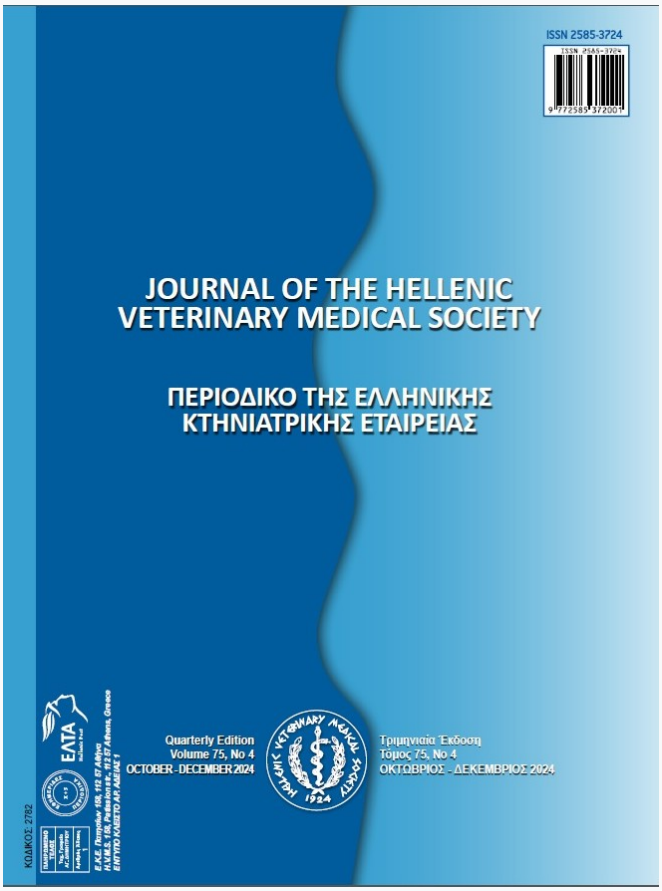
Journal of the Hellenic Veterinary Medical Society

Vol 75, No 4 (2024)



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doi: 10.12681/jhvms.37463

To cite this article:

Flouraki, E., Koutinas, C., Anagnostou, T., Savvas, I., & Kazakos, G. (2025). Two anaesthetic protocols and perioperative monitoring in a dog with asymptomatic right bundle branch block. *Journal of the Hellenic Veterinary Medical Society*, *75*(4), 8495–8500. https://doi.org/10.12681/jhvms.37463

J HELLENIC VET MED SOC 2024, 75 (4): 8495-8500
ΠΕΚΕ 2024, 75 (4): 8495-8500

Case report
Κλινικό περιστατικό

Two anaesthetic protocols and perioperative monitoring in a dog with asymptomatic right bundle branch block

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ABSTRACT: A 16-year-old mixed breed dog was presented for skin mass excision, one located in the head and one in the lumbar region. During initial evaluation, a right bundle branch block and a mitral valve insufficiency were detected, while concentration of cardiac troponin-I (cTnI) was slightly elevated at 0.653ng/ml. The dog was anesthetized with fentanyl and propofol, maintained with isoflurane and a ring block of lidocaine was also performed. Anaesthesia and peri-operative monitoring was uneventful, while post-operative concentration of cTnI was elevated at 1.34 ng/ml. The following day a partial urethral obstruction was noted, and the dog was rescheduled for cystotomy and urethrostomy to avoid complete obstruction. The second anaesthetic protocol consisted of fentanyl, midazolam and etomidate for induction and isoflurane for maintenance with the addition of fentanyl as a constant rate infusion. Anaesthesia and perioperative monitoring were also uneventful. Post-anaesthetic evaluation revealed an increased cTnI plasma concentration at 2.57 ng/ml. Ten days later, during re-examination, the plasma concentration of cTnI had returned to normal and no deterioration was noted on ECG examination. Four months later, the patient's physical status and ECG examination indicated no further dysfunction of the heart.

