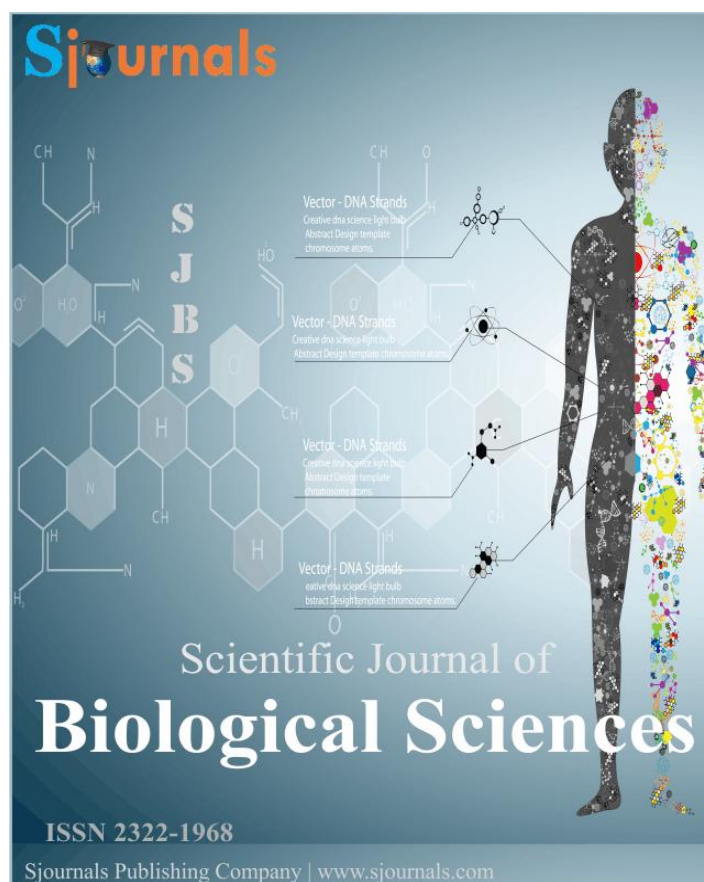


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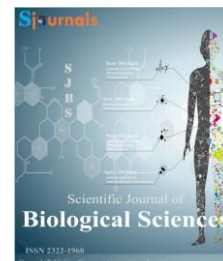
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Original article

Presentation of an intraoral approach for mandibular alveolar nerve block in cattle: Cadaveric study

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ABSTRACT

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The mandibular alveolar nerve at the point of entry at the mandibular foremen was anatomically determined in bovine in order to distinguish the capability to reach the nerve via the oral cavity. The mandibular nerve provided sensation to the check teeth, tongue and mandible. Desensitization of the mandibular alveolar nerve enables surgeons to perform effectively and safely in these structures. Extra and intraoral approaches of the mandibular alveolar nerve block are well recognized in human and horses. An intraoral approach to the mandibular alveolar nerve in bovine was presented in the present study based on the anatomical findings. It is hypothesized that the approach was reliable, applicable and safer than the extraoral method.

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1. Introduction

Many surgical oral diseases can interfere with cattle's prehension of food; Mandibular fracture, dental injuries and decay (periodontal or endodontal diseases), lingual and buccal membrane wounds as well as lacerations are examples of such cases (Ducharme, 2004) that require surgical intervention under the effect of anesthesia. Although general anesthesia still a choice for surgical intervention in cattle, there are some risks with its use. Many surgical procedures can be performed humanely and safely in cattle by using a combination of

physical restraint, sedation, and local or regional anesthesia. Local or regional anesthesia is effective, safe and is still the most desirable and applicable procedure in many situations (Edmondson, 2008). Benefits of effective nerve blocks include owner compliance for invasive surgery, ease of administration, minimal equipment requirements, low cost, and reduced incidence of complications (Ivany and Muir, 2004). The mandibular region in cattle is anatomically unique; the parotid salivary glands are located ventral to the ear, extend along the caudal border of the mandible. The mandibular glands are more axial than the parotid one and centered on the angle of the mandible (Ducharme, 2004). The mandibular nerve was sensory to the teeth, oral mucosa, and skin of the lower jaw, as well as the tongue, parotid gland, and part of the ear (Budras et al., 2003). Mandibular nerve block is commonly applied to perform surgeries at this region in horses, dogs and cats (Lantz, 2003; Fletcher, 2004; Dixon et al., 2005; Tremaine, 2007; Lowder, 2012; Henry et al., 2014).

