Endoscopic management of tracheal stenosis with flexible CO2 laser fibers, balloon dilation, and mitomycin C

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ABSTRACT

Objective: Tracheal stenosis is a challenging and complex disease process. This study reports our experience with the management of tracheal stenosis using flexible CO2 laser fibers, balloon dilation and mitomycin C.

Methods: Retrospective chart review was performed at a tertiary care center. All subjects with tracheal stenosis treated between June 2007 and July 2011 who underwent endoscopic CO2 laser incision and balloon dilation with mitomycin C application were included.

Study Design: Retrospective chart-review

Results: A total of 15 (8 male, 7 female) subjects undergoing 49 procedures comprised the study group. The mean age at presentation was 40 years (range 19-62). Etiologies of tracheal stenosis included previous intubation (n=11, 73%), tracheostomy (n=8, 53%), inhalational burn injury (n=4, 27%), sarcoidosis (n=1, 7%), and idiopathic (n=1, 7%). One patient (7%) was preoperatively staged Coton-Meyer grade I stenosis, n=6 (40%) grade II, and n=2 (13%) grade III. The mean number of laser incisions with balloon dilation procedures performed was 3.3 (range 1-8). Two patients required tracheal resection, but developed stenosis postoperatively. These patients underwent salvage laser incision and balloon dilation with good effect. One patient had tracheomalacia requiring stent placement. The average follow-up was 16 months (range 2-37 months). At last follow-up, 15 (100%) patients had patent airways without dyspnea. There were no complications.

Conclusions: Endoscopic management of patients with tracheal stenosis using flexible CO2 laser fibers, followed by balloon dilation and mitomycin C application is both safe and effective. Multiple procedures may be required given the recalcitrant nature of this disease process.

INTRODUCTION

Tracheal stenosis (TS) is a complex disease process with multiple etiologies. The most common cause is mechanical trauma related to postintubation injury. Other etiologies of TS include upper respiratory infection, chemical or thermal burns, neoplasms, or systemic diseases such as Wegener’s granulomatosis, and idiopathic.

The ideal management of TS has challenged physicians for many years. The ultimate treatment goals are to enlarge the airway, and improve patient quality of life without inducing further airway trauma. In this study, we report our experience with endoscopic management of tracheal stenosis using flexible CO2 laser fibers, balloon dilation and mitomycin C application.

METHODS AND MATERIALS

Institutional Research Board approval for this project was obtained from the Medstar Health Research Institute. A retrospective chart review was performed of patients 18 years and older who underwent treatment for TS at Medstar Washington Hospital Center between June 2007 and November 2011. We used the Myer-Cotton grading system to rate the severity of stenosis.

Surgical Technique

Patients underwent general anesthesia using a 5.5 or 6.0 endotracheal (ET) tube. After the induction of anesthesia, a laryngoscope was used to visualize the larynx. Once adequate visualization was obtained, the ET tube was removed, the laryngoscope was passed gently into the subglottis, and the laryngoscope was suspended from the operating room table. Using a 0° telescope, the stenotic site was evaluated and the distance from the vocal cords to the proximal end of the stenosis and the length of the stenosis were measured. Laser incisions and balloon dilation was performed under apneic conditions. The ET tube was intermittently placed into the airway through the laryngoscope for oxygeation.

Standard laser safety precautions were followed. The Omniguide CO2 laser (Omniguide, Inc., Cambridge, MA) flexible fiber delivery system was used during the procedure. A saline soaked pledget was placed below the level of stenosis to protect the distal end of the airway. The 0° or 30° degree telescopes along with the Omniguide laser were used to make radial incisions at the 12, 3, and 9 O’clock positions throughout the length of stenosis (Figure 4A & B). The laser was set on continuous mode at 10 watts. Once adequate excision of stenotic tissue was accomplished, saline filled balloons (Boston Scientific CRE balloon, Natick, MA) were used for dilation (Figure 2A & B) to a diameter of 2 cm. At the end of the procedure, mitomycin C (0.5 mg/mL) was applied topically to the stenotic site for 5 minutes. Residual mitomycin C was suctioned out. Patients were placed on inhaled fluticasone 220 mcg 2 puffs bid postoperatively.

