CLINICAL REPORT

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Anesthetic protocol in a greylag goose (*Anser anser*) undergoing prolapse reduction and cloacoplasty

Protocolo anestésico em ganso-doméstico (Anser anser) submetido a redução de prolapso e cloacoplastia

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ABSTRACT: The objective of this study was to describe an anesthetic protocol in a greylag goose (*Anser anser*), using propofol as the induction agent, for surgical prolapse reduction and cloacoplasty. The goose was considered suitable for surgery after disease diagnosis and a thorough pre-anesthetic evaluation. Pre-anesthetic medication included intramuscular administration of butorphanol, midazolam, and ketamine at doses of 0.5, 0.5, and 9 mg kg^{-1}, respectively. Subsequently, intravenous administration of propofol at 5 mg kg^{-1} over one minute allowed for airway intubation but did not achieve the surgical plane of anesthesia. Two additional one-minute boluses of propofol were administered, but the goose still exhibited paddling and caruncle retraction reflexes. The effective propofol dose to reach the ideal surgical plane was 10 mg kg^{-1} min^{-1} over 5 minutes, without apnea events, with a post-induction decrease in systolic blood pressure. Using propofol as anesthetic agent was satisfactory and suitable for the procedure and safe for the animal, indicating its potential as an alternative to inhalation agents for both optimizing anesthetic induction and simple, short-duration procedures under conditions contraindicating inhalant agents.

KEYWORDS: anesthesiology; birds; anseriformes; wildlife.

RESUMO: Objetivou-se descrever um protocolo anestésico em indivíduo de ganso-doméstico (Anser anser) empregando o propofol como agente indutor, para procedimento cirúrgico de redução de prolapso e cloacoplastia. Após diagnóstico da enfermidade e avaliação pré-anestésica completa, o paciente foi considerado apto para os procedimentos cirúrgicos. Foi então pré-medicado com butorfanol, midazolam e cetamina, nas doses de 0,5 mg/kg, 0,5 mg/kg e 9 mg/kg, respectivamente, por via intramuscular. Após, foi realizada a aplicação intravenosa de propofol 5 mg/kg em 1 minuto, a qual permitiu a intubação da via aérea, mas não promoveu plano cirúrgico. Foram realizados mais dois bolus de 1 minuto cada um, após os quais o paciente ainda possuía reflexos de pedalagem e retração da carúncula. A dose de propofol efetiva para obtenção de plano ideal foi de 10 mg/kg/min, em 5 minutos, não ocorrendo eventos de apneia, e sendo identificada moderada queda na pressão arterial sistólica após a indução. A escolha do fármaco como agente indutor foi satisfatória, mostrando-se adequada ao procedimento e segura ao paciente, e sendo recomendada pelos autores como alternativa aos agentes inalatórios, tanto para otimização da indução anestésica quanto em procedimentos simples de curta duração, quando o uso de agentes inalatórios for contraindicado.

PALAVRAS-CHAVE: anestesiologia; aves; anseriformes; animais silvestres.

INTRODUCTION

Greylag goose *(Anser anser)* is a waterfowl species of the family Anatidae (Anseriformes), notably characterized by its serrated and laterally flattened bill, which is adapted for feeding in water (Cândido, 2014). Geese of this species have anatomical adaptations in the bill and nostrils that include trigeminal receptors, which are stimulated during diving conditions, allowing the animal to hold its breath underwater, a mechanism known as the diving reflex (Ludders, 2017).

This anatomical feature has significant implications during anesthetic procedures: the trigeminal receptors in the bill and nostrils of these animals can induce apnea when stimulated or

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under stress. This mechanism is believed to hinder anesthetic induction when using inhalation agents or even simply placing an oxygen mask over the face and nostrils, potentially causing apnea for up to 5 minutes (Ludders, 2017; Samour, 2016). Therefore, considering the use of an intravenous anesthetic agent in these species is significantly pertinent.

