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RESEARCH PAPER

Brachial plexus blockade in chickens with 0.75% ropivacaine

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Abstract

Objective To evaluate the quality of brachial plexus blockade with 0.75% ropivacaine in domestic chickens.

Study design Prospective experimental trial.

Animals Six 30-week-old female chickens, weighing 4.5 ± 0.4 kg.

Methods Six brachial plexus injections were performed after anesthetic induction with isoflurane. After achieving adequate muscle relaxation, the animals were positioned in dorsal recumbency and injected with ropivacaine (1 mL kg^{-1}). The birds recovered and assessments of motor function and response to pinch were scored every 5 minutes for 180 minutes. The scores were from zero (no response) to three (greatest response). The scores over time were analyzed using a Wilcoxon nonparametric test with statistical significance accepted if $p \leq 0.05$.

Results There was a significant difference ($p < 0.05$) from 15 to 130 minutes and 15 to 120 minutes for motor and sensory blocks, respectively. The onset of both blocks took 15 minutes and the effective periods of sensory and motor anesthesia were 105 and 115 minutes, respectively. Comparison between blocks at different times did not demonstrate significant differences ($p > 0.05$).

Conclusions and clinical relevance No complications were observed after the technique. Brachial plexus blockade with 0.75% ropivacaine is a simple and effective technique for procedures on the thoracic limb of domestic chickens.

Keywords birds, brachial plexus, chickens, local anesthesia, ropivacaine.

Introduction

Research in anesthesia is conducted with the aim of developing techniques that reduce risk to the animal and the cost of the procedure without compromising its efficacy. The great advantage of using local anesthesia is that it may be safer because it reduces the quantity of inhalational or intravenous anesthetics needed to assure a surgical plane of anesthesia. In addition, local anesthetics produce excellent analgesia, even in the immediate postoperative period (Massone 2002). The major limitations of the use of local anesthetics are the need for a good knowledge of the anatomic site for performing the blocks, as well as an understanding of the effects and toxic doses of anesthetics in each species (Cruz 2005).

Regional blocks are based on the injection of a local anesthetic around a peripheral nerve or group of nerves that forms a plexus, causing desensitization of large areas. Brachial plexus block has been carried out to allow interventions in the thoracic limb in regions below the elbow of dogs (Futema et al. 2002). Ropivacaine is the first local anesthetic utilized exclusively as the levorotary isomer (S-enantiomer) and is less cardiotoxic than bupivacaine in humans (McClellan & Faulds 2000). Moreover, ropivacaine causes less vasodilation than bupivacaine in humans (Akerman et al. 1988), increasing the duration of block and analgesia. In humans, post-operative analgesia lasted more than 20 hours in some patients undergoing brachial plexus blockade with 0.75% ropivacaine, reducing the need for further analgesic drug administration (Casati et al. 1998). The quality of motor block and duration of anesthesia in dogs were thought to be superior and the pain after injection was less pronounced in comparison to other anesthetics (lidocaine and bupivacaine) (Feldman & Covino 1988).

In the present study, ropivacaine was used for regional anesthesia of the brachial plexus in domestic chickens, with the aim of determining the effect, duration and quality of motor and sensory blocks achieved after its administration.

Materials and methods

The Institutional Animal Care and Use Committee approved the protocol and procedure (approval protocol no. 67618/2007).

Anatomic study

A preliminary study was carried out on specimens from the Anatomy Laboratory of the University for better visualization and localization of the brachial plexus. This was also carried out to determine the injection site by means of dissection of the area after injection of 1% Alcian blue stain, at the same volume as the anesthetic to be injected (1 mL kg^{-1}) (Fig. 1).

Animals

Six 30-week-old chickens (*Gallus domesticus*) weighing 4.5 ± 0.4 kg (mean ± SD) were used. These birds were obtained from a broiler chicken farm; they had been vaccinated for Gumboro and Marek's disease and were considered healthy after clinical and laboratory examinations. The animals were kept in a group in an appropriate area for birds, with bedding of wood shavings, feeders and water drinkers; the feed (bird ration) was provided twice daily, and water *ad libitum*.

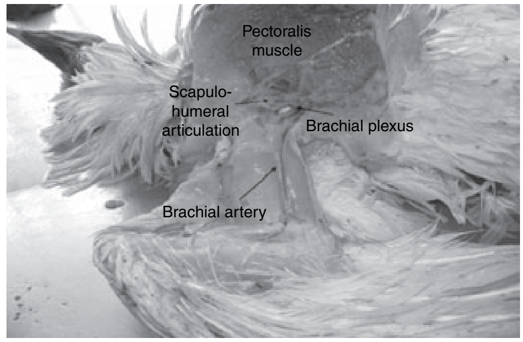

Figure 1 Illustration of the brachial plexus and its relationship with other anatomical structures.

Anesthetic procedure

Six blocks of the brachial plexus were performed, always in the right wing. The chickens were removed from their housing, transferred to individual cages and fasted for 12 hours, to reduce the risk of regurgitation and aspiration of stomach contents during inhalational anesthesia. On the day of the procedure the bird was kept in a climate controlled room, until there were no signs of excitation due to handling.