Keywords: Right bundle branch block; dog; anaesthesia; cardiac troponin

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Date of initial submission: 17-4-2024
Date of acceptance: 16-8-2024

INTRODUCTION

Anaesthesia in veterinary medicine is associated with a relatively high risk of mortality, compare to human medicine. Specifically, 1 out of 1800 (0.05%) healthy dogs is prone to anaesthesia - related death [1], whereas the risk increases significantly in patients with underlying cardiovascular disease [2]. Most pre-anaesthetic and anaesthetic agents contribute to varying degrees of cardiovascular depression. Consequently, such patients may struggle to compensate for the alterations in cardiac and respiratory function induced by these agents. [3]. The primary objective when anaesthetising patients with cardiac diseases is to minimize disruptions in cardiac rhythm, avoid reductions in preload and prevent volume overload [3].

Conduction disturbances, particularly bundle branch blocks, are not often observed in veterinary practice. Among these, right bundle branch block (RBBB) is an infrequent congenital condition in dogs [4, 5]. In humans, RBBB is typically asymptomatic, and even though delayed conduction to the right ventricle causes desynchrony of contraction in left and right ventricle, patients may tolerate this effectively. However, in the presence of underlying heart disease or heart failure, RBBB can exacerbate symptoms, potentially leading to dyspnoea, pulmonary oedema, or malignant dysrhythmias [6, 7].

In dogs, RBBB is a rare, typically asymptomatic conduction abnormality. Although anaesthetic management of patients with RBBB and other conduction disturbances have been extensively documented in human medicine, the authors are not aware of any published reports regarding the anesthetic considerations for dogs with RBBB. This case report aims to present two successful anesthetic protocols used in a dog with RBBB and concurrent mitral valve insufficiency which underwent two elective surgical procedures within 48-hour period.

CASE HISTORY

A 16-year-old castrated male mixed-breed dog, weighing 10 kg was referred to our clinic for excision of two basal cell carcinomas, previously diagnosed with fine needle aspiration and cytology. The first mass was located on the head and the second in the lumbar area. The dog was alert and responsive in initial evaluation. The heart rate (HR) and the respiratory rate (RR) were 80 beats/min, and 20 breaths/min, respectively. Noninvasive arterial blood pressures were normal with systolic (SAP) at 135 mmHg, diastolic (DAP) at 70 mmHg and mean arterial pressure (MAP) at 105 mmHg. During pre-anesthetic auscultation and electrocardiography, a 3rd grade, holosystolic heart murmur and Right Bundle Branch Block (RBBB) were detected (Figure 1). In radiographic evaluation cardiac silhouette was normal whereas echocardiography revealed mitral valve insufficiency with fractional shortening within normal limits (56%). Laboratory investigation included CBC, and a thorough biochemical profile (CREA, BUN, ALT, ALP, GLU, P, Ca, K, Na). All values were within normal limits, except of the serum concentrations of cardiac troponin - I (cTnI), which was slightly elevated (0.653 ng/mL) (reference range: <0.2 ng/mL). The following day, after evaluation was completed, the dog was anaesthetised for the planned procedure. For premedication, fentanyl (Fentanyl; Janssen-Cilag, Pefki, Greece) was administered at 2 μg/kg IV and pre-oxygenation with O2 flow by at 3 l/min was instituted. Five minutes later, anaesthesia was induced with propofol (Propofol; Fresenius Kabi, Agia Paraskevi, Greece) (3 mg/kg) IV, followed by tracheal intubation with a 7 Fr cuffed tube (Lo-Contour Murphy; Mallinckrodt, Ireland). Anaesthesia was maintained with isoflurane (Isoflurine; Neocell, Athens, Greece) in oxygen, administered through a circle system. Crystalloids (Lactated Ringer's) were administered at 5 ml/kg/h, along with the infusion of fentanyl (constant rate infusion - CRI) at 0.1 μg/kg/min. Additionally, local infiltration of lidocaine 2% (Xylozan 2%; DEMO, Attica, Greece) at 2 mg/kg was also performed and carprofen (Rimadyl; Pfizer Inc, Neo Psichico, Greece) was administered IV at 2 mg/kg after induction, to ensure analgesia during procedure. For antibiotic prophylaxis, cefuroxime (Zinacef; GlaxoSmithKline, Chalandri, Greece) (30 mg/kg IV) was administered pre - operatively. The surgical procedure lasted 90 minutes. The duration of anaesthesia was uneventful, the ECG revealed no changes (Figure 2), HR ranged from 80 to 100 beats/min, RR from 10 to 15 breaths/min, SAP from 100 to 120 mmHg, MAP from 75 to 90 mmHg, EtCO2 (end-tidal partial pressure CO2) was slightly elevated ranging from 40 to 50 mmHg and the EtISO (end-tidal partial pressure Isoflurane) was maintained at 1.2 to 1.3%. At the end of the surgical procedure, pethidine (Pethidina Cloridato, Molteni, Firenze, Italy) was administered IM at 3 mg/kg and a nasal catheter was used to provide oxygen supplementation during recovery. Recovery was uneventful and the patient was admitted to the