The circulatory system of birds is particularly characterized by a proportionally larger heart and a higher heart rate compared to mammals of similar size (Macwhirter, 2010), as well as higher cardiac output and blood pressure, but with slightly lower peripheral vascular resistance than in mammals (Cubas; Rabelo, 2014; Samour, 2010; Lumeij; Ritchie, 1994).

The respiratory differences in birds include the absence of an epiglottis, which increases the risk of aspiration of foreign material when the trachea is not protected by intubation (Fantoni; Pinheiro, 2021a); complete tracheal rings, implying the use of uncuffed or deflated cuffed endotracheal tubes to avoid the risk of ischemia and necrosis if the cuff is inflated (Longley, 2008; Ludders, 2017); a syrinx (phonation organ) with variable intraluminal location depending on the species, making its identification important in procedures involving intubation; an elongated trachea, leading to increased dead space and consequently increased tidal volume, thus slowing the respiratory rate by approximately one-third (Ludders, 2017); non-expandable lungs, absence of a diaphragm, and the presence of 8 to 9 air sacs in the coelomic cavity, making respiration primarily dependent on the movement of the sternum and the abdominal and intercostal muscles (Fantoni; Pinheiro, 2021a).

In this context, the objective of the present study was to report an anesthetic protocol for a greylag goose, using propofol as the induction agent, for a surgical procedure involving prolapse reduction and cloacoplasty. This protocol was considered appropriate for the procedure and safe for the animal, with no significant anesthetic complications during and after the administration of the drug.

CASE REPORT

An adult female Greylag Goose (*Anser anser*) was admitted to a veterinary hospital with a cloacal prolapse that had been noticed by the owner at least 2 days prior. Physical examination showed an alert bird weighing 3 kg, with a body condition score of 2.5 in a scale of 5, a heart rate of 160 bpm, and a respiratory rate of 19 breaths per minute. Auscultation revealed clear air sacs and lung fields. The mucous membranes were moist and presented a normal color. The ulnar vein refill time was less than 1 second. There was a moderate to severe cloacal prolapse, which was covered in debris, preventing temperature measurement during the initial examination.

The cloaca was cleaned with saline solution, followed by a clinical evaluation and radiography of the coelomic cavity, which revealed a cloacal rupture and a large amount of radiopaque material in the gastrointestinal tract, consistent with obstructive content, leading to the decision to proceed with surgical intervention.

Preoperative tests included hematocrit, total proteins, albumin, and uric acid analysis. The results showed no abnormalities indicating increased surgical risk, classifying the bird at score 3 on the avian anesthetic risk classification proposed by Sinn (2006). Therefore, surgical preparation was scheduled for the following morning, with no need for fasting.

The pre-anesthetic protocol began with intramuscular (IM) administration of butorphanol at a dose of 0.5 mg kg^{-1}, immediately followed by IM administration of a combination of midazolam (0.5 mg kg^{-1}) and ketamine (9 mg kg^{-1}). After 20 minutes, a 24-gauge venous catheter was placed in the jugular vein, and intravenous (IV) induction with propofol at 5 mg kg^{-1} over one minute was performed, which was sufficient for endotracheal intubation using a 3.5 mm endotracheal tube with a deflated cuff. A satisfactory surgical plane of anesthesia was achieved only after IV administration of 15 mL of propofol over 5 minutes (3 mL min^{-1}), corresponding to 10 mg kg^{-1} min^{-1}. Isoflurane in a universal vaporizer was used for anesthesia maintenance. The oxygen flow rate was maintained at 2 L min^{-1}. Intraoperative fluid therapy was maintained with IV administration of warmed lactated Ringer's solution at 5 mL kg^{-1} $hour^{-1}$.