RESULTS

A summary of patient characteristics can be found in Table 1. Eight male and 7 female patients with a mean age of 40 years (range 19 - 62) were treated for TS. The most common etiologies included previous intubation (n = 11, 73%), followed by previous history of tracheostomy (n = 8, 53%). There were no grade IV stenoses. The average distance between the true vocal folds and the proximal extent of stenosis was 2.3 cm (range, 1 - 4). The average length of stenosis was 1.5 cm (range, 0.5 – 3).

During the study period, a total of 49 procedures were performed in 15 patients. The mean number of procedures performed was 3.3 (range 1 – 8). The mean interval between subsequent procedures was 69 days (range 1 – 471) (Table I). During the study period, two patients (#5 & #9) underwent tracheal resection for refractory stenosis. However, both patients developed re-stenosis after tracheal resection and salvage laser incision and balloon dilation with excellent results. Patient #5 required one, and patient #9 required two salvage procedures, respectively, before establishing a patent airway.

Patient #7 underwent two attempted laser incision and balloon dilation procedures, but was ultimately found to have significant tracheomalacia resulting in recurrent stenosis. He underwent tracheal stent placement with excellent result.

Two patients had tracheotomy tubes in place at the onset of treatment (Patients #1 and #6). Both patients were successfully decannulated after 6 and 2 procedures, respectively.

At last follow-up (mean 16 months (range 2 – 37)), 15 of 15 (100%) patients had patent airways without dyspnea. No patients had tracheotomy tubes placed during the course of treatment with laser incision and balloon dilation procedures. There were no intraoperative or postoperative complications experienced.

DISCUSSION

Tracheal stenosis (TS) is a complex and recalcitrant disease process that has challenged physicians for many years. Management strategies for TS range from simple dilations to complex procedures such as tracheal resection which carry higher morbidities.

Historically, rigid dilation has not been very effective in managing TS. Unlike rigid dilation, the technique of balloon dilation relies on radial forces to dilate the stenotic segment instead of shear forces. Also, with balloon dilation, only a single pass is required to maximally dilate the trachea (the diameter is increased to 20 mm by increasing the amount of saline within the balloon). The combination of radial dilation forces along with a lower number of passes through the stenotic segment likely results in less mucosal trauma and a better long-term outcomes as witnessed by our results.

Traditionally, endoscopic delivery of the CO2 laser beam has been through the use of micromanipulators. These micro-manipulators require a line-of-sight visualization of the stenotic segment, which can be difficult to obtain in the distal portions of the stenotic segment. The development of flexible CO2 laser fibers has overcome many of these limitations. Mitomycin C has been demonstrated to have significant benefit in preventing recurrent tracheal stenosis in multiple retrospective studies. In another study, the authors concluded that Mitomycin use did not prevent stenosis recurrence, but rather delayed the time to developing recurrent stenosis.

Previously, it was described that patients with Grade I or II Myer-Cotton scores with stenosis lengths of 1.5 cm or shorter with an intact cartilage framework have been good post-operative outcomes. However, in our study, we have demonstrated that patients with grade III stenosis, and stenotic segments up to 2.5 cm in length can be treated effectively with a minimally invasive endoscopic approach. To our knowledge, this is the first case series that describes the use of flexible CO2 laser fibers, balloon dilation and mitomycin C in the management of tracheal stenosis.

CONCLUSIONS

Endoscopic management of patients with tracheal stenosis using flexible CO2 laser fibers, followed by balloon dilation and mitomycin C application is both safe and effective. However, it is important to recognize that multiple procedures may be required given the recalcitrant nature of this disease process.

REFERENCES

6. For best viewing.