

Role of Gum Elastic Bougie Dilatation in Benign Tracheal Stricture

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Abstract

Objective: Benign tracheal stenosis after endotracheal intubation is a common iatrogenic problem with impactable psychological and socioeconomic burden on health care needs immediate intervention. There are no clear cut guidelines on definitive therapy for tracheal stenosis and consensus on definition of good outcome. Endoscopic dilatation is usually preferred in patients with mild stenosis of grade I or II and a stenotic segment of <1 cm. Patients with complex grade III and IV stenosis requires proper planning and evaluation before definitive surgery or palliative procedure like stenting, dilatation. But all patients with tracheal stenosis do not present to hospital in stable condition. Many patients present with acute respiratory distress with unstable general condition requires immediate intervention to tide over the crisis and buy time for stabilization and further evaluation before planned procedure. Other procedures like balloon dilatation, laser coagulation not feasible in that acute crisis situation. Gum elastic bougie dilatation is available in all establishments and can be performed with ease and cost effectively. But limited data and study literature available on the role of dilatation in complex and grade III and IV stenosis. This study is to know the role of bougie dilators in grade III and IV and complex type of benign tracheal stenosis. **Patients and methods:** in our institution 149 patients with complex stenosis grade III and IV Myer-Cotton classification underwent tracheal stenting with Montgomery T-tube for benign tracheal from Jan 1984 to Jan 2019. Those patients with simple stenosis and grade I and II Myer-Cotton classification were excluded from the study. Not all 149 patients were directly taken for T-Tube insertion as many of them presented in acute respiratory crisis and stridor. These were stabilised before T-tube stenting by bronchoscopic gradual dilatation with carrot type elastic bougie and followed up with bronchoscopic evaluation. **Results:** Totally 149 patients underwent T-tube insertion for benign tracheal stenosis 25 (17%) were prior tracheostomised and 124 (83%) complex grade III and IV stenosis. Out of 149 patients 61 (41%) were treated initially with dilatation before T-tube insertion. 5 (8%) developed Subcutaneous emphysema and 3 (5%) had pneumothorax. 40 patients 65% underwent subsequent planned procedure within 72 hours (3 days) and 21 (35%) within 48 hours (2 days). **Conclusion:** elastic bougie dilatation has definite role in complex tracheal grade III and IV stenotic patients who are presented with acute respiratory distress to tide over the crisis and buy time to plan and work up for definitive subsequent procedures. Gum elastic bougie dilators are simple to use and much cheaper than balloon dilators. Advantages of dilation were the provision of both visual and tactile feedback to the operating surgeon. Infrastructure facility for rigid elastic bougie is simple, easily available and easily reproducible at all centres.

Keywords: Benign tracheal stenosis; T-Tube; Rigid Gum Elastic bougie; Tracheal Dilatation.

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Introduction

Benign tracheal stenosis after endotracheal intubation is a common iatrogenic problem needs immediate intervention. Tracheal stenosis is a complex disease with impactable psychological and socioeconomic burden on health care. The incidence

of tracheal stenosis is increasing in view of more number of available intensive care units in the recent few years, performing more number of intubations and tracheotomies with expanding indications for mechanical ventilation and prolonged ventilation time [1,4,5]. 2%–3% of patients who undergo intubations and tracheostomy develop tracheal stenosis [11].

The causative factor is loss of regional blood flow due to cuff pressure on the tracheal wall causing ulceration and subsequent healing, starting with granulation, progressing to cicatrization, and finally scar contraction, presenting with air way obstruction [2,3]. This ischemic injury begins within the first few hours of intubation, and healing of the damaged region can result in web-like fibrosis within 3–6 weeks [4]. The use of high volume low pressure cuffs reduces mucosal ischemia and subsequent injury [5,6]. Post tracheostomy stenosis occurs most commonly at the stoma site or less commonly at the site where the tip of the tube has impinged on the tracheal mucosa [9].

