Tracheal resection for tracheal stenosis

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ABSTRACT

Anatomically, patients with refractory tracheal stenosis benefit from tracheal resection, depending on the medical comorbidities or challenging tracheal anatomy, which is often the reason for denial of this option in these patients. We evaluated 15 patients undergoing tracheal resection at our institution from May 2016 through December 2017. Eleven patients had a history of previous tracheostomy, six in place at the time of resection. One had idiopathic stenosis with no known comorbidities. Major comorbidities included chronic obstructive pulmonary disease, non-insulin-dependent diabetes mellitus, hypertension, and cardiovascular disease. One had a left ventricular assist device, and one was a lung transplant recipient. All had primary resection through the cervical approach with a median length of 3.5 cm. Fourteen patients were eventually decannulated. One patient had re-resection 1 year later for recurrent stenosis. Twelve were alive at a median follow-up of 15 months with patent airways. In conclusion, tracheal stenosis patients have significant comorbidities that increase the risks after resection. However, these patients should still be considered for surgery for an improved quality of life and eventual resolution of severe stenosis.

KEYWORDS Endotracheal intubation; tracheal resection; tracheal stenosis

Although patients with refractory tracheal stenosis would typically benefit from definitive tracheal resection, many are denied surgery due to medical comorbidities or challenging airway anatomy. Nonsurgical therapies have become appealing thanks to improvements in technology, especially for patients with coexisting conditions and poor general health unfit for surgery. The mainstay of nonsurgical therapy is tracheal dilatation and endoscopic scar division, with 83% showing an initial improvement. However, 80% of patients experience a recurrence of symptoms within 2.5 years of treatment.¹ Recurrence rates of stenosis are 44% with balloon dilatation and 26% with endoscopic scar excision,² although steroid and mitomycin C application lessen this likelihood, thus moderately increasing the success rate to 75%.³ Additionally, endoscopic interventions for tracheal stenosis can lead to further fibrosis, worsening of the stenosis, and life-threatening airway compromise.⁴ For operable patients, tracheal resection may be the best option for an overall improved quality of life. We evaluated the results of our single-center experience.

METHODS

Charts were retrospectively reviewed for patients 18 years and older undergoing subglottic resection procedures at our institution from May 2016 through December 2017 with a 6-month follow up. Patient demographic characteristics, coexisting conditions, surgical characteristics, outcomes, complications, and mortality were assessed. Tracheal resections were classified at our institution as standard risk vs high risk, assessed by the technical aspects of the procedure as well as the presence or absence of major medical comorbidities. Resections were considered high risk if the stenosis involved the cricoid, was ≥ 4 cm in length, or required a hyoid release maneuver or if the patient required an indwelling tracheostomy at the time of resection. Major comorbidities considered included the presence of a major cardiac disorder, significant underlying lung disease, renal failure requiring dialysis, morbid obesity with a body mass index >35 kg/m², non-insulin-dependent diabetes mellitus, recurrent stenosis after tracheal resection, immunosuppressed state requiring continuous immunosuppression, a major defined psychiatric disorder, and active substance abuse.

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Table 1. Demographic characteristics of 15 patients undergoing tracheal resection

Patient	Sex	Age (years)	Race/ethnicity	BMI (kg/m ²)	Previous tracheostomy	Preoperative tracheostomy in place	Preoperative comorbidities
1	M	21	Black	19	+	+	Pneumonia, coagulation disorder
2	M	28	White	30	0	0	Chronic alcoholism, prolonged intubation for aspiration pneumonia
3	F	33	White	20	+	0	MVA 8 y prior
4	F	33	White	57	+	0	MVA 12 y prior with facial reconstruction
5	F	37	Black	36	0	0	None
6	M	48	White	28	0	0	PE 7 y prior, CVA 6 y prior, HIV, Non-Hodgkin's lymphoma, Guillain-Barre syndrome 6 y prior
7	F	51	White	22	+	0	COPD, pneumonia, hepatitis C, NIDDM with DKA
8	M	53	White	30	+	+	CABG 4 mo prior
9	F	54	White	22	+	+	Bilateral lung transplant for bronchiolitis obliterans 7 mo prior with graft rejection
10	F	56	White	30	+	0	COPD, GERD, CKD
11	F	59	Black	25	0	0	ESRD on dialysis, tracheomalacia, CVA 1 y prior
12	M	60	White	31	+	0	MVA 1 y earlier
13	F	61	Black	29	+	+	Chronic tracheostomy, ECMO 1.5 y prior
14	M	61	Hispanic	29	+	+	Ischemic cardiomyopathy
15	F	67	White	30	+	+	CABG 5 mo prior

BMI indicates body mass index; CABG, coronary artery bypass graft; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; CVA, cerebral vascular accident; DKA, diabetic ketoacidosis; ECMO, extracorporeal membrane oxygenation; ESRD, end-stage renal disease; GERD, gastroesophageal reflux; HIV, human immunodeficiency virus; MVA, motor vehicle accident; NIDDM, non-insulin-dependent diabetes mellitus; PE, pulmonary embolism.

