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Minimally invasive unilateral arytenoid lateralization in dogs: A cadaveric study

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ABSTRACT

The aim of this study was to develop a minimally invasive thyroarytenoid lateralization technique (MITAL). Eleven unilateral MITAL procedures were performed on 11 canine cadavers. Two hypodermic needles were passed through the skin into the lumen of the larynx, penetrating the thyroid and arytenoid cartilages. Suture material was passed through the needles to lateralize the arytenoid cartilage. A rigid endoscope was used to visualize needle insertion and suture material placement. A key-hole approach to the larynx was performed and the suture material was knotted on the lateral aspect of the thyroid cartilage. The change in the rima glottidis area was recorded as were the duration of the procedure and complications encountered.
The landmarks for needle insertion were easily palpated, and a significant increase in the area of the rima glottidis was documented after performing unilateral MITAL. In conclusion, unilateral MITAL is a quick, minimally invasive procedure which increases the area of the rima glottidis in cadaveric dogs.

1. Introduction

Laryngeal paralysis results in partial or complete loss of the ability of the arytenoid cartilages to abduct during inspiration (Bjorling, 1995; Hedlund, 2002; White, 1989). Although a congenital form of the disease is reported, the acquired form is the more common, affecting middle-aged to older large and giant breed dogs (Greenfield, 1987; Holt and Harvey, 1994; MacPhail and Monnet, 2001; White, 1989). Multiple etiologies are associated with laryngeal paralysis; however, in cases of idiopathic laryngeal paralysis (Gaber et al., 1985; MacPhail and Monnet, 2001; Ridyard et al., 2000), it has been shown that degeneration of the recurrent laryngeal nerves leads to atrophy of the intrinsic abductors of the larynx that are critical for normal function (Thieman et al., 2010). Affected animals present with a wide variety of clinical signs including change in phonation, stridor, coughing (especially during eating and drinking), exercise intolerance, and respiratory distress (Gaber et al., 1985; White, 1989).

Surgery is indicated in dogs with moderate to severe clinical signs or decreased quality of life. The aim of surgical treatment is to decrease laryngeal resistance by manipulating laryngeal tissues that obstruct the rima glottidis during inspiration (Monnet and Tobias, 2012). Many techniques have been described and include, unilateral arytenoid lateralization (MacPhail and Monnet, 2001; White, 1989), bilateral arytenoid lateralization (Burbidge et al., 1993; Rosin and Greenwood, 1982), bilateral thyroarytenoid lateralization (Monnet and Tobias, 2012), vocal fold excision and mucosoplasty (Schofield et al., 2007), vocal fold resection (Ridyard et al., 2000), partial laryngectomy (Harvey and O'Brien, 1982; Ross et al., 1991) and castellated laryngofissure (Gourley et al., 1983). The method of choice is unilateral cricoarytenoid lateralization (Hedlund, 2002), however, in a previous report, there was no difference in clinical outcome between crico- and thyroarytenoid lateralization (Griffiths et al., 2001).

The superficial location of the larynx, the location of the arytenoid cartilage medial to the thyroid cartilage, and the ability to visualize the lumen of the larynx, favor the development of a minimally invasive technique for unilateral thyroarytenoid lateralization. The aims of this study were to develop a minimally invasive thyroarytenoid lateralization (MITAL) technique, and to evaluate a safe corridor for the placement of the prosthesis in canine cadavers.

2. Materials and methods

The procedure described herein is a modification of the open thyroarytenoid technique (Rosin and Greenwood, 1982), in which the arytenoid cartilage is sutured to the thyroid cartilage, resulting in arytenoid cartilage lateralization. Eleven canine cadavers free of laryngeal or pharyngeal pathology, euthanized for unrelated reasons, were used. Dogs were refrigerated (5 °C) immediately after euthanasia and the procedure was performed within 48 h.

A 10 mm, 15° rigid endoscope attached to a light source, camera, and monitor (Karl Stortz, Germany) was used. Video data were captured on a digital storage device (SDC HD, Stryker) and analyzed using Videopad Video Editor Software.[1] Individual images were captured from the video

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[1] See: http://www.nchsoftware.com/videopad/index.html.

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0034-5288/

using the Videopad software and used to determine the area of the rima glottidis prior to, and following the procedure.

2.1. Surgical procedure

Eleven unilateral MITAL procedures were performed on 11 canine cadavers. MITAL was performed on the right side in all cadavers; and is illustrated in an isolated larynx in Fig. 1. The hair on the ventral and lateral aspect of the neck was clipped. Dogs were placed in ventral recumbency, with the head extended and lifted off the table with a loop of gauze bandage passed caudal to the maxillary canine teeth as described for soft palate resection (Richard, 2006). The endoscope was passed into the oropharynx until the entire rima glottidis was visible. A gingival probe with millimeter markings was advanced and placed cranial to the corniculate processes to provide scaling. The probe was removed and an endotracheal (ET) tube, with a diameter that did not extend dorsal to the junction of the vocal fold and the arytenoid cartilage, was placed.

Two, 1.5 inch, 18 gauge needles were inserted, percutaneously, into the laryngeal lumen from the right. The first needle was advanced through the skin, parallel to the floor, from lateral to medial, until it entered the laryngeal lumen after penetrating the thyroid and arytenoid cartilages. In a pilot study completed prior to this study, it was determined that the needles must penetrate the lateral aspect of the thyroid cartilage, craniodorsally, in order to pass into the lumen of the larynx while engaging both thyroid and arytenoid cartilages. Ideally, both needles should pass through the craniodorsal aspect of the thyroid cartilage as depicted in Fig. 2. The craniodorsal aspect of the thyroid cartilage is caudal to the cranial horn, ventral to the dorsal border, and caudal to the cranial border of the thyroid cartilage. The craniodorsal aspect can be found by palpating the space between the thyrohyoid cartilage and the cranial border of the lateral lamina of the thyroid cartilage.