ICU for a 24 - hour hospitalization. Analgesia during hospitalization consisted of carprofen at 2 mg/kg, administered every 12 hours and pethidine at 3 mg/kg every 4 hours. Serum concentration of cTnI was measured during recovery and was found elevated at 1,34 ng/ml.

During the 24-hour hospitalization, partial urethral obstruction was detected, and a catheter was inserted into the urethra to facilitate urination. Abdominal ultrasonography highlighted the presence of massive calculus in the bladder. Urethrotomy and cystotomy were scheduled for the next day to avoid complete obstruction of the urethra.

On the next day, anaesthesia was induced with fentanyl at 2 μg/kg IV, midazolam (Dormicum; Roche, Marousi, Greece) at 0.1 mg/kg and etomidate (Hypnomidate, Demo, Attica, Greece) at 0.5 mg/kg IV, and maintained with isoflurane in oxygen. Fentanyl (0.1 μg/kg/min) was used as a CRI during the procedure. The duration of the surgical procedure was 120 min and the peri - operative monitoring was the same as before. Crystalloids (Lactated Ringer's) were administered throughout the procedure at 5 ml/kg/h, and cefuroxime at 30 mg/kg was administered before the beginning of the surgical procedure and two hours later. Anaesthesia was uneventful, EtISO was maintained in between 1.2 and 1.3%, $EtCO_2$ ranged from 35 to 55 mmHg, HR ranged from 75 to 112 beats/min RR was between 7 to 12 breaths/min, SAP ranged from 90 to 120 mmHg, MAP ranged from 75 to 95 mmHg and the ECG remained the same (Figure 3). After recovery, the patient was admitted to the ICU for 24 hours. Treatment included the administration of oxygen through the nasal catheter, pethidine (3 mg/kg IM) every 4 hours starting at the end of the surgical procedure and carprofen (2 mg/kg IV) every 12 hours.

Post-anaesthetic laboratory evaluation revealed no abnormalities, except for the serum concentration of cTnI, which was increased (2.57 ng/ml). The patient was discharged three days postoperatively, with a follow-up examination scheduled ten days later. During the re-evaluation, electrocardiographic findings remained unchanged, and cTnI concentration had returned to normal values (0.3 ng/ml). At a subsequent assessment four months later, the physical status and electrocardiographic profile of the dog remained the same, with no evidence of cardiac dysfunction.

