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BRONCHOSCOPIC CRYOTHERAPY IN MANAGEMENT OF POST TRACHEOSTOMY TRACHEAL STENOSIS: AN UNCONVENTIONAL NOVEL APPROACH

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Abstract:

Post tracheostomy / Post intubation -tracheal stenosis is a relatively rare but a serious problem which warrants a precise diagnosis and a multimodality-multidisciplinary approach for successful outcome. Traditionally, depending upon the type and site of stenosis, such cases are managed by open surgical approach and occasionally by endoscopic approach with dilatation.

We report a case, a post traumatic quadriplegic on tracheostomy tube with suprastomal granulation and web like fibrous stenosis, which was managed successfully by bronchoscopiccryotherapy.Bronchoscopiccryotherapy can be considered as primary modality treatment in select group of cases.

Key words: bronchoscopy, cryotherapy, cryoadhesion, suprastomal granulation, tracheal stenosis

Introduction:

Endotracheal intubation and tracheostomy are commonly performed procedures on ICU patients. With increase in survivorship of ICU patients, post op ICU care is of paramount importance for improved quality of life. Patient with history of intubation / tracheostomy presenting with respiratory distress should be suspected to have develop tracheal stenosis.

Tracheal stenosis once occur, is a serious surgical problem. Tracheal resection and end to end anastomosis is considered the main stay treatment. However, with advent of endoscopic approaches, as good outcomes have been reported, the balance has been tilting towards them. In select situations endoscopic procedure have been tried for recanalization of obstructed airway. Procedures like interventional bronchoscopic dilation (mechanical or balloon), endoluminal treatment with electorcautery, lasers and stenting, use of cryotherapy have stood the test of time [1].

We present a case of post traumatic quadriplegia on prolonged tracheostomy tube who developed suprastomal granulations and web like fibrous stenosis leading to difficulty in phonation. He was successfully managed with flexible bronchoscopiccryotherapy under controlled sedation using dexmedetomidine.

Case description:

32 year old male, on long term fenestrated double lumen tracheostomy with speaking valve, after suffering a cervical spine injury in road traffic accident in December 2016. Posterior C1-2 plate and screw fixation was done for the cervical spine injury and was tracheostomized on the 7th day of RTA. Diaphragmatic pacing was also done in view of bilateral diaphragmatic palsy. He was referred to our center with progressive difficulty in phonation since sept 2018. Fibreoptic laryngoscopy identified granulation in the

subglottic region obstructing >90% of the tracheal lumen (Fig 1).

Fig1: Granulation tissue visualized in the tracheal lumen during bronchoscopy

A contrast enhanced computed tomogram revealed an enhancing soft tissue thickening superior to the tracheostomy tube at the level of stoma, predominantly in the anterior aspect, with cranio-caudal extension of 13mm (Fig 2).

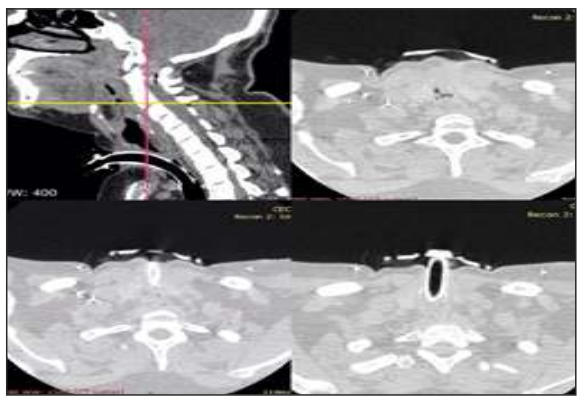

Fig 2: CECT showing suprastomal granulation tissue (black arrow) with almost completely occluded tracheal lumen (green arrow)

Patient was discussed in multidisciplinary clinic amongst Head Neck surgeon, Pulmonologist and Anaesthesiologist. In view of no neck extension available, it was decided to re-canalize the obstructed airway by fibre optic bronchoscopy with cryotherapy and electro cautery for extraction of granulation tissue over multiple sittings. Sedation, during each of these sittings was achieved using an initial infusion of 50 µg of fentanyl followed by loading dose 1µg/kg of dexmedetomidine infused over 10 min and the loading dose was followed by infusion at a rate of 0.5 µg/kg/h and ventilation was maintained through tracheostomy tube.

