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Original Article

Surgical Outcomes of Post Intubational or Post Tracheostomy Tracheal Stenosis: Report of 18 Cases in Single Institution

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Purpose: Tracheal resection and end-to end anastomosis (TRE) is known as standard treatment of tracheal stenosis (TS) and there are various methods to keep ventilation during operation. We reviewed ventilation methods and postoperative outcomes in patients with postintubational (PI) or posttracheostomy (PT) TS.
Patients and Methods: From May 2006 to May 2013, 18 patients with PI or PTTS underwent TRE in our hospital. All patients' records were retrospectively reviewed.
Results: The mean duration of intubation and tracheostomy were 14.2 days (range: 2 to 27 days) and 114.9 days (range: 43 to 215 days). The location of stenosis was tube cuffs (n = 10), stoma (n = 6) and double stenosis involving cuff and stoma (n = 2). The mean diameter of stenotic lesion was 5.4 mm (range: 2 to 9 mm. ECMO (n = 4) was performed in critical stenosis. Of two cases with double stenosis, one underwent preoperative endotracheal balloon dilatation and the other underwent TRE with cricoplasty. The overall complication rate was 11.8%. The mean follow-up duration was 14.0 months (range: 0.9 to 56.3 months).
Conclusion: Comparing with the literatures, TS treated by TRE in our hospital has shown satisfactory outcomes. To maintain appropriate ventilation for critical stenosis, ECMO could be one of safe methods.

Keywords: tracheal stenosis, tracheal resection and end-to end anastomosis (TRE), extracorporeal membrane oxygenation (ECMO)

Introduction

Postintubational (PI) or posttracheostomy (PT) tracheal stenosis (TS) is caused by ischemic necrosis by the tube's cuff and stoma of tracheostomy.[1–5] The incidence of TS has been decreased with modification of tube management, however, it is still serious clinical problem.[4–7] Among various methods to repair TS, tracheal resection and end-to end anastomosis (TRE) remains the standard treatment. And there are several methods to maintain appropriate ventilation during operation. Herein we reviewed the ventilation methods during operation and postoperative outcomes in patients with PI or PT TS.

Patients and Methods

From May 2006 to May 2013, 18 patients with PI or PT TS underwent TRE in Pusan National University Hospital. All patients' records were reviewed for the etiologies—duration of intubation or assessment of the stoma, the stenotic status—length, location and vocal cord involvement, ventilation methods, surgical technique, and outcomes.

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Informed consent was not required for this retrospective study.

Pre-operative work-up

To have an optimal repair of tracheal stenosis, past history of patient was collected and physical examination was performed. The airway computed tomography with three dimensional reconstruction revealed the stenotic status including stenotic length and location. To evaluate vocal cord mobility, the flexible bronchoscopy was performed. In cases with decreased mobility of vocal cord or mucosal inflammation, operation was delayed for appropriate repair. When the patient has emphysematous lung, preoperative pulmonary function test might be performed to assess anesthetic risk and advise postoperative lung care.

Anesthesia and airway management

For the patient without tracheostomy, the orotracheal tube (OTT) needs to be placed beneath the stenosis to secure the airway or, in case of the patient with previous tracheostomy, the endotracheal tube (ETT) could be easily placed distal to the stenotic lesion. In patient with very severe stenosis without tracheostomy, extracorporeal membrane oxygenation (ECMO) was applied until securing the distal airway. In cases with ECMO, vascular access usually performed in both femoral veins and lower amounts of heparin (100 IU/kg followed by 30–50 IV/kg/h for ACT 160–180 s) was required. After sectioning distal airway, ETT crossing surgical field was placed, so the ventilation could be easily under control by the coordination between the anaesthesiologist and the surgeon.

Tracheal surgery

The patient is placed supine position with neck extension by placing cushion under shoulder. Usually, collar incision is made in 1.5–2.0 cm superior to the sternoclavicular joints, however, in patient with tracheostomy, cervical incision is extended laterally from the previous tracheostomy. The pretracheal plane is dissected until exposing the thyroid cartilage as upward and down to the level of carina. Prior to sectioning trachea distal to lesion, bilateral traction sutures are placed in both sides of upper and lower trachea. Then, trachea is resected at distal extent of the lesion, and ETT crossing surgical field is placed in distal airway. The posterior surface can be released by precautious pulling of cross-field ETT and traction sutures in lower trachea, and dissected closely to posterior membrane. Lateral dissection is limited to the stenotic lesion and anastomosis site. The stenotic lesion is sectioned at the upper margin under direct vision. Then, the intraluminal interrupted sutures in the posterior surface are performed creating the neck flexed. The OTT could be passed down through the anastomosis and the interrupted sutures in cartilaginous face are completed by making every knots extraluminally. The anastomosis is checked under saline with the cuff deflated, then, the traction sutures are tied and the sealant is applied around the suture line. The drain is left near to the anastomosis and a chin-to chest suture is performed to prevent neck hyperextension.

Postoperative management

The cervical flexion position needs to be maintained until performing bronchoscopy to check tracheal anastomosis in postoperative 7–9 days. A chin-to-chest suture is usually released prior to bronchoscopy and if any signs of complications are not detected, the drain is removed.