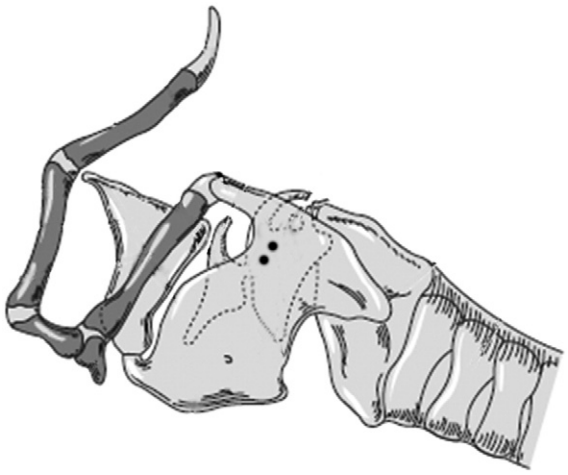

Fig. 2. Lateral view of the larynx of a dog. The two dots indicate the location at which the needles should penetrate the thyroid cartilage.
Modified from Miller's anatomy of the dog. 4th edition (reprinted with permission).

The dorsal aspect of this space is closed by the attachment of the thyrohyoid cartilage to the cranial horn of the thyroid cartilage.

The desired location of needle penetration of the arytenoid cartilage was caudal to the intersection of the dorsal aspect of the vocal fold and the arytenoid cartilage (Fig. 3). The needle was considered to be placed incorrectly if it was located cranial to the intersection of the vocal fold and the arytenoid cartilage and penetrated the laryngeal ventricle, if it was located in the vocal fold ventral to the arytenoid cartilage, or if it exited the thyroid cartilage and could be seen crossing the piriform recess from lateral to medial prior to penetrating the arytenoid cartilage. The second needle was placed into the laryngeal lumen using an

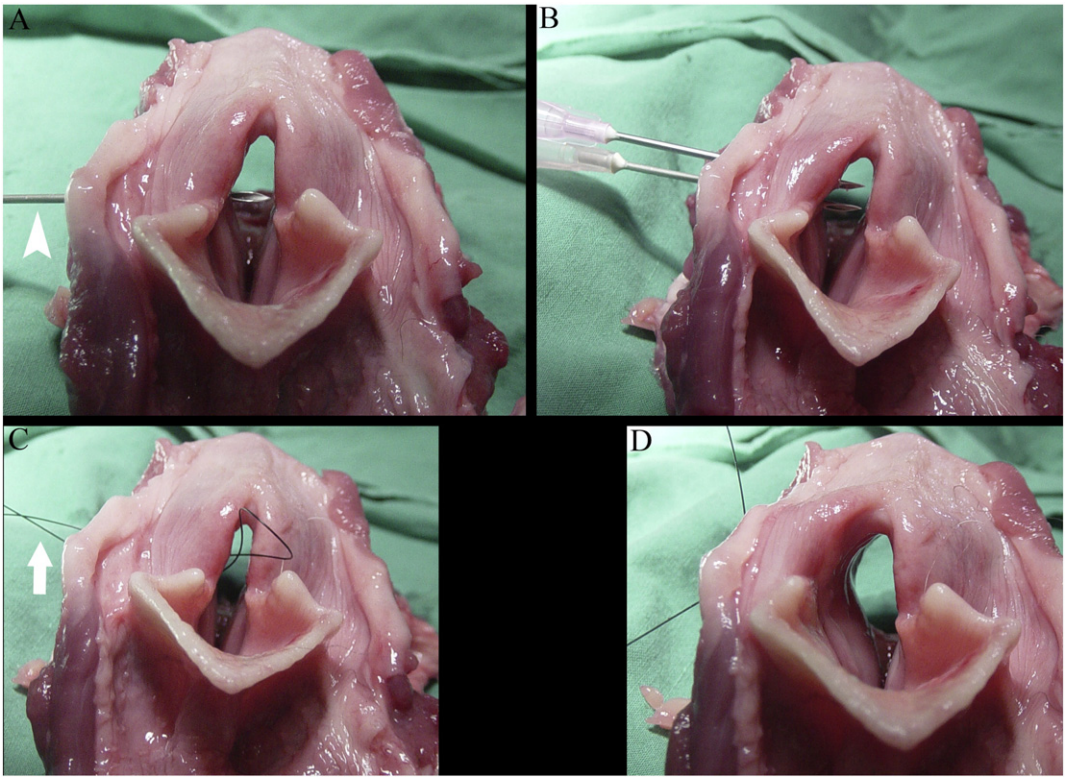

Fig. 1. Isolated larynx showing the technique used to perform the percutaneous thyroarytenoid lateralization procedure. A. Placement of the first 18G hypodermic needle (white arrowhead) through the right lateral aspect of the thyroid cartilage and the arytenoid cartilage into the lumen of the larynx. B. Placement of the second needle dorsal to the first needle. C. Placement of 2/0 nylon suture material through the needles (white arrow). D. Knotting the suture material adjacent to the thyroid cartilage, which results in abduction of the ipsilateral arytenoid cartilage and opening of the rima glottidis.