Friable granulation tissue attached to the anterior aspect of the trachea was visualised, which bled on touch. It was causing almost complete occlusion of the tracheal lumen. Bipolar electrocautery probe (Vio 200S, ErbeElektromedizin GmbH, Germany) was inserted through the working channel of the bronchoscope and de-bulking of the granulation tissue at 9'O clock, 12'O clock and 2'O clock position was done. Patient was again taken up for bronchoscopy after 03 days of the initial procedure. Sedation was again given using dexmedetomidine and fentanyl. Necrosed granulation tissue was visualised. The cryoprobe (Erbecryo2, ErbeElektromedizin GmbH, Germany) was inserted through the working channel with nitrogen oxide as cryogen was used. The tip of the cryoprobe was kept directly over the granulation tissues. 02 activations for 10 seconds each were applied to the necrosed granulation tissue. The tissue was adherent to the cryoprobe after the second activation and it was extracted from the tracheal lumen by withdrawing the cryoprobe along with the bronchoscope (Fig 3).

Figure 3: Suprastomal granulation tissue removed using the cryoprobe

There was only minimal bleeding during the second procedure. Bronchoscopic evaluation revealed adequate recanalization of the trachea and the tracheostomy tube could be visualised.

Patient was administered systemic steroids along with inhaled steroid for three days.
Same procedure was repeated after 2 weeks for remaining granulation tissues. Patient after the procedure was able to phonate well and even tolerated capping of the tracheostomy tube. Patient is on regular follow up since then. Intraluminal is adequate, well mucosalised with no evidence of restenosis. He is being planned for decannulation. (Fig 4).

Fig 4: Follow up pic with adequately wide tracheal lumen, no granulations and tracheostomy tube visualised distally (arrow)

Discussion:

Tracheal stenosis occurring post intubation or post tracheostomy although rare, are still the most common cause [2]. Among all intubated patients, the reported incidence of stenosis ranges from 10 to 22%, although, only 1–2% of the patients are symptomatic. Presently, estimated incidence of severe post intubation or post tracheostomy stenosis is 4.9 cases per million per year in the general population [3].

The site of stenosis depends, whether patient was intubated or tracheostomised. Intubated patient generally develop stenosis at the site of cuff. Tracheostomy patient develop stenosis due to a) abnormal wound healing with excessive granulation tissue around the stoma or over fracture cartilage site[3]. b) Mechanical leverage of the tube due to unsupported weight of ventilator circuit can cause pressure necrosis. c) Rigidity of tracheostomy cannula causing friction and damage to mucosa [4].d) During coughing, the cannula thrusts repeatedly against the upper edge of the stoma and crushes down the anterior wall of the trachea, leading to suprastomal collapse and granuloma formation [5]. e) High cuff-pressure and failure to deflate cuff intermittently, also play an important role in the development of stenosis. Over inflation of non-elastic plastic cuff with pressure exceeding the mucosal capillary pressure (30 mm of Hg) of trachea, the mucosa that lies between the cuff of the balloon and the underlying cartilages develops ischemia. Long standing ischemia can leads to ulceration and chondritis of tracheal cartilages, followed by fibrotic healing, leading to progressive tracheal stenosis [6].

Patients remain asymptomatic unless there is significant stenosis reducing the tracheal lumen diameter to 50% to 75%. The patient develops stridor if tracheal lumen is narrower than 5mm in adults [7].

Traditionally, open surgical approach have been the main stay of treatment with maximum cure rates. However, with development of endoscopic endoluminal approach, which are less invasive and with comparative outcomes, these are also being employed in management of tracheal stenosis. Interventional bronchoscopic dilation (mechanical or balloon), endoluminal use of electorcautery, lasers, stenting, and use of cryotherapy have expanded treatment options [8].