Other less common causes are chronic granulomatous infections (eg. Tuberculosis, histoplasmosis, Wegner's granulomatosis), inhalation burns, traumatic injuries, infectious tracheobronchitis, systemic diseases such as amyloidosis, inflammatory bowel disease, relapsing polychondritis, sarcoidosis, saber sheath deformity of the trachea, tracheobronchopathia osteochondroplastica and broncholithiasis [9].

There are no clear cut on guidelines on definitive therapy for tracheal stenosis and consensus on definition of good outcome. The choice of ideal treatment should be based on the characteristics of each patient after evaluating the advantages and disadvantages of the procedures [20].

There are various treatments including surgical resection, dilatation (rigid or balloon), airway stenting (silicone or metallic), and Nd:YAG or CO₂ laser photoablation, local mitomycin-C infiltration.

In symptomatic patient with benign tracheal stenosis, surgical resection and reconstruction is the optimal standard treatment of choice [6,7,8,20].

Historically, Tracheobronchial stenosis has been managed with dilatation alone using Jackson dilators and rigid bronchoscopes. Treatment of tracheal stenosis varies with the type and extent of disease, presence or absence of tracheomalacia and skeletal deformity. The majority of patients with long segmental stenosis or tracheomalacia require the surgical resection with end-to-end anastomosis or tracheostomy and stenting either with T-Tube or self expanding stents.

The severity of stenosis was described based on the "Myer-Cotton" classification. The grade I, luminal narrowing of <50%; grade II, luminal obstruction of 51%–70%; grade III, luminal obstruction of 71%–90%; and grade IV, luminal obstruction of 100% (virtually no lumen) [12]. Although the Myer-Cotton grading system was originally developed to describe subglottic stenosis, the recent literature tends to use it for cervical tracheal stenosis, as well [13,14]. The tracheal stenosis is classified as simple, which is a soft, short segment web-like narrowing often limited to the mucosa only or complex stenosis, which is a hard, long-segment stricture with destruction of tracheal cartilages and fibrosis [11].

Endoscopic dilatation is usually preferred in patients with mild stenosis of grade I or II and a stenotic segment of < 1 cm. It is especially preferred in patients with a high surgical risk and poor general condition. But, it is not effective for circumferential scarring, longer stenotic segments, or loss of cartilage support [10,15,16].

Endoscopic dilatation techniques, which can be broadly classified into rigid dilatation (e.g. bougie, bronchoscope, tracheal dilator) and balloon dilatation (e.g. laryngeal balloon, angioplasty balloon, esophageal balloon). Endoscopic interventions in the form of dilatation and stenting may work in very selected cases of complex stenosis, but are mostly reserved for inoperable cases or for those not fit for surgery.

Acute distress from airway obstruction lesion not responding to medical measures requires immediate bronchoscopic intervention to tide over the crisis and buy time for subsequent proper evaluation and definitive management in majority of patients. This allows ventilation and oxygenation of the patient, dilation of the stenosis, and distal toileting of the airway immediately re-establishes adequate tracheal calibre temporarily, allows comfortable breathing, provides immediate relief and gives time for preoperative assessment and convenient preparation for definitive operation. For complex lesions, nonsurgical methods like, dilatation, laser coagulation, stenting are chosen in cases where surgery is not possible either due to the complexity of the stenosis or the patient is unfit for definitive procedure once the crisis is managed.

Gum elastic bougie dilators are simple to use and much cheaper than balloon dilators. Advantages of bougie dilation were the provision of both visual and tactile feedback to the operating surgeon. Success rates gum elastic bougie dilatation is 70.6%, which is within the reported success range for dilatation

procedures that were reported in a number of series were within the same range for balloon dilatation (52–100%) and for rigid dilatation (53–100%) for grade I and II stenosis with less success in grade III and no improvement in grade IV stenosis [17,18,19]. Infrastructure facility for rigid / gum elastic bougie is simple, easily available and easily reproducible at all centers.