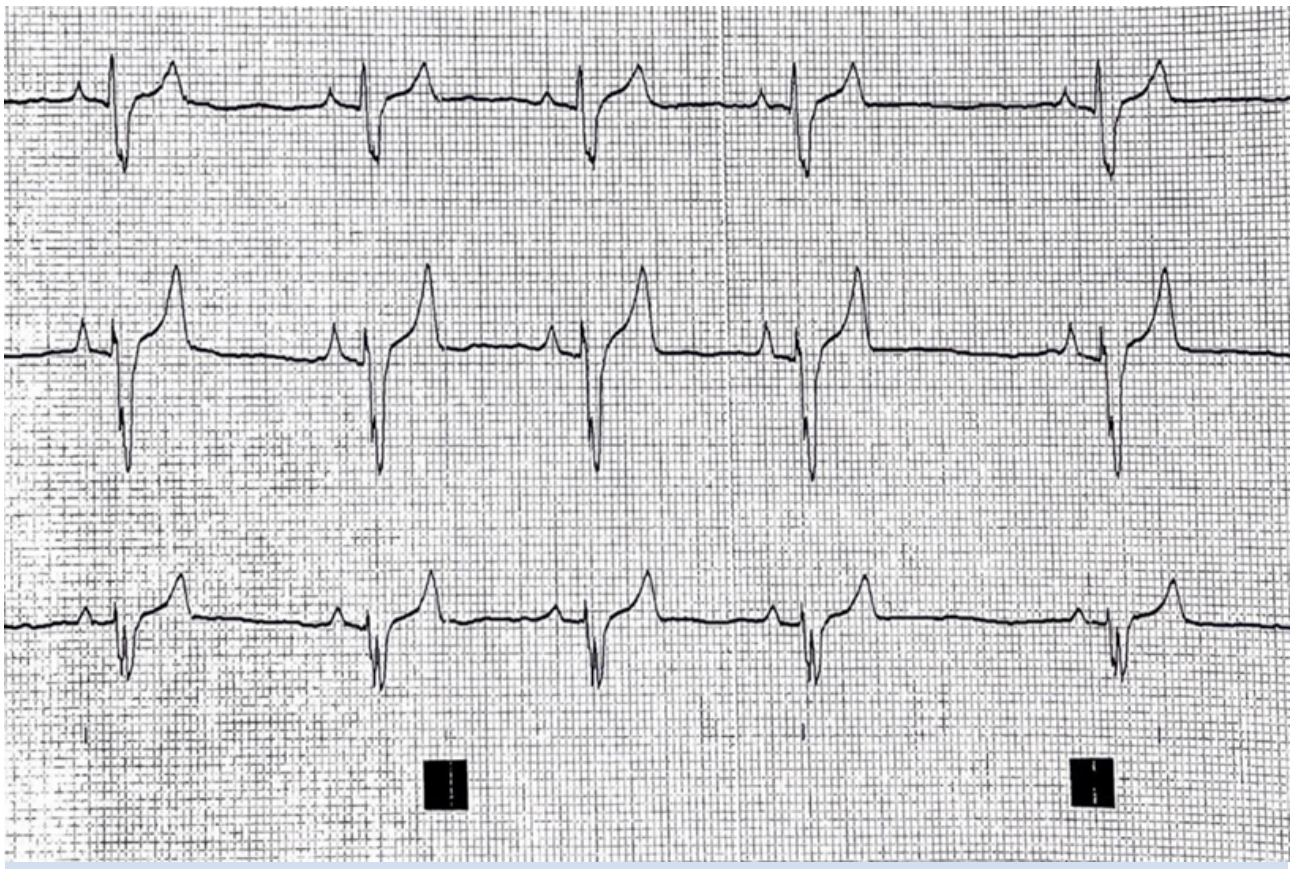

Figure 1. Right Bundle Branch Block in a 16-year-old dog. Lead I, II, III

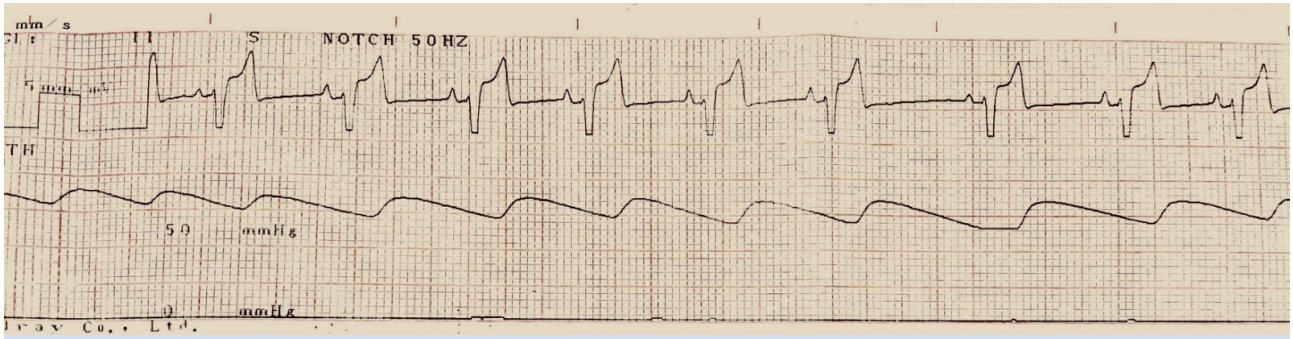

Figure 2. Right Bundle Branch Block in a 16-year-old dog under anaesthesia with fentanyl, propofol and isoflurane. Heart rate at 89 beats/min.

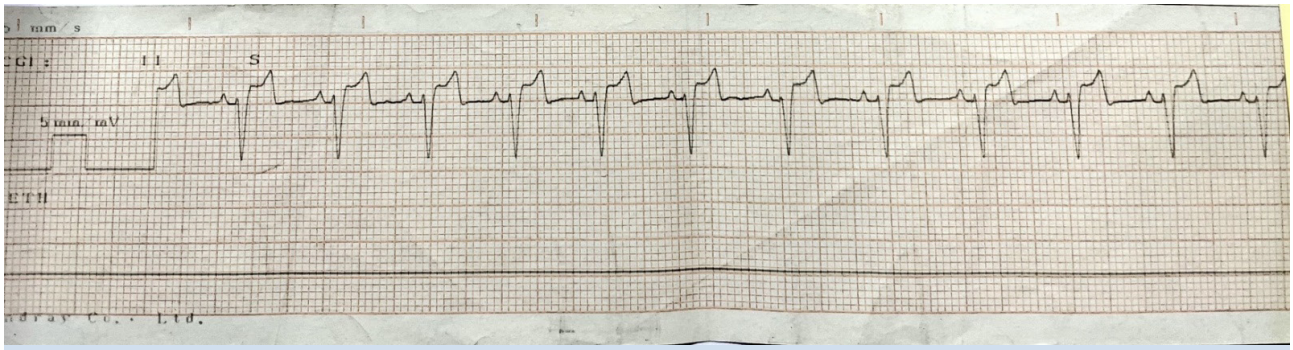

Figure 3. Right Bundle Branch Block in a 16-year-old dog under anaesthesia with fentanyl, midazolam, etomidate and isoflurane. Heart rate at 112 beats/min.

DISCUSSION

The pathophysiology of RBBB, observed in humans, is complex and it is believed that is responsible for 4-12% of sudden deaths [8]. A variety of different anaesthetic protocols have been used in human patients with RBBB undergoing non-cardiac surgeries, with desirable outcomes. The anaesthetic agents most commonly employed for the induction and maintenance of anesthesia in patients with RBBB, include fentanyl, propofol, thiopental, isoflurane and sevoflurane [9].

In the first anaesthetic protocol, presented in our case, fentanyl, propofol and isoflurane were used to induce and maintain anaesthesia. Premedication with an α2-agonist was avoided, as it is known to exacerbate ECG abnormalities and increase the risk of ventricular arrhythmias [8].

Fentanyl is a short acting opioid agent, which constitutes a highly effective analgesia [10]. It has been associated with respiratory depression, which abates due to its rapid distribution in plasma and central nervous system [11]. As far as the cardiovascular effects are concerned, most opioids have minimum effects on the cardiovascular system. Cardiovascular stability is well maintained and intravenous administration of fentanyl, in dogs, is associated with a minor decrease of heart rate [10, 12]. Fentanyl has been used in almost every surgical case with RBBB in humans [9], likely because of its minor cardiovascular and strong analgesic effects, resulting in decreased risk of intra- and post- operative ventricular arrhythmias.