RESULTS

Fifteen patients met the study criteria and were included in this analysis. The most frequent indication for surgery was posttraumatic, with a history of tracheal stenosis at the location of a previous tracheostomy in 10 of the 15 patients. Eleven patients had undergone multiple previous bronchoscopic dilatations (*Table 1*). The 14 patients undergoing primary surgery underwent resection through a cervical approach, while 1 patient undergoing re-resection required an upper sternotomy for exposure.

The median length of resection was 3.5 cm (range, 2–5) (*Table 2*). Nine cases had technical aspects considered high risk, with three patients requiring suprahyoid release due to the extended length of stenosis resected. These nine high-risk patients had a median length of stay of 8 days, and three of

these patients were reintubated after resection. Twelve patients had coexisting conditions considered high risk, including obesity, chronic obstructive pulmonary disease, end-stage renal disease, an immunosuppressed state, major cardiac disease, major psychiatric illness, and active substance abuse (*Table 1*). Their median length of stay was 8 days.

Overall, there was no in-hospital mortality, but 10 patients experienced postoperative complications. The hospital length of stay ranged from 3 to 34 days (mean, 7). The 7 patients whose stay was >7 days had surgical complications. Five patients required reintubation after surgery due to airway edema (4 patients) or hemorrhage (1 patient); 3 patients required tracheostomy after tracheal resection due to persistent airway edema or respiratory failure, although 14 of the 15 patients were successfully decannulated. The median

Table 2. Surgical parameters of 15 patients undergoing tracheal resection

Patient	Resection (cm)	Release maneuver	High-risk resection surgery	High-risk comorbidities	LOS (days)
1	3.5	None	Proximity to vocal cords	+	4
2	2	None	No	+	12
3	3	None	No	0	3
4	4.5	None	Long resection ^a	+	3
5	2.5	None	High resection ^b	0	7
6	2	None	No	+	5
7	4	None	No	+	5
8	5	Suprahyoid release	High resection	+	23
9	2.5	None	Proximity to vocal cords	+	6
10	4	Suprahyoid release	Long resection	+	34
11	3.5	None	High resection	+	8
12	2	None	No	0	3
13	2.5	None	High resection	+	8
14	4.5	Suprahyoid release	High and long resection	+	14
15	4	None	No	+	30

LOS indicates length of stay.

^aResections >4 cm.

^bResections reaching up to the cricoid cartilage.

follow-up ranged from 2 to 27 months (mean, 17). Three patients died within 6 months of resection.

DISCUSSION

Tracheal stenosis may occur with postintubation injury, trauma, gastroesophageal reflux, Wegner's granulomatosis, connective tissue disorders, or idiopathic causes. In a large prospective study published in 1981, Stauffer et al reported tracheal stenosis in 19% of patients with a history of endotracheal intubation and in 65% of patients with a history of tracheostomy.⁵ Even with recent improvements in the endotracheal and tracheostomy cuff design, it is still estimated that 10% to 59% of patients will develop tracheal stenosis due to airway instrumentation.^{6,7}

Options other than balloon dilatation for tracheal stenosis include stents and tracheostomy. Tracheal stents for benign tracheal stenosis have a poor track record with intraoperative (4%) and postoperative (8.8%) complications, stent migration (11%), sputum retention (7%), granulations (22%), and bleeding complications (43%)⁸ and have largely been abandoned.⁹ Permanent tracheostomy or T-tube is associated with major compromises to phonation and difficulty in swallowing. In addition, patients

have been shown to have an overall poor Health-Related Quality of Life score, with a decline in mental health and worsening self-esteem.^{10–12} Additionally, tracheostomies and T-tubes require continued daily maintenance, which can prove challenging.

Despite a high success rate, studies have shown up to a 50% complication rate with tracheal resection,¹³ especially when performed in high-risk patients. One study reported significant clinical comorbidities, with 45% of diabetics and 38% of those with >4 cm resections developing complications after resection. Nonetheless, at 1.5-year follow-up, 91% were breathing normally without stridor and with no mortality.¹⁴

While mortality in our cohort was low, there was considerable morbidity, including cardiovascular disease, renal disorder, psychiatric disorder, and diabetes mellitus. There were mostly high resections, with three patients with multiple existing comorbidities having suprahyoid release maneuvers. Three patients required early tracheostomy due to persistent airway edema or the need for more prolonged mechanical ventilation. Most of those with ≥4 cm resections as well as diabetic patients had a complicated postoperative course, with one death in each of these groups. Though there were no hospital deaths, three patients died in our short follow-up. One patient died of lung graft failure, another patient died of a severe hypoglycemic episode, and the third patient died of reasons unrelated to resection, showing that major medical comorbidities present in this patient population are ongoing risks for death after their surgery, likely reflecting the population of patients presently developing tracheal stenosis.

This was a single-center study with a small sample size and limited follow-up. Patient selection and determination of acceptable risk were subjective, and there was no comparator group to evaluate outcomes for patients who did not undergo resection.

In conclusion, surgical resection can help in providing symptomatic relief from stenosis-associated problems and improve quality of life in these otherwise sick patients to help them focus on other medical illnesses.

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