But limited data and study literature available on the role of dilatation in complex and grade III and IV stenosis. This study is to know the role of Gum Elastic Bougie dilators in grade III and IV and complex type of benign tracheal stenosis.

Patients and Methods

Totally 149 patients with complex stenosis grade III and IV Myer-Cotton classification underwent tracheal stenting with Montgomery T-tube for benign tracheal stenosis from Jan 1984 to Jan 2019, who are highly symptomatic and are not suitable for definitive primary surgical reconstruction at the time of evaluation. Those patients with simple stenosis and grade I and II Myer-Cotton classification were excluded from the study.

Patients who are chosen for stenting as a first line of treatment rather than for tracheal surgery, according to local and general conditions. Contraindications either temporary or permanent in this study included local causes like severe granulation and inflammation at the site of stenosis, excessive longitudinal length of trachea, (50% or more of tracheal length), immediate subglottic stenosis, incompetent vocal cords with aspiration and difficulty in phonation. General conditions which needed prolonged ventilation such as respiratory failure, head injury, neurological, psychiatric, problems were frequently encountered in our study due to referral from other emergency departments.

Not all 149 patients were directly taken for T-Tube insertion. Significant number of patients, who were presented with acute life threatening condition were stabilised before stenting (Fig. 2) by bronchoscopic gradual dilatation (Fig. 3) with carrot type gum elastic bougie. Once the patients were stabilised they are evaluated with bronchoscopy either flexible or rigid bronchoscope to assess the length of stenosis, distance of the stenosis from vocal cords and carina, diameter of the trachea, and in few patients complemented with CT/MRI images to assess the severity and grading of

tracheal stenosis. All patients in this study who are treated by T-Tube stenting were in grade III and IV stenosis with complex nature of stenosis.

Positioned under sedation on ventilating through with rigid bronchoscope with spontaneous or jet ventilation. A mixture of topical lignocaine 2% and adrenalin 1:100,000 was installed on the vocal cords, the subglottis, and the trachea. A diagnostic laryngoscopy was first performed with a telescope followed by Lubricated gum elastic bougie dilators (Fig. 1) of gradually increasing sizes were then used. The dilator passed until the stenotic segment was directly visualized, and the rest of the insertion was guided by tactile feedback. The widest part of the dilator was positioned at the level of stenosis and beyond the stenotic level. The acceptable size of the dilator's insertion was determined appropriate for age and body surface area, specific airway diameters. Great care was taken and gentle insertion was applied to avoid perforation of the trachea or bronchus and false passage. Following the maximal dilatation, the telescope was re-introduced and the airway was inspected for signs of bleeding or tear.

Once the adequate tracheal lumen was established distal secretions were suctioned out and toileting of distal air way was performed. Secretions were sent for analysis and microbial culture and sensitivity. Antibiotics as per culture sensitivity initiated and measures taken to improve the general condition and preparation continued for proposed surgery. Successful dilatation is defined by a passing adequate size of elastic bougie dilator through a stenosis as for age and sex, an increase in tracheobronchial diameter of the stenotic segment by bronchoscopy immediately after dilatation and improvement of the patient's clinical symptoms.



Fig. 1: Gum Elastic Bougie Dilators

Observation and Results

1. Totally 149 patients underwent T-tube insertion for benign tracheal stenosis due to post intubation and prolonged ventilation, out of them 25 (17%) were prior tracheotomised before development of stricture and 124 (83%) were without tracheotomy, presented with symptoms and proven as complex grade III and IV stenosis.
2. Out of 149 patients 61 (41%) were treated initially with dilatation before T-tube insertion. All the patients who needed dilatation were critical and in severe respiratory distress.
3. Subcutaneous emphysema around neck and upper thorax 5 (8%) of patients which subsided on its own without any intervention and pneumothorax 3 (5%), required intervention.
4. All patients who underwent dilatation were complex stenosis of grade III and IV of Myer-Cotton classification.
5. All the patients after dilatation underwent a subsequent procedure, T-Tube insertion electively after stabilization and planning.
6. 40 patients 65% underwent subsequent planned procedure within 72 hours (3 days) and 21 (35%) within 48 hours (2 days). This gives adequate time for stabilization of patients from other comorbid conditions,, further radiological investigations and adequate time to plan suitable subsequent procedures accordingly.