The goose was monitored throughout the anesthetic procedure via cardiac auscultation and measurement of heart rate (HR), body temperature, systolic blood pressure (SBP), and blood-oxygen saturation. An additional dose of midazolam and butorphanol was administered IM 1 hour and 36 minutes and two hours after the initial pre-anesthetic medication (PAM), respectively. Vital signs remained stable throughout anesthesia, with the following values: HR of 168 bpm, body temperature of 38.9 °C, SBP of 161 mmHg, and respiratory rate (RR) of 15 breaths per minute (with some variability, mainly during the first hour of the procedure). Blood-oxygen saturation remained satisfactory, between 94% and 100%.

The animal exhibited pedal, palpebral, and caruncle retraction reflexes 5 minutes after the end of the procedure, allowing for extubation. The immediate post-operative protocol included IV administration of ceftriaxone (75 mg kg^{-1}), dipyrone (50 mg kg^{-1}), and meloxicam (1 mg kg^{-1}). The goose was allowed to consume water and solid food spontaneously two hours after awakening. It primarily recommended to restrict the animal from bodies of water for 24 hours after surgical interventions.

DISCUSSION

The animal was subjected to a thorough clinical evaluation and tests prior to the anesthetic procedure, based on the avian anesthetic risk classification proposed by Sinn (2006). This classification is analogous to the American Society of

Anesthesiologists (ASA) risk score used for dogs and cats, where: ASA 1 (minimum risk): healthy young bird undergoing an elective procedure; ASA 2 (some risk): healthy young bird undergoing a non-elective procedure, or a healthy adult bird undergoing a non-elective procedure; ASA 3 (risk): bird with an ongoing health problem undergoing a procedure for this or another issue; ASA 4 (high risk): bird with a serious and unstable health problem undergoing a procedure; ASA 5 (moribund): last efforts to save the life of the bird.

The goose was classified with a score of 3, indicating moderate risk. Combining the anesthetic risk classification with a thorough physical and hematological evaluation provided a more comprehensive and accurate assessment of the anesthetic risk and greater safety in choosing the protocol; the hematological analysis showed levels within the normal reference values for the species (hematocrits: 45%; total proteins: 5.6 g dL^{-1}; albumin: 1.45 g dL^{-1}; and uric acid: 1.85 mg dL^{-1}). This approach allowed for a better understanding of the animal's overall health status and hepatic synthesis function (total proteins and albumin) and renal function (uric acid), which are essential in the pre-anesthetic evaluation (Cândido, 2014; Fantoni; Pinheiro, 2021b; Schmidt, 2014). Additionally, although an avian anesthetic risk score is crucial, it has limited specificity and should be interpreted alongside other factors.

The choice of butorphanol as one of the analgesics in the protocol was primarily due to its ability to reduce the need for general anesthetics inherent to opioids, and its lower potential for causing respiratory depression compared to morphine and methadone (Ludders, 2015). This is particularly important for maintaining good ventilation during anesthetic procedures in animals of this species. Additionally, butorphanol has a satisfactory effect when used for mild to moderate visceral pain in surgical procedures (Moraes, 2021), and its use has been considered for situations similar to the present case report. According to Fantoni and Pinheiro (2021c), butorphanol has a short duration of action and is therefore better suited for pre-anesthetic medication (PAM) and outpatient procedures than for surgical analgesia. However, in the present case, this drug was administered IM (dose of 0.5 mg kg^{-1}) as part of PAM and intraoperative analgesia, with an additional dose administered IM two hours after the anesthetic procedure. This approach kept the animal stable throughout the procedure, with no significant fluctuations in HR, RR, SBP, and pedal reflex. Thus, the analgesia employed was considered adequate for the procedure. Pavan *et al.* (2021) reported an anesthesia protocol in a goose of the same species, using an intravenous bolus of ketamine at 0.1 mg kg^{-1} for intraoperative analgesia.