In our patient, we opted for flexible bronchoscope assisted cryotherapy due to following reasons: a) Quadraplegic patient with cervical spine injury with plating and fixation of C1-2 cervical vertebrae leading to inability to extend neck prohibiting rigid bronchoscopic procedures. b) Diaphragmatic pacing in view of bilateral diaphragmatic palsy. c) Pre-existing

tracheostomy with thin stenotic segment. d) Relatively thin fibrotic stenosis. e) Concerns over effects of general anaesthesia. f) Able to make patient phonate with no primary intention of decannulation.

Cryotherapy was first used on an endobronchial tumor in 1968 by Gage, who used a rigid applicator known as a cryoprobe . The use of cryotherapy became more widespread with the advent of the flexible cryoprobe in 1994 [9]. International guidelines in interventional pulmonology and American college of chest physicians acknowledged the use of cryotherapy in treating intrinsic airway lesions [10].

Cryotherapy is the insertion of cryoprobe through the working channel of the bronchoscope for the application of extremely low temperature and create a freeze thaw effect on tissues. It is based on the Joule–Thomson physical principle whereby a liquefied gas under pressure that exits through a small orifice undergoes rapid conversion and expansion to the gaseous form. This liquid–gas conversion is accompanied by a dramatic temperature drop that is captured in the cryoprobe tip. Tissue damage occurs when the cryoprobe is brought into contact with the target tissue. When using the cryoadhesion technique, the frozen probe tip is abruptly pulled away from adherent tissue during the rapid freezing phase. The goal is tissue removal, rather than tissue injury and cell death [11]. Most authors have used cryoadhesion technique for the removal of tissue only through a rigid bronchoscope under complete sedation. We did our procedure with a flexible bronchoscope, under conscious sedation with dexmedetomidine. Various authors have used dexmedetomidine for anaesthesia during bronchoscopy. They have reported excellent results with good patient tolerance of the procedure and improved patient comfort [12]. Our patient also tolerated the procedure and had a good post procedure recovery.

It is important to note that the cryosensitivity of a tissue depends on its intracellular water content and vascularity. Fat, cartilage, nerve sheath, connective tissue, and fibrosis are known to be cryoresistant, whereas tumor, granulation tissue, skin, mucous membranes, nerves, and endothelium are cryosensitive [13].

Cryotherapy has been used for multiple indications like malignant and benign central airway obstruction, foreign body removal or cryoextraction, endobronchial biopsy, and transbronchial biopsy. The advantages being: a) there is selective tissue destruction, Cryotherapy is less likely to affect the cartilage, collagen, or fat tissues in the airway; thus, the risk of perforation/ damage to airway is low. b) Chances of hemorrhage are low. c) Unlike laser which is generally used with rigid bronchoscope, cryotherapy can be used with flexible bronchoscope. e) There is no risk of airway fire when concurrently used with high oxygen (Fio2 >0.4) as compared to other modalities like electrocautery. f) It is comparatively inexpensive g) relatively simple to perform [11][14].

However no technology is without its set of complications. Commonly noted complications or drawbacks are a) Bleeding [15]. b) Inability to use in treating critical or emergent central airway obstruction, as there is increased inflammation after the procedure. Follow up bronchoscopy is required to clear necrotic tissue left behind [9]. c) Rapidly expanding cryogen leading to barotrauma and hypoxemia [14].

Conclusion:

Cryotherapy is an important tool that can be

safely used with fibre optic bronchoscope to treat variety of conditions pertaining to central airway.We report successful use of cryotherapy in managing suprastomal granulation tissue caused by prolonged tracheostomy. Bronchoscopicelectrocautery followed by cryotherapy was performed in our patient under sedation with dexmedetomidine with favourable outcomes. Our experience suggests that a multimodality approach should be used for the management of granulation tissue and the same principle can be used effectively in the management of other malignant and non-malignant central airway lesions.

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