qPropofol, which was used for induction, is characterized by a rapid onset of action. Several studies concerning the hemodynamic effects of propofol have revealed a wide range of cardiovascular responses associated with its administration. It has also been shown that even though propofol decreases arterial blood pressures due to its direct effect on vascular smooth muscles; it has not always been associated with a reflux tachycardia [13]. The myocardial depression which can be seen after propofol administration is dose and rate - dependent [14, 15]. In a study performed in dogs, the authors concluded that following the administration of propofol, cardiac output and arterial pressure may be preserved if preload is sustained [16]. The hemodynamic profile of a patient may be altered following the administration of propofol, though low dose propofol infusion combined with fentanyl has not been associated with clinically important heart depression [15]. In this case, the decision to induce anaesthesia with propofol in the

first anaesthetic protocol was based on the fact that the myocardial contractility was preserved, despite the presence of RBBB and mitral valve insufficiency. Furthermore, as the myocardial depressant effects of propofol are dose-dependent and it undergoes rapid metabolism and clearance, it was anticipated that its use would not result in a prolonged reduction in oxygen delivery. However, given the post-operative elevation of cTnI levels, the induction protocol was modified for the second surgical procedure.

The second anaesthetic protocol used, included fentanyl, midazolam, and etomidate for induction. Etomidate is mainly indicated for induction of anaesthesia in critically ill patients and patients with severe cardiovascular problems [17]. Induction with etomidate in both dogs and humans has not been linked to cardiovascular depression. Its administration has been associated with only minor and clinically insignificant changes in heart rate and blood pressure, highlighting its suitability for use in patients with compromised cardiovascular function. [18, 19]. The combination of etomidate with an opioid-based anesthetic protocol is widely used in patients with heart disease. Although etomidate is not commonly used in patients with RBBB, it appeared to be a reasonable choice in our case. The combination of etomidate with a benzodiazepine, such as midazolam, as used in our protocol, effectively prevents muscle rigidity associated with etomidate administration.

During both surgical procedures, isoflurane was the main agent used for maintenance of anaesthesia. Isoflurane is an inhalant agent, with dose-dependent respiratory and cardiovascular effects [20, 21]. Although isoflurane may increase heart rate, it has not been linked to the development of cardiac arrhythmias. Additionally, its ability to provide rapid recovery and allow easy control of anaesthetic depth makes it a relatively safe anaesthetic agent for patients with heart disease [22]. To minimize the amount of isoflurane required to achieve an adequate plane of anaesthesia, fentanyl continuous rate infusion (CRI) was administered during both procedures, and lidocaine infiltration was performed during the first procedure.

Anaesthesia may potentiate the risk of cardiac injury and cell damage which results in releasing specific heart enzymes, such as cardiac troponins into the bloodstream, in proportion to the extent of injury [23, 24]. Cardiac troponins are normally non-detectable in dogs without myocardial disease [25]. In the present case, the cTnI values revealed slightly above normal concentration before anaesthesia, representative of possible minor heart injury. The increased cTnI concentration after surgery may signify cardiac injury peri-anesthetically. These results point out that although clinical monitoring of the patient was unremarkable, and ECG revealed no changes, in fact, cardiac injury occurred during anaesthesia. Recent studies have demonstrated that there is an increase in cTnI serum concentration in dogs with renal failure, not proportional to the extension of kidney damage. It is suggested that several non-cardiac diseases have been associated with elevation of cTnI concentrations which do not relate to heart injury [26]. Nevertheless, we hypothesized that the alterations in cTnI concentrations observed in the present case, are consistent with minor cardiac ischemia peri-operatively.

In conclusion, in the present case, induction with either propofol or etomidate combined with midazolam and maintenance with isoflurane and fentanyl CRI proved to be efficient and relatively safe. Monitoring during both anaesthetic periods did not reveal any alterations and cTnI concentration, although elevated during the post operative period, was not associated with clinical deterioration, and returned to normal values shortly thereafter. Since the main goals of anaesthesia in patients with heart diseases are to avoid severe changes in cardiac output, heart rate and respiratory function and to prevent the occurrence of ventricular arrhythmias, we believe that both anaesthetic protocols had a successful outcome.

DATA AVAILABILITY STATEMENT

Data presented in this report are available on request from the corresponding author.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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