The conventional approach to desensitize the inferior alveolar nerve in equine described by Tremaine (2007). A 130-150 mm long needle is introduced at the medial aspect of the ventral margin of the ramus of the mandible, at the level of the rostral insertion of the masseter muscle. The needle is advanced along the medial side of the ramus to an intersection point of a horizontal line drawn along the buccal occlusal surface of the maxillary cheek teeth and a vertical line drawn from the rostral insertion of the masseter muscle to the lateral canthus of the eye. Fletcher (2004) described an alternative approach where the needle is inserted from the caudal aspect of the ramus of the mandible. Henry et al. (2014) presented an intraoral approach. The needle is introduced just distal and caudal to the third molar tooth of the quadrant to be anaesthetized.

In concern with the mandibular alveolar nerve block associated with difficulty in assuring that the anaesthetic solution is deposited close to the mandibular foramen, risks of inadvertent damage of structures when performing this block and iatrogenic lingual trauma from inadvertent desensitization of the lingual nerve (Henry et al., 2014). The intraoral approach for inferior alveolar nerve desensitization has been used in human, dogs and horse (Yagiela, 2000; O'Morrow, 2010; Henry et al., 2014). It has been found in horse that injecting the local anaesthetic rostral to the mandibular foramen resulted in adequate desensitization of the inferior alveolar nerve with minimal complications. The objectives of this study were to: 1) Determine average measurements of the location of the mandibular foramen on adult cattle skulls, 2) Demonstrate that an alveolar mandibular nerve block can be performed intraorally on five cadaver heads.

2. Materials and methods

2.1. Anatomical study

Twenty adult cattle skulls and five fresh heads obtained from slaughterhouse were examined to document the approximate location of the mandibular foramen. Measurements include the mandibular foramen to the rostral border of the ramus of the mandible and mandibular foramen to the pterygomandibular fold as well as the distance from the mouth commissure to the pterygomandibular fold. All measurements were tabulated and mean value will be estimated by using of Vernier caliper (0-150 mm) and documented in Table 1. Surgical anatomy of structures of the mandibular region was demonstrated according to Budras et al. (2003) in bovine.

2.2. Experimental intraoral mandibular alveolar nerve block

Results of the landmark measurements were used as a guide to introduce a tool designed to reach the mandibular foramen effectively. The tool designed for intraoral mandibular alveolar nerve block with 20 cm Allis tissue forceps, 6 cm, 16-gauge needle with Luerlock hub on an extension set with syringe attached (Fig. 2). The mouth is opened with mouth gage, the tongue is grasped and fixed on a side of the mouth, the needle is advanced caudally and inserted into the pterygomandibular fold immediately below the hard palate. The 6-cm length needle is advanced totally. Five ml methylene blue dye is injected. The mandibular alveolar nerve at the other side is blocked at same manner (Fig. 3).

2.3. Evaluation and assessment

Infiltration of 5 ml of methylene blue on each side was performed. Dissection was performed to distinguish the area infiltrated and to evaluate if the nerve is included. Evaluation and assessment process is performed according to Campoy et al. (2008) and El-Khamary et al. (2017).