Most protocols commonly applied for chemical restraint in Anseriformes consist of balanced combinations of dissociative drugs with benzodiazepines or alpha-2 adrenergic agonists (Cândido, 2014). In the procedure for the present case, a combination of ketamine at 9 mg kg^{-1} and midazolam at 0.5 mg kg^{-1} was administered IM after the opioid, successfully promoting immobility and relaxation of the animal. Pavan *et al.* (2021) used a PAM consisting of ketamine and midazolam at 20 and 1 mg kg^{-1}, respectively, consistent with the doses described by Cândido (2014) for using this combination in animals of this species. The use of an opioid as part of the PAM in the present case may justify the effectiveness in reducing the ketamine dose by more than half and the midazolam dose by half compared to the those described by Pavan *et al.* (2021) and Cândido (2014).

Midazolam does not cause irritation or pain when administered intramuscularly, and has sedative and hypnotic effects, making it the most commonly used benzodiazepine in birds and recommended for short procedures due to its short duration of action. Importantly, the duration of action of benzodiazepines varies according to the species and drug combinations (Fantoni; Pinheiro, 2021c; Moraes, 2021). An additional dose of midazolam was necessary during the surgery in the present case.

Propofol was used as an alternative anesthetic agent to isoflurane in the present case to evaluate its effects on a greylag goose (*Anser anser*) and to optimize anesthetic induction based on the anatomical peculiarities of the animal's beak. According to Ludders (2015), Samour (2016), and Pavan *et al.* (2021), the beak anatomy of these geese can challenge anesthetic inductions using inhalation agents; however, they reported successful anesthetic induction in these animals when using inhalation agents.

Propofol reduces cerebral metabolism by enhancing the inhibitory effects of the neurotransmitter gamma-aminobutyric acid (GABA) (Ludders, 2017; Moraes, 2021). The dose for anesthetic induction in domestic mammals when used alone is usually between 6 and 8 mg kg^{-1}; however, the use of a pre-anesthetic medication (PAM) protocol can allow for using lower doses of propofol. Generally, the time to achieve the anesthetic effect is up to 60 seconds after administration (Moraes, 2021).

According to Hawkins *et al.* (2018), a propofol induction dose of 5 mg kg^{-1} is recommended for turkeys; however, no specific information on anesthetic induction doses has been reported for Anseriformes in the literature. In the present case report, IV administration of propofol as a bolus of 5 mg kg^{-1} over one minute was sufficient to facilitate tracheal intubation; however, three 1-minute boluses of this dose were not enough to reach the ideal surgical anesthesia plane, which was achieved with administration of a dose-response in a 5-minute bolus, corresponding to a dose of 10 mg kg^{-1} min^{-1}.

Anesthetic induction is divided into four stages, and the third one is considered the anesthetic stage. This stage is subdivided into light, medium, and deep planes, with the medium plane corresponding to the surgical plane (Fantoni; Pinheiro, 2021d). The goose in the present case was considered to be in the surgical plane of anesthesia based on the criteria proposed by Heatley (2008) and modified by Fantoni and Pinheiro (2021d) for monitoring anesthetic stages and planes in birds, where the surgical plane of anesthesia is reached in the absence of palpebral, pedal, and caruncle retraction reflexes in response to pinching, and no pain response to feather plucking.

Initial HR and RR were 160 bpm and 16 breaths per minute, respectively, while cloacal temperature was 39.1 °C. Core body temperature was estimated during the intraoperative procedure by placing the thermometer in the pharynx, as cloacal temperature measurement was impractical due to the proximity to the surgical site. Core body temperature decreased by 0.2 °C compared to the initial temperature.

HR in birds weighing more than 2 kg is estimated at 110 bpm at rest, ranging from 110 to 175 bpm in motion, whereas normal RR at rest and in motion are estimated at 19 to 28 and 20 to 30 breaths per minute, respectively (Samour, 2010). The normal cloacal temperature range for birds has been well documented in the literature, with reference values ranging from 40 to 44 °C depending on the bird size and species (Tully Jr; Dorrestein; Jones, 2010). Cloacal temperatures of 38 °C and higher are commonly observed in healthy birds, whereas birds excessively affected by physical restraint stress have shown higher temperatures, above 40 °C.

