Ultrasound-guided inferior alveolar nerve block in donkeys
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ABSTRACT

The objective of the present study was to describe an ultrasound-guided technique of the inferior alveolar nerve block in donkeys. Preliminary study involved performing descriptive dissection of the mandibles of three fresh donkey heads as a base for ultrasound-guided injection of a colored dye just beside the nerve in another six intact fresh donkey head. Assessments of the technique and the most appropriate approach were recorded Color doppler flow ultrasound was used to guide the needle insertion for inferior alveolar nerve block in six alive donkeys. A full anesthetic evaluation was performed. The surgical anatomy of the ventral mandible of the donkey was similar to the horse. The course and relations of the inferior alveolar nerve and blood vessels were recorded. The proper location of ultrasound transducer with the most appropriate diagnostic angle was determined and the point of needle insertion with the least tissue invasiveness regarding the preliminary study results were also documented. The color flow doppler offers great assistance in locating the blood vessel accompanying inferior alveolar nerve and make approaching the nerve block more fast, feasible and efficient. The clinical anesthetic evaluation showed a hundred percent efficiency and no post anesthetic complications. Advancement of veterinary diagnostic tools at the same time with low costs and readily availability make the use of ultrasound a reliable option for guidance in nerve blocks especially for those deep nerves related with vital structures.

Keywords: Donkey; Inferior alveolar nerve; Ultrasound guided nerve block; Local analgesia

1. Introduction

Mandibular fracture, dental injuries, mandibular periodontal and endodontal diseases and other surgical disorders of mandible may require surgical intervention under the effect of regional or general anesthesia (Ducharme, 2004). General anesthesia is associated with high anesthetic risks. The safer and more reliable option; regional analgesia plays a fundamental role in providing the required anesthesia and analgesia either in the field or in animals with high risk of anesthetic complications (Lizaragga et al., 2004). Regional analgesic techniques provide an immediate pain relief, very smooth recovery and no hospital stay in contrast to general anesthesia (Singelyn et al., 1998; Capdevila et al., 1999). Various factors can markedly affect the success and outcome of peripheral nerve blocks. These include the exact location of the nerve to be blocked and how it may be reached safely and accurately and the type and amount of the local anesthetic used for the block. (Futema et al., 2002). The anatomy of the mandibular region in equines is complicated.

The inferior alveolar nerve (IAN) adheres to the medial aspect of the mandible with the inferior alveolar artery lateral to it. The mylohyoid nerve innervating the mylohyoid and digastric muscles lies caudal to the IAN. The lingual nerve lies ventromedial to the IAN, giving branches to the base of the tongue (Henry et al., 2014). The IAN is a main branch of the mandibular nerve. It runs in a shallow groove on the medial aspect of the mandible until enter to the mandibular foramen as the mental nerve with six or furthermore branches. (Dyce et al., 2010 and Budras et al., 2012). The IAN forms a complex with the inferior alveolar blood vessels (IABv). The inferior alveolar complex (nerve and blood vessels) runs between the internal pterygoid muscle and the mandible and enter the mandibular canal together (Dyce et al., 2010 and Budras et al., 2012). Inferior alveolar nerve of both sides of the mandible provides innervation to the ipsilateral canine, premolars, molars, incisor teeth, skin and lip rostral to the mental foramen. Inferior alveolar nerve block desensitizes these structures and provide analgesia adequate for surgery (Doherty and Schumacher, 2011; Ashdown and Done, 2011).

Inferior alveolar nerve block has more than one approach. The ventral approach is performed by advancing a 12.5 cm spinal needle transcutaneous at ventral ramus while maintaining it in close proximity to the medial mandibular periosteum, underneath the medial pterygoid muscle, until the convexity of the dorsal margin of the foramen is contacted (Fletcher, 2004 and Tremaine, 2007). Fifteen to twenty cc of local anesthetic solution is infiltrated in the area as described by (Fletcher, 2004 and Henry et al., 2014). Complete desensitization within 15 to 30 minutes is recorded (Woodie, 2013). Other reported approaches include the caudal approach (Fletcher, 2004) and intraoral approach (Henry et al., 2014). These approaches comprise insertion of the needle either from the interior of mouth cavity or at the caudal angle of the mandible to reach the target nerve before entering the mandibular foramen.

