International Journal of Pediatric Otorhinolaryngology 108 (2018) 120–124

Contents lists available at ScienceDirect

International Journal of Pediatric Otorhinolaryngology

journal homepage: www.elsevier.com/locate/ijporl

Endoscopic percutaneous suture lateralization for neonatal bilateral vocal fold immobility☆

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ARTICLE INFO

Keywords:
Vocal-fold paralysis
Endoscopic
Lateralization
Airway
Neonatal

ABSTRACT

Objective: Bilateral vocal-fold immobility (BFVI) is a rare but significant cause of severe respiratory distress in neonates. The primary aim of treatment is to provide an adequate airway while minimizing adverse effects such as aspiration and dysphonia. Our objective here is to describe the outcomes of a series of neonates undergoing percutaneous endoscopic suture lateralization for BVFI using a novel technique.

Methods: In this retrospective case series, we present 6 neonates (mean age: 18 days) with BVFI from three tertiary academic medical centers. The etiologies included 4 idiopathic, 1 unspecified neurodegenerative disorder, and 1 acquired from cardiac surgery. All had stridor and respiratory distress with hypoxemia requiring respiratory support at diagnosis. Endoscopic vocal-fold lateralization was performed under spontaneous-breathing suspension laryngoscopy using a novel technique of percutaneous needle-directed placement of 4–0 prolene suture without use of specialized equipment.

Results: All patients had clinical improvement in stridor and respiratory support requirements and avoided tracheostomy. One patient had persistent aspiration after lateralization that resolved after suture removal. One patient required bilateral lateralization procedures. One patient expired of epilepsy due to neurodegenerative disease unrelated to airway pathology. At last follow-up (mean 12.6 months), 5/5 remaining patients were on room air without tracheostomy and feeding orally without aspiration; 4/5 had partial or complete return of vocal-fold function.

Conclusion: Endoscopic percutaneous suture lateralization may be a safe and effective non-destructive primary treatment modality for neonatal BVFI. All neonates undergoing this procedure avoided tracheotomy.

1. Introduction

Bilateral vocal-fold immobility (BFVI) is a rare but significant cause of severe respiratory distress in neonates often requiring urgent intervention. Etiologies include birth trauma, neurological disorders such as Arnold-Chiari malformation, hydrocephalus, cerebral palsy, hypoxia, and cardiac surgery. The etiology in most cases is unknown [1]. The primary aim of treatment is to provide an adequate airway for ventilation while minimizing adverse effects such as aspiration and dysphonia. Current management options vary widely on a spectrum that includes non-invasive positive pressure ventilation (NIPPV), endoscopic surgery such as cricoid split [2–4], cordotomy [5], and tracheotomy. In some series, up to 90% of patients with BVFI underwent tracheostomy [6,7]. The considerable rate of spontaneous recovery, which is greater than 50% in both idiopathic and acquired cases, makes more invasive or destructive treatments less desirable [7,8]. Here, we present the first multi-institutional series of neonates undergoing reversible endoscopic percutaneous suture lateralization for BVFI.

Suture laterofixation has been a treatment modality for BVFI for several decades in adults since it was introduced by Ejnell and Tisell in 1993 [9]. The Lichtenberger endo-extralaryngeal needle carrier has become a popular tool to perform laterofixation [10]. However, this technique is not feasible in neonates due to the size and angle of the insertion tool obstructing visualization. A recent small case series described a modified version of the Lichtenberger needle insertion tool that was used for endoscopic suture lateralization in neonates at a single institution; however, this specialized instrument is not widely available [11].

☆ This work was presented at the American Society of Pediatric Otolaryngology Spring Meeting, Austin, TX, May 19, 2017.

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https://doi.org/10.1016/j.ijporl.2018.02.032
Received 4 January 2018; Received in revised form 9 February 2018; Accepted 20 February 2018

In this study, we describe outcomes in 6 neonates with BVFI who underwent a novel technique for endoscopic suture lateralization. Our technique does not require any specialized modified instruments, but can be performed with equipment and materials that are readily available as part of routine pediatric direct laryngoscopy and bronchoscopy.

2. Materials and methods

We reviewed the charts of 6 patients with BVFI from two tertiary academic medical centers who all underwent endoscopic suture lateralization. Demographic information obtained included patient age at diagnosis, comorbidities, etiology and length of follow-up. Perioperative information obtained included amount and type of respiratory support, medical evaluation including MRI, aspiration and feeding status. Outcome measures were respiratory support and airway status, vocal fold function, and feeding and aspiration on follow-up. Approval for this retrospective study was obtained from the Committee on Human Research of the University of California, San Francisco and the Institutional Review Board of Seattle Children's Hospital.

Included patients all had BVFI diagnosed upon awake flexible laryngoscopy, with clinical correlation that BFVI was causing associated respiratory distress or feeding difficulty. Preoperative counseling was performed describing the primary benefits of the surgery as improvement in respiratory distress and feeding difficulty with a goal for avoidance of tracheostomy. The risks described included, but were not limited to, airway edema leading to worsening respiratory distress, worsening aspiration, stitch abscess, and granuloma formation.

All children underwent suspension direct laryngoscopy while spontaneously breathing under total intravenous anesthesia using propofol. Intermittent endotracheal intubation was performed with an uncuffed endotracheal tube as needed. 0.5 mg/kg dexamethasone and prophylactic antibiotic for skin coverage were administered at the onset of the case.