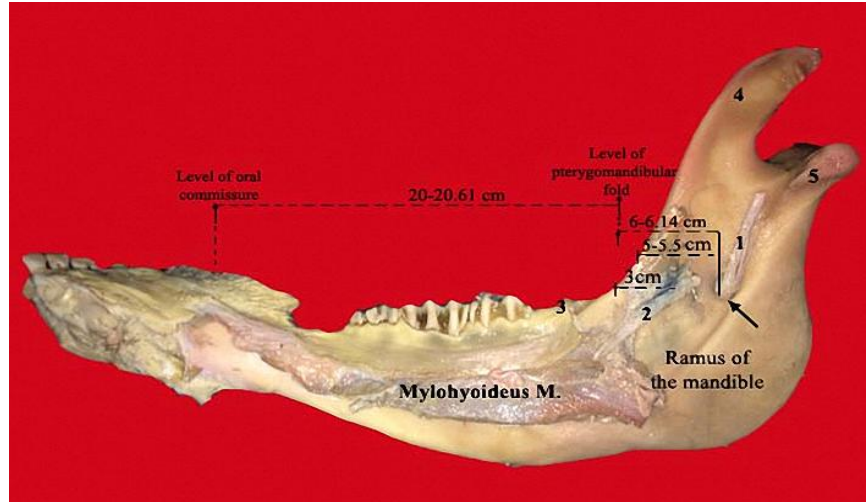


Fig. 1. Showing the medial aspect of the right mandibular ramus.

1- Mandibular alveolar nerve 2- Lingual branch of mandibular nerve 3- Pterygomandibular fold (cut).



Fig. 2. A photograph showing the tool designed for intraoral mandibular alveolar nerve block.

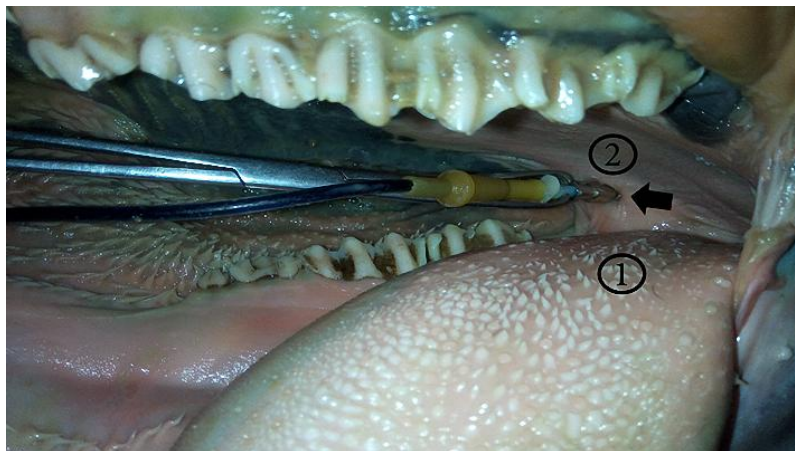


Fig. 3. A photograph showing the right intraoral mandibular alveolar nerve block.

1- Base of the tongue, 2- Hard palate. The black arrow indicates the injection site at the pterygomandibular fold.

3. Results and discussion

3.1. Anatomical findings

The mandibular alveolar nerve passes commonly with the lingual one of the mandibular nerve within an adipose sheath. In the pterygoid region (Fig. 4), the inferior alveolar nerve which known by the mandibular alveolar

nerve descends rostroventral and laterally to insinuate in between the pterygoideuslateralis muscle (dorsolateral) and the pterygoideusmedialis muscle (ventromedial). The nerve emerges on the lateral face of the pterygoideusmedialis muscle where it detaches the mylohyoid nerve, which proceeds rostroventrally on the lateral aspect of the latter muscle, then it extends ventrally to innervate both the mylohyoid muscle and the rostral belly of digastricus muscle. The mandibular alveolar nerve inclines toward the medial aspect of the ramus of the mandible to enter the mandibular foramen (Fig. 5). The latter is located about 6-6.5 cm from the pterygomandibular fold with the same level of the hard palate. At the point of entrance of the inferior alveolar nerve between the pterygoideuslateralis and medialis muscle, the lingual nerve detaches out with an acute angle and passes rostrally caudal to the pterygomandibular fold by about 2.5-3 cm where it crosses the rostral border of the pterygoideusmedialis muscle in a rostroventral direction, then it inclines ventrally to the styloglossus muscle and sublingual salivary gland.