In suspicion of dehiscence, the drain should be maintained until resolving dehiscence, however, V.A.C. Ulta™ negative pressure wound therapy system (Kinetic Concepts, Inc., San Antonio, Texas, USA) could be applied through a small incision if the drain is already removed.

Regular follow-up is performed in the outpatient clinic after discharge over 4 to 42 months. When suspicious symptoms of dehiscence or stenosis are occurred after the initial follow-up, the patients needs to be returned for an additional evaluation.

Results

Of 18 patients (10 males and 8 females), the mean age was 41.9 years (range: 18 to 71 years), and the mean duration of endotracheal intubation only, and endotracheal intubation and tracheostomy were 14.2 days (range: 2 to 27 days) and 114.9 days (range: 43 to 215 days). The location of stenosis was the area of airway tube cuffs (n = 10), the stoma site (n = 6) and double stenosis involving cuff and stoma (n = 2) (**Table 1**). The mean length of stenotic segment was 2.24 cm (range: 1 to 6 cm) and the mean diameter of stenotic lesion was 5.4 mm (range: 2 to 9 mm). Most patients had intact vocal cord movement, except 4 patients who had unilateral vocal cord palsy. Of two cases with double stenosis, one patient underwent preoperative balloon dilatation of

Table 1 The characteristics of patients with tracheal stenosis

Characteristics	
Sex (No.)	
Male	10
Female	8
Age (years), mean (range)	41.9 (18–71)
Airway tube (No.)	
ETT only	4
ETT and tracheostomy	14
Duration of intubation (days), mean (range)	
ETT only	14.2 (2–27)
ETT and tracheostomy	114.9 (43–215)
ETT	12.4 (2–19)
Tracheostomy	104.2 (3–207)
Location of stenosis (No.)	
Cuff	10
Stoma	6
Double (cuff and stoma)	2
Length of stenosis (cm), mean (range)	2.24 (1–6)
Diameter of stenosis (mm), mean (range)	5.4 (2–9)
Ventilation methods during operation (No.)	
OTT	5
ETT through tracheostomy	9
ECMO	4

ETT: endotracheal tube; OTT: orotracheal tube; ECMO: extracorporeal membrane oxygenation

distal trachea and the other underwent TRE with cricoplasty and intraoperative dilatation of distal trachea by hegar dilator.

The ventilation was provided through small sized OTT in five cases, ETT through tracheostomy in nine cases, and by application of ECMO in four cases (**Table 1**).

Postoperative restenosis occurred in 3 patients (17.6%), however, one patient was asymptomatic 7 months after endotracheal balloon dilatation with application of mitomycin. In 2 patients (11.8%), restenosis occurred even after endotracheal balloon dilatation, so bougination with application of mitomycin under rigid bronchsope is being considered while maintaining tracheostomy. The mean follow-up duration was 14.0 months (range: 0.9 to 56.3 months).

Discussion

The incidence of PITS almost reached 20% of patients who had prolonged intubation before 1980, however, the modification of cuff design, the meticulous management of tube and the technological improvement of tracheostomy have decreased the incidence of PI or PT TS as 0.6%–6%, which is still troublesome. TS usually occurs at the cuff site and stoma of tracheostomy.[2–8] When the cuff pressure exceeds 25 cmH_2O, it decreases capillary blood flow to make mucosal ulceration, edema and necrosis which would make granulation proliferation and scarring.[1,4,6,7,9] In case of performing tracheostomy, making too large stoma and inserting large tube through small stoma could damage cartilage which causes stenosis at the stoma site.[5]

Although there have been different approaches to treat the TS, such as airway stent insertion, balloon dilatation, laser therapy, tracheal reconstruction and airway transplantation,[3,7,10–12] TRE have shown good results in several centers and have accepted the standard treatment of TS.[2,7,13–15] In some cases of involving subglottis, challenging surgical techniques and minor modifications are necessary. Of our cases, TRE with cricoplasty was performed in one patient.

For operation, securing airway and adequate ventilation is difficult and challenging part.[3,7,16] In most cases, it is possible to pass a small size OTT or easy to place ETT through tracheostomy. However, in very critical stenosis without tracheostomy, preoperative tracheal dilation or intraoperative veno-veno ECMO could be considered.[17,18] Of them, the tracheal dilation might cause airway obstruction, so veno-veno ECMO was preferred as one of safe methods until securing distal airway in our study. Although few cases with use of ECMO to support ventilation during tracheal surgery have been reported, ECMO was successfully used in four patients with TS without tracheostomy of our study. In addition, performing tracheostomy under sedation with regional anesthesia is another option to secure airway.[19,20] Not in this study, we safely performed it in patient with papillary thyroid cancer invading trachea.

Comparing with other series, the overall complication rate was low as 11.8% in our study. The most common cause of complication was the formation of granulation tissue at the suture line. With regards to some articles, it could be developed depending on the suture material and the severity of mucosal damage,[5–7,13,15] however, tension-free anastomosis with meticulous surgical technique could be one of important factor to prevent the postoperative restenosis. Still, the further long term follow-up is necessary to get definitive postoperative outcomes of this study.

Disclosure Statement

The authors have no conflict of interest.

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