We prepare the following equipment: 1) Lindholm laryngoscope with suspension arm; 2) Microlaryngeal instruments including graspers, laryngeal distending forceps, a long-handled knife, scissor, or pick; 3) Minor plastics tray; 4) 4–0 prolene suture x 3; 5) 22 gauge and 19 gauge needles without filters; 6) 1 cc syringe with stub-tip x 3; 7) 1-mm-thick silastic sheet fashioned into a 5 × 5 mm button with two buttonholes; 8) 5–0 fast absorbing suture, histoacryl for skin closure; 9) 4-mm 0-degree Hopkins rod telescope with camera and light cord; and 10) operating microscope.

First, sutures are prepared prior to laryngoscopy. A 4–0 Prolene suture (suture #1) is loaded into a 22 gauge needle and secured with a 1-cc stub-tip syringe with the tip of the suture just inside the bevel of the needle. A second 4–0 Prolene suture loop (suture #2) is loaded into a 19-gauge needle and also secured with a 1-cc stub-tip syringe. Preloading suture through the needle tip, and securing it loosely with the syringe was found to be critical, as placement of the suture through the hub end of the syringe intraoperatively was challenging. The silastic button is fashioned and soaked in betadine on the sterile field.

Next, the patient is placed into suspension laryngoscopy with a Lindholm laryngoscope and vocal folds palpated to confirmed passive mobility and absence of firm fixation. Weight-based topical lidocaine is applied to the larynx. Best visualization is obtained with a 4 mm 0° telescope, but one may use a microscope if single surgeon is performing the operation. Next, a 4-mm neck incision is made in a relaxed skin tension line at inferior border of thyroid cartilage, 1-cm lateral to midline. Skin is elevated to expose the surface of the strap muscles sufficient to accommodate the subcutaneous 5-mm silastic button. Laryngeal distending forceps are placed to allow adequate visualization of the subglottis and true vocal folds (TVFs).

Precise needle placement is critical for surgical success and minimization of airway bleeding. Needles were placed percutaneously, and the airway not entered until the mucosa was clearly seen to be tented by the needle in the proper location. The 22-gauge needle is placed through the incision, approximately 7 mm lateral to midline, at inferior edge of thyroid cartilage and directed through the paramedian cricothyroid membrane to enter the airway under the TVF just anterior to the vocal process. Once the tip of needle is in airway, suture #1 is advanced into the airway and retrieved with endoscopic laryngeal graspers, and the 22-gauge needle is withdrawn. Next, the 19 gauge needle is passed through the same incision aiming more superiorly so that the thyroid cartilage is firmly engaged by the needle tip. This needle passes through the thyroid cartilage and should enter the airway in the ventricle, just superior to the TVF and just anterior to the vocal process. Once the tip of the 19-gauge needle is seen in the ventricle, the suture loop is passed into the airway. With the needle still in the airway, the end of suture #1 is passed through the loop of suture #2 and retrieved out of the laryngoscope under tension. The suture loop is then pulled out the back of the 19-gauge needle, bringing suture #1 with it. Suture #2 is removed together with the 19-gauge needle. At this point, suture #1 is around the vocal ligament with both ends coming out the incision. These two ends are passed through the holes in the silastic button. While observing the airway, suture #1 is tied over the button, while watching the TVF lateralize. At this point, the button and suture knot are within the subcutaneous soft tissue of the neck. The patient was taken out of suspension and the neck wound irrigated and closed over the button and suture, which are completely buried.

Management of post-operative endotracheal intubation was considered individually. All patients received 0.5 mg/kg decadron every 8 h for 24 h and acid suppression through postoperative period. Clinical and radiographic swallow evaluation, advancement of oral intake and weaning off respiratory support were managed on a case-by-case basis.

3. Results

We present 6 neonates (median age at diagnosis, 2 days, range 2–81 days) with BVFI from three tertiary academic children's hospitals who underwent endoscopic percutaneous suture lateralization (Fig. 1, Supplemental Video 1). The etiologies included 4 idiopathic, 1 unspecified neurodegenerative disorder, and 1 acquired after cardiac surgery (Table 1). All presented with stridor that was worse on agitation with O_2 desaturation. Preoperative airway management varied from intermittent nasal cannula to endotracheal intubation. Most required nasogastric tube feeding prior to surgery. All underwent preoperative MRI, with only one (patient 6) with abnormal findings.

Supplementary video related to this article can be found at http://dx.doi.org/10.1016/j.ijporl.2018.02.032.

All patients experienced clinical improvement in stridor and respiratory support requirements and avoided tracheostomy (Table 2). Of the 6 cases, three had a straightforward course where symptoms of stridor and supplemental oxygen dependence improved immediately after initial suture lateralization with durable benefit and no long-term change in swallow function. One of these 3 had transient clinical concern for new aspiration immediately post-op confirmed with modified barium swallow study. He was allowed to breastfeed without nasogastric tube placement and had clinical resolution of aspiration without complication. Three of the 6 cases were more complicated. Two of them required further procedures, and one patient expired of underlying neurologic disease but still successfully avoided tracheostomy. Details of the complicated cases are as follows.

Patient 2 was diagnosed at 3 months of age due to ongoing stridor, failure to thrive, respiratory distress with oxygen requirement, severe reflux and aspiration. His past medical history was significant for double aortic arch coarctation for which he underwent repair, as well as subsequent plication of the right hemidiaphragm for an iatrogenic right phrenic paralysis. Aspiration was confirmed with videofluoroscopy, and he underwent laparoscopic nissen and gastrostomy tube placement prior to diagnosis of BVFI and suture lateralization. On initial diagnosis of BVFI, he had slight movement of the right TVF and no movement of