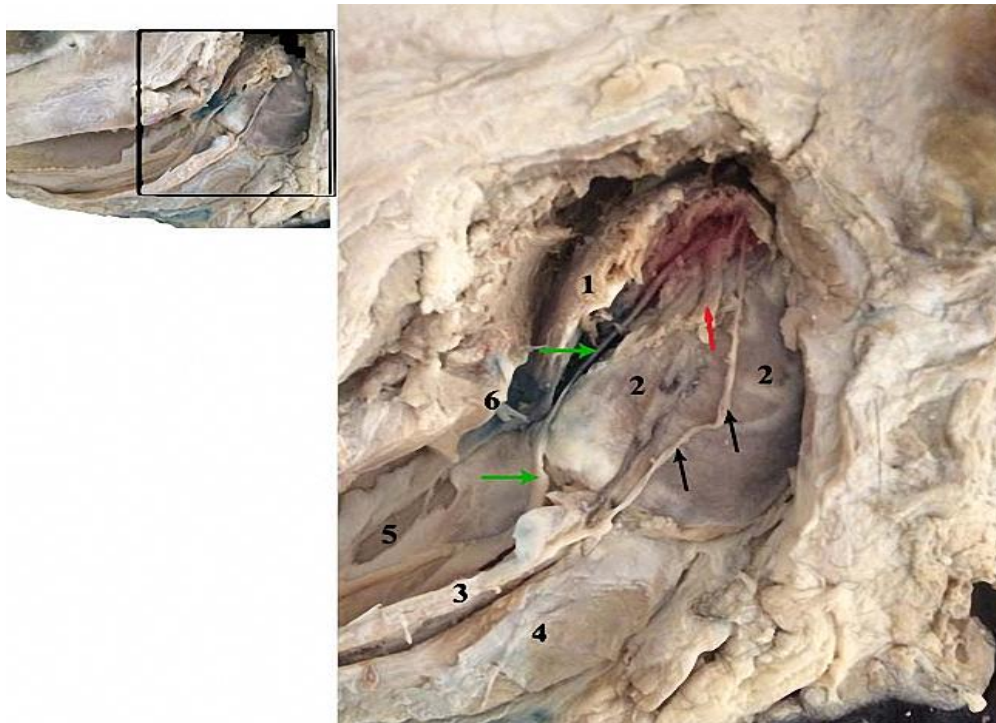


Fig. 4. A photograph showing the deep dissection of the medial aspect of the mandible (left side) after removing its ramus.

1- Pterygoideuslateralis M. 2- Pterygoideusmedialis M. 3- Mylohyoides M. 4- Rostral belly of digastricus M. 5- Styloglossus M. 6- Pterygomandibular fold. The black arrows indicate the mylohyoid nerve, the green arrows indicate the lingual nerve of mandibular N. and the red arrow indicates the mandibular alveolar nerve.

Table 1

Morphometric measurements of the bovine mandible.

Morphometric parameter	Mean + SD
Mandibular foramen to cranial border of mandible	5±55
Mandibular foremen to the pterygomandibular fold	6±14
Distance of mouth commissure to the pterygomandibular fold	20±61

3.2. Assessment of the intraoral mandibular alveolar nerve block approach

The insertion of the needle to distinguish the landmarks was easily applied. Dissection of the medial aspect of the mandible revealed infiltration of the methylene blue dye 2 cm area around the mandibular alveolar nerve trunk at its emergence at the mandibular foremen (Fig. 5). Infiltration of local anesthetic solution with aid of 2 cm

style needle desensitizes the lingual nerve (lingual nerve block), while using 6 cm needle desensitizes the mandibular alveolar nerve (mandibular alveolar nerve block).