Ultrasound guided nerve block (UGNB) is a recent advanced technique. The ultrasound provides the operator with an image of either the nerve or in other instances the blood vessels associate the nerve with the aid of color flow Doppler. UGNB offers an accurate needle direction and position and monitor the distribution of the local anesthetic solution in real-time. This technique also has the potential advantages of improved nerve block efficacy, faster approach, and smaller volumes of local anesthetic solution required (Marhofer et al., 1997, 1998, 2005 and Grau, 2005).

2. Material and methods

2.1. Animals

The present experimental study was carried out on nine fresh heads of donkey cadavers prepared for undergraduate student anatomy sessions, and six healthy donkeys of both sexes with average body weight 150-200 kg and age 4- 8 years for the clinical experimental study. All procedures were performed at the department of surgery, faculty of veterinary medicine, Damanhour University and obtained an ethical approval 3/10-
Figure 1: The caudal approach of injection of methylene blue under direct visualization with ultrasound.

Figure 1: Anatomical dissection of the mandibular area that demonstrating inferior alveolar nerve, inferior alveolar artery, medial pterygoid, mandibular bone and masseter muscle.

Figure 1: (A). The Ultrasonogram of the medial aspect of the mandible with the caudal approach in cadaver. The red circle demonstrating the inferior alveolar nerve. (B) shows anatomical dissection from the lateral aspect of the mandible.
Figure. 4: Anatomical dissection from the medial aspect of the mandible after injection of the mandibular nerve by methylene blue. (a) pterygoid muscle, (b) inferior alveolar nerve.

Figure. 5: A) Shows needle penetration through the caudal aspect of the mandible beneath the pterygoid muscle (the red circle marks the distance to the target nerve). The distance from skin to the nerve is 3.92cm. B) The red circle demonstrating the mandibular artery and associated inferior alveolar nerve (the site of LA injection).
Further dissection of the facia to expose the inferior alveolar nerve. Intraoral points were recorded and tabulated for statistical analysis. The distance differs according to the age, sex and body habitus of ultrasound-guided inferior alveolar nerve block in donkeys. High scoring of staining with methylene blue dye showed a close correlation of the appropriate position and angle of ultrasound transducer, degree of tissue invasiveness, the optimal point of needle insertion, and feasibility of the procedure.

Results

The mandibular inferior alveolar nerve block is a challenging procedure. Both ventral and caudal blind approaches comprise various technical difficulties and frequent intra and post anesthetic complications. The individual anatomical variations are a serious issue for the success of the nerve block. The present study was based on a rationale of offering a reliable, feasible and an accurate technique for inferior alveolar nerve block in donkeys. Several approaches are described for the inferior alveolar nerve block in different animal species. In pet animals, the intraoral approach is a common technique (Goudie-DeAngelis et al., 2016) and the extraoral ventral approach is not more common (Beckman, 2007). In cattle the ventrocaudal extraoral approach (Ducharme, 2004) and intraoral approach was performed in cadavers (Ashdown and El-Sherif, 2018). In equine, more than one approach is reported; the caudal, the ventral extraoral (Fletcher, 2004) and the intraoral approach (Henry et al., 2014). Ultrasound guidance is a common assistance process used in several superficial and deep nerve blocks in animal species (O’Morrow, 2010; El-Khamary et al., 2017). To our knowledge, the present study is the first article describing the use of ultrasound as a guidance for the inferior alveolar nerve block in donkeys. An in detail anatomical description of the inferior alveolar nerve and its relation to adjacent blood vessels and tissues are described in donkeys in the current study. The mandibular foramens was located on the medial aspect of the mandible and the best site to reach it was located at a 4cm space. Frequency of the approach was 3 to 4 cm in average distance. The distance varies according to the age, sex and physical conformation of the animal.

In the clinical study, ultrasound was beneficial to identify the mandibular nerve that appeared as a hypoechoic band and surrounded by a hypoechoic pulsating area of the inferior alveolar artery that declared by Doppler flow ultrasound. Color doppler flow ultrasound offers great assistance for more accurate inferior alveolar nerve block in donkeys, reduced the volume of local anesthetic and accuracy of the procedure. The individual anesthetic needed, resulted in faster onset of action and reduced risk of local and systemic toxicity. These results elect this approach for wide use and evaluation by veterinarians in clinics and in the field.

Conclusion

Color doppler flow ultrasound offers great assistance for more accurate inferior alveolar nerve block in donkeys, reduced the volume of local anesthetic needed, resulted in faster onset of action and reduced risk of local and systemic toxicity. These results elect this approach for wide use and evaluation by veterinarians in clinics and in the field.

Competing Interests

The authors have no conflict of interest.

References


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