The motor and sensory tests were applied before the bird was anesthetized and taken as the baseline (see below).

The birds were anesthetized with isoflurane (Forane; Abbott Laboratories, Rio de Janeiro, Brazil) in oxygen using a face mask. Once adequate muscle relaxation to perform the block had been achieved, the administration of isoflurane was discontinued and the birds were maintained on 100% oxygen until the procedure was completed.

The bird was placed in dorsal recumbency and the right wing was positioned perpendicular to the keel. To locate the plexus, the bird was subjected to movements and palpation of the scapulo-humeral articulation where the roots of the plexus are located.

After preparation of the area, the block was performed by an injection of 1 mL kg^{-1} of 0.75% ropivacaine (Ropi 7.5 mg mL^{-1}; Cristália Chemical and Pharmaceutical Products, Itapira, São Paulo, Brazil) (dose of 7.5 mg kg^{-1}) with a 5 mL syringe and 40 × 0.8 mm hypodermic needle introduced into the pectoral musculature at a 90° angle to the wing and to the neck of the animal, using the technique described by Mendes et al. (2003) (Fig. 2). After the placement of the needle, 90% of the local anesthetic was administered and the remaining 10% was injected during the withdrawal of the

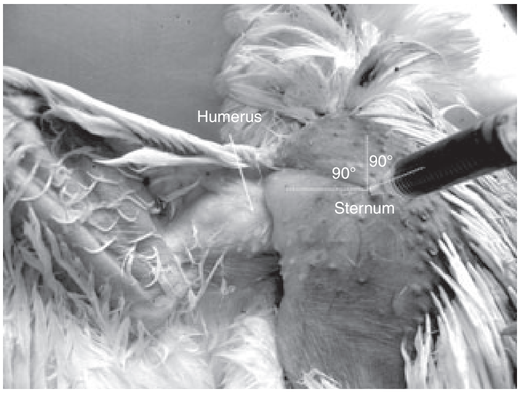

Figure 2 Picture of the site for performance of brachial plexus blockade in chicken.

needle from the musculature. The area was massaged manually for better dispersion of the anesthetic.

Evaluation of the block

At the end of the procedure, oxygen administration was discontinued, and the bird's recovery was monitored. From 5 to 180 minutes post-injection of ropivacaine, assessments of motor and sensory blockades were made at intervals of 5 minutes. For all evaluations the birds remained in the standing position in a restricted area of 1.0 m^2. The motor activity was evaluated by stimulation of the birds to flap their wings (a little push on the chicken's thorax), observing for opening of the blocked wing in relation to the nonblocked wing, and scoring the result as shown in Table 1. After this motor test, the sensory test was performed by applying a noxious stimulus at the proximal third of the radius/ulna of the two wings. The stimulus was a pinch with a Kelly hemostat until the first ratchet, applied for 3 seconds, and was scored as described in Table 2. These assessments were always performed by the same person (LBC).

The time from injection to the time where scores of 0 or 1 were reached for both evaluations was recorded as the latency for the initiation of the block. The interval between the start (score of 0 or 1) and end of the nerve block (return to score 3) was recorded as the duration of the block.

Table 1 Scoring for the evaluation of response to motor stimulus in the blocked wing

0	Without movement
1	Slight movements, almost imperceptible
2	Moderate movements, easily perceived
3	Abrupt movements, similar to that of nonblocked wing

Table 2 Scoring for the evaluation of response to sensory stimulus in the blocked wing

0	Withdrawal reflex and vocalization absent
1	Discrete withdrawal reflex, without vocalization
2	Disturbed upon pinching, with withdrawal reflex
3	Rapid withdrawal and/or vocalization

Statistical analysis

Sigma Stat software for Windows version 2.0 (Jandel Corporation, San Rafael, CA, USA) was used. Data from different times and baseline were analyzed with the Wilcoxon nonparametric test to determine possible differences. Comparison between blocks at different times was also performed by the Wilcoxon test. Significance level for statistical tests was set as $p \leq 0.05$.

Results

Scores of motor evaluations were significantly different from time zero at all time points from 15 to 130 minutes. Similarly, sensory scores were significantly different from time zero at all time points from 15 to 120 minutes. The latencies of both blocks were 15 ± 0.15 minutes and the durations were 115 ± 1.2 and 105 ± 1.1 minutes (mean ± SD) for the motor and sensory blocks, respectively (Fig. 3). Neither the latency nor the duration were different between motor and sensory blocks. One block did not work (score of 3 at all time points) and the data from this bird were excluded.

During the study, there were no signs of toxicity related to the dose of 7.5 mg kg^{-1} of ropivacaine. One bird showed excitation (vocalization, flapping of wings, defecation), but this was believed to be caused by the nature of the individual in response to physical restraint. One bird regurgitated before anesthetic induction, which could have been associated with inadequate withholding of food and water in the pre-anesthetic period.