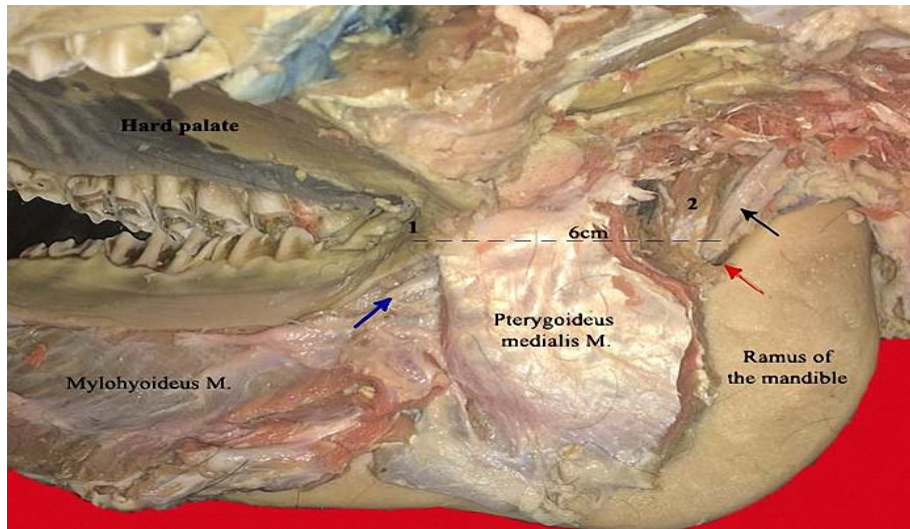


Fig. 5. Showing the medial aspect of the right mandibular ramus.

1- Pterygomandibularfold, 2- Pterygoideuslateralis M. The black arrow indicates the mandibular alveolar nerve. The red arrow indicates the mandibular foramen and the blue arrow indicates the lingual of mandibular nerve.

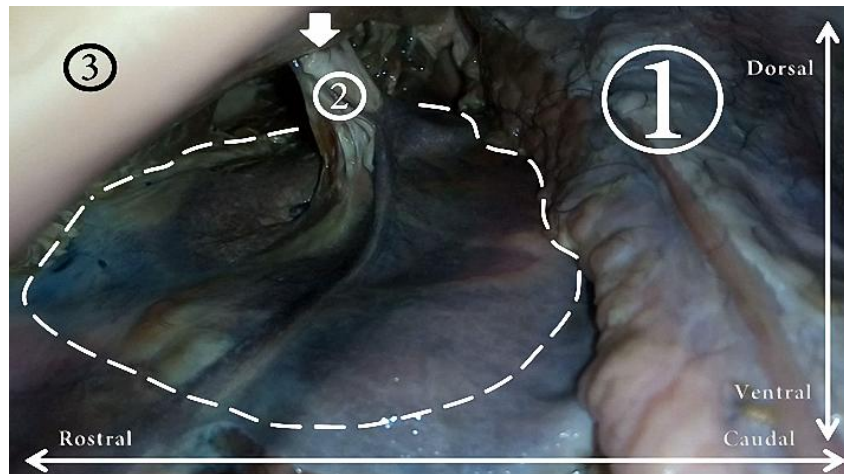


Fig. 6. A photograph to evaluate the intraoral mandibular alveolar nerve block.

1- Parotid salivary glands, 2- Mandibular alveolar nerve, 3- Ventral border of the mandible. The white arrow indicates the mandibular foremen, the white dotted area stained with methylene blue dye is the desensitized area.

The anatomical study in the recently intended work, described the course of the mandibular alveolar nerve with its related nerves and muscles as well as the anatomical location of the mandibular foramen from the rostral border of the ramus of the mandible. These findings were nearly achieved by Henry et al. (2014) in horse. In this aspect, our present investigation represented the results in both cadaveric and bony states and according to the anatomical findings, the measurements of the mandibular foramen were done from the rostral border of the mandible. The results under discussion achieved that intended the intraoral mandibular nerve block the method of choice rather than the extraoral one. This statement was not recorded and denied by the available literatures. On the other hand, Allouch (2014) in bovine and Gambo et al. (2014) in Kuri cattle focused on the landmarks of the foramen from the caudal, basal and angle of the mandible in the bony state only. Accordingly, they prepared these studies for the extraoral method for the mandibular nerve block.