HR during the anesthesia period ranged from 143 to 183 bpm, with an average of 168 bpm. The lowest RH values were recorded between PAM and the anesthetic induction stage, while the highest HR was recorded two hours after the start of the anesthesia procedure. This peak coincided with the surgical moment of greatest pain stimulus (removal of necrotic tissues) and the minimal duration of action of butorphanol. Minimum, average, and maximum respiratory rate (RR) were 9, 15, and 28 breaths per minute (rpm), respectively. The lowest RR values were recorded after PAM and after anesthesia induction using propofol, whereas the highest RR was found during the surgical field irrigation and necrotic tissue removal. The highest were found during surgical site cleaning and necrotic tissue removal.

Blood-oxygen saturation (SpO_2) ranged from 94% to 100%. SpO_2 is an important parameter to monitor for preventing hypoxia. The pulse oximeter should be placed in an area with good perfusion, minimal pigmentation, and no fur or feathers (Moraes, 2021). In the present case report, it was placed on the tongue, which is an appropriate area for the procedure, facilitated by the size of the animal. Regarding smaller birds, the oximeter is typically placed on featherless areas of the pelvic or thoracic limbs (Fantoni; Pinheiro, 2021d).

Systolic blood pressure (SBP) was measured throughout the intraoperative period using a Doppler system. An attempt to measure SBP prior to PAM was unsuccessful due to lack of cooperation from the animal. However, four measurement points were particularly important during monitoring. The first measurement was taken immediately after PAM to more accurately estimate the normal pressure of the individual, resulting in an SBP of 188 mmHg. The second measurement was conducted after anesthetic induction, showing an SBP of 144 mmHg, indicating a moderate reduction. The third measurement was during the removal of necrotic tissues, which showed a stable SBP. Ultimately, BP was measured at the end of the procedure when the goose was still slightly sedated, showing a value of 184 mmHg, close to the initial SBP. This could be related to a return to a light plane of anesthesia or some degree of postoperative pain.

Monitoring blood pressure is crucial during anesthetic procedures as it is a reliable indicator of the depth of anesthesia. Hypertension during anesthesia can occur due to vasoconstriction, light anesthesia, pain, hyperthermia, sympathomimetic drugs, or renal insufficiency. Hypotension during anesthesia may occur in cases of hypovolemia, low cardiac output, vasodilation, blood loss, and negative inotropism caused by drugs such as propofol and isoflurane, which cause dose-dependent cardiovascular depression (Moraes, 2021). Birds have high cardiac output and blood pressure, which ranges from 108 to 220 mmHg depending on the species (Lumeij; Ritchie, 1994). The use of propofol as anesthetic agent may have contributed to the reduction in SBP after its administration.

The duration of the anesthetic procedure was 3 hours and 10 minutes, with no loss in the quality of respiratory movements at any moment. Extubation was performed 5 minutes after the end of the procedure. Birds anesthetized for extended periods with a higher degree of muscle relaxation may experience reduced gas exchange due to muscle relaxation and the weight of the viscera on the air sacs, reducing their volume for ventilation (Vilani, 2014).

The primary post-anesthetic recommendation was to prevent the goose from accessing bodies of water within 24 hours post-operation to avoid drowning due to the sedative effects of the drugs used.

CONCLUSIONS

The use of propofol as an anesthetic agent in a greylag goose (*Anser anser*) was found to be appropriate, efficient, and safe when using a bolus of 10 mg kg^{-1} min^{-1} over five minutes to achieve the ideal surgical plane of anesthesia. Significant variations in respiratory and cardiovascular parameters were not found, although there was a more considerable reduction in respiratory rate during the anesthetic induction.

Therefore, propofol can be used as an alternative to inhalation agents to optimize and reduce the time of anesthetic induction, as well as for simple, short-duration procedures under conditions contraindicating the use of inhalant agents. However, further studies on this species are necessary to determine standardized doses of propofol and the expected effects.

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