Fig. 2: Before Dilatation

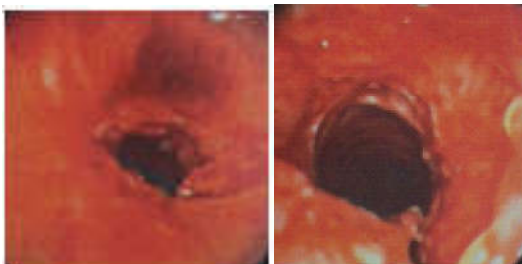


Fig. 3: After Dilatation

Discussion

Ideally In symptomatic patient with benign tracheal stenosis, surgical resection and reconstruction is the optimal standard treatment of choice [6,7,8,20].

For simple grade I and II tracheal stenosis endoscopic dilatation either balloon, bougie, laser with adjuvant therapies are commonly used and results are encouraging [10,15,16,17,18,19]. The decision for immediate surgery or bronchoscopic intervention should be guided by the severity of clinical symptoms. There are no available studies comparing endoscopic and surgical intervention for complex stenosis. Endoscopic interventions in the form of dilatation and stenting may work in selected cases of complex stenosis, but are mostly reserved for inoperable cases or for those not fit for surgery [17,18,19].

Majority of patients were not fit to undergo definitive surgical procedure at the time of initial presentation in view of complexity of the stenosis and comorbid conditions, poor general conditions, and severity of respiratory distress requires immediate less invasive interventions like dilatation, stenting. If selected, properly endoscopic dilatation of airway stenosis could be the first or adjunctive treatment modality for those with a poor general condition when primary definitive surgery is not tolerated.

Success rates bougie dilatation is 70.6%, which is within the reported success range of balloon dilatation that were reported in a number of series. For balloon dilatation (52–100%) and for rigid dilatation (53–100%) for grade I and II stenosis with less success in grade III and no improvement in grade IV stenosis [17,18].

Facilities and expertise for balloon and laser not easily available in all places and economically costly to set up the facilities at all centers. Infrastructure facility for gum elastic bougie is simple, easily available and reproducible at all centers and economically viable.

Gum elastic bougie dilatation for Grade I and II stenosis is routinely practiced with good results [17,18,19] and has definitive role in grade III and IV complex tracheal stenosis who are presented with acute respiratory distress. Rigid dilatation helps to tide over the crisis, to Overcome the emergency situation and buy time till a definitive or subsequent procedures are planned and stabilization.

Conclusion

There are no clear cut guidelines on definitive therapy for tracheal stenosis and consensus on definition of good outcome. The choice of ideal treatment should be based on the characteristics of each patient after evaluating the advantages and disadvantages of the procedures. Aim is to restore normal natural patent airway without disturbing phonation and cosmesis, either by surgical reconstruction, dilatation (balloon/rigid), laser ablation, and stenting with adjuvant local infiltration therapies. But many of these Procedures are time consuming and not feasible for emergency life threatening conditions, not easily available, needs high cost for establishment. Elastic Bougie dilatation has definite role in complex tracheal grade III and IV stenotic patients who are presented with acute respiratory distress to tide over the crisis and buy time to plan and work up for definitive subsequent procedures.

Gum elastic bougie dilators are simple to use and much cheaper than balloon dilators. Advantages of rigid Dilatation, where the provision of both visual and tactile feedback to the operating surgeon. Infrastructure facility for rigid elastic bougie is simple, easily available and easily reproducible at all centers.

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