Regarding the critical anatomical structures in the parotid region in our work which represented in the massive parotid and mandibular salivary glands, parotid lymph node and the great blood vessels (common carotid artery and maxillary vein), the administration of the mandibular nerve block safely indicated intraorally. That was similarly done in horse (Tremaine, 2007; Harding et al., 2012; Lowder, 2012; Henry et al., 2014; Molly, 2017). The recently performed dissection declared out that the mandibular alveolar nerve arose at the same level of the hard palate. It was caudally situated by 6-6.5 cm from the pterygomandibular fold, accordingly, the introduced needle should be inserted just ventral to the hard palate in the fold with a caudal direction for about 6- 6.5 cm in depth. These results were not correlated with Henry et al. (2014) in horse which intended the injection site caudal to the last molar teeth in the pterygomandibular fold.

The results applied in our observations recorded the anatomical course of the lingual branch of the mandibular nerve of cattle, it ran ventrally on the rostral border of the pterygoideusmedialis muscle and 2.5-3 cm caudally to the pterygomndibular fold. This finding pointed out that for the lingual nerve block, the needle should be inserted mildly deep for about 2.5-3 cm in the fold. A result which was not pointed out by any of the available literatures. The results which demonstrated on the mandibular alveolar nerve block from an extraoral approach were documented for surgical procedures of the mandible in the horse (Tremaine, 2007; Harding et al., 2012; Lowder, 2012). Intraoral approach of mandibular alveolar nerve block was clinically applied in horses (Henry et al., 2014). Successful block and minimal complications were reported as main results of the study. The present study shows successful approach of the mandibular alveolar nerve. Anatomical variations between horse and cattle presented in large continuous salivary glands at the caudal aspect of the mandible and mandibular angle makes the extraoral approach more tissue destructive. Also, anatomical location of the linguofacial vessels caudal to the mandibular alveolar nerve makes the intraoral approach more appropriate and less invasive than the extraoral technique.

The methylene blue dye infiltration demonstrated that the intraoral approach to the mandibular alveolar nerve block allowed an accurate placement of the local anaesthetic at the mandibular foramen. The needle placement at the mandibular foramen was easily performed and the distribution of the local anesthetic adequately infiltrated the area of the mandibular alveolar nerve. The volume of local anesthetic injected (5 ml) that represented by the methylene blue dye adequately covered 2 cm wide area around the mandibular alveolar nerve. This volume of local anesthetic (5 ml) is much less than the volume used for extraoral approach (10-20 ml) in horses (Caldwell and Easley, 2012). The reliability and efficacy of the block should be confirmed by the submission of the approach to clinical cases. An intra-operative complication includes trauma of the lingual branch or the mandibular alveolar nerves. This is a concern with both the extra and intraoral approaches. The needle used in the present study (Sprotte type) has pointed closed end (Fig. 2) and the hole is not at the tip, otherwise, two holes are located at the side of the needle with 1 cm in between distance. This type of needle decreases the incidence of nerve trauma and makes distribution of the local anesthetic more appropriate. Sprotte type needle is used for spinal anesthesia and advised for its minimal dura trauma incidence (Turnbull and Shepherd, 2003).

4. Conclusion

The intraoral mandibular alveolar nerve block approach is based on a good understanding of bovine head anatomy. To our knowledge, this is the first report presents this approach in cattle, tools required are 6 cm Sprotte type needle with an extension PVC tube and a delivery syringe and fitted on 20 cm Allis tissue forceps that allows the operator to manipulate the needle securely in the oral cavity. The needle is introduced just distal to the hard palate and caudal to the last molar tooth on both sides, on the medial surface of the ramus of the mandible, allowing infiltration of the local anesthetic directly over the mandibular alveolar nerve at its entrance to the mandibular foramen. Further studies should be performed to evaluate the reliability, efficacy and safety of the current technique.

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