Discussion

There are no data on the use of ropivacaine for brachial plexus block in domestic mammals for

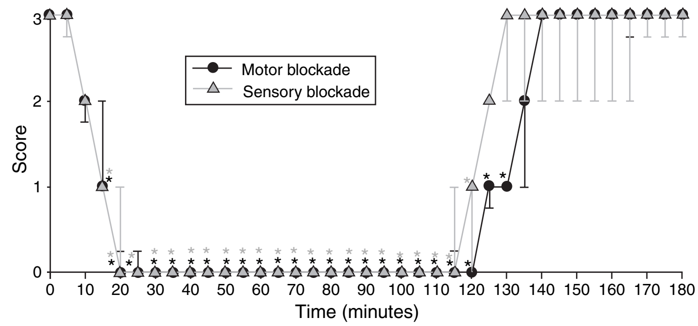

Figure 3 Variation of scores for response to motor and sensory stimuli in domestic chickens (n = 5) submitted to brachial plexus block with 0.75% ropivacaine. Values are shown as the median and interquartile ranges. *Significant differences in relation to M_0 ($p < 0.05$).

comparison with the results obtained in the present study. However, despite the faster metabolic rate of birds, the period of anesthesia was shown to be sufficient to perform some surgical procedures on thoracic limbs. When sensory and motor blocks were compared at different evaluation times during the experimental period, no statistical differences were noted. These results in chickens were different than in other species. Rosenberg & Heinonen (1983), McClellan & Faulds (2000) and Whiteside & Wildsmith (2001) reported that ropivacaine is more selective for fibers involved in motor function (A-beta) than for nociceptive fibers (A-delta and C) in comparison with bupivacaine. Cortopassi et al. (1999) and Feldman & Covino (1988) also showed that in similar concentrations, ropivacaine produces motor block of lesser intensity and shorter duration than bupivacaine in dogs, making it a good choice when the aim is to induce analgesia without loss of motor function. In addition, Caetano et al. (2006) reported that the utilization of sacral peridural block in children, submitted to inguinal herniorrhaphy with 0.2% ropivacaine, promoted sensory block of longer duration than motor block, which is considered an advantage for use in children who are uncomfortable with immobility of the limbs. We could not explain why the durations of both blockades were similar.

Futema et al. (2002) stated that the level of success of a technique depends on many factors, such as the distribution of the anesthetic, site of injection, volume administered, tissue conformation and structures adjacent to the nerve to be blocked. According to Massone (2002), the action of a local anesthetic is better when there is less connective tissue and vascularization at the site of injection. The efficacy of the block can be increased by the use of an apparatus such as an electrostimulator of peripheral nerves, which permits the exact localization of the nerves, thus helping the administration of anesthetic as close as possible to the target location. Another alternative is the use of the obstruction of arterial blood flow technique combined with multiple injections, as reported by Futema (2005) in dogs, which contributes to greater block effectiveness. The latency period and duration of blocks can be related to the improvement of the technique, since it was observed that these times became shorter and longer, respectively, during the course of the study. With regard to the chicken that did not respond to anesthetic block, we assumed that this was an error of technique, as this animal did not show any sign of anesthetic effect. For this reason, its data were not included in statistical analysis.

Ropivacaine produces less CNS and cardiovascular toxicity than racemic mixtures of bupivacaine because it contains only the S-isomer. However, it has a lower threshold for cardiovascular and CNS toxicity than lidocaine in rats, pigs and humans (Feldman et al. 1989; Johnson et al. 1999). The toxicity of ropivacaine has not been determined in chickens, nevertheless the use of lidocaine in local anesthesia of these animals demonstrated that the dose is important and is related to complications. Cruz (2005) reported that convulsions and cardiac arrest have been observed in chickens when using lidocaine at a dose of 67 mg kg^{-1}, and Mendes et al. (2003) utilized the same anesthetic at a dose of 20 mg kg^{-1} without complications, despite the maximal recommended dose being 4.0 mg kg^{-1} (Ludders & Matthews 1996). We observed no signs of toxicity after using the dose of 7.5 mg kg^{-1} of ropivacaine. The excitation showed by one animal was due to physical restraint and no problems were noted after the anesthetic procedure. The stress and excitation associated with physical restraint can result in the need for higher anesthetic doses to the point of killing the animal (Ludders & Matthews 1996). These same authors cited that despite recommendations that fasting be very limited in birds, due to their high rate of metabolism and low hepatic reserves of glycogen, a 12-hour fast is not deleterious to the bird to be submitted to anesthesia. The episode that involved regurgitation in one chicken could have produced life-threatening complications for the animal, such as aspiration pneumonia. However, the bird was observed for several weeks and did not show any sign of respiratory distress.

The utilization of isoflurane to induce anesthesia with the use of a face mask was satisfactory. It produced adequate relaxation and made the performance of the procedure quick and effective, without major risks to the animals (Ludders & Matthews 1996; Guimarães et al. 2000; Murphy & Fialkowski 2001).

Conclusion

Based on the present study, we conclude that brachial plexus blockade with the use of 1 mL kg^{-1} of 0.75% ropivacaine is easy to carry out and results in anesthesia with satisfactory duration and intensity for the performance of procedures on the wing of chickens. This may be especially useful when combined with general anesthesia to allow a reduced dose of the general anesthetic.

Dedication

This work is dedicated to our beloved Levi, an example of happiness and hard work.

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