# Tracheal stenosis—resection and reconstruction

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## Clinical vignette

The patient is a 64-year-old woman with post intubation tracheal stenosis. Three years prior to presentation, she had undergone craniotomy for a meningioma and developed postoperative respiratory failure requiring prolonged intubation and tracheostomy. She made a full neurologic recovery and was decannulated from her tracheostomy. Several months later, she developed stridor and shortness of breath and was diagnosed with stenosis at the site of her prior tracheal stoma. She underwent tracheal dilation and laser treatment with modest improvement in her symptoms but overall, she remained limited by her breathing. As part of her preoperative planning she lost 25 kg. She also underwent direct laryngoscopy and was found to have normal vocal cord function. She was then brought to the operating room for bronchoscopy followed by tracheal resection and reconstruction.

## Surgical techniques

### Preparation

The procedure begins with bronchoscopy to establish an airway and ensure that conditions are optimal for resection. Dilation of the airway is sometimes required. The patient is then placed in a supine position with arms tucked, back slightly elevated in a "beach chair" position, and neck gently extended on a thyroid bag. Equipment for cross-table ventilation should be readied for use by an experienced anesthesia team.

### Exposition

Lesions in the proximal and mid trachea are amenable to a cervical approach. An upper sternal split may be needed in rare cases. A prior stoma site should be incorporated into the skin incision. The operation then proceeds with creation of subplatysmal flaps and vertical separation of the strap muscles to expose the anterior trachea.

### Operation

The goal of tracheal resection is to perform the minimum amount of dissection necessary to create a tension-free anastomosis without disrupting tracheal blood supply or damaging surrounding structures. The first step in the operation is to localize the lesion precisely. This is accomplished by having the surgeon perform a bronchoscopy while the assistant passes a small-gauge needle through the airway to mark the inferior and superior extent of the stenosis. The trachea is then divided at the midpoint of these boundaries. The tip of the oral endotracheal tube is secured to a flexible catheter and withdrawn into the proximal airway.

The distal airway is intubated on the field and cross-field ventilation is begun. This tube is withdrawn frequently for periods of apnea such that dissection and suturing may be performed in an unobstructed field. The trachea is then resected proximally and distally until normal tissue is reached. Frequent tests of anastomotic tension are performed by having the anesthesiologist gently flex the neck while the surgeon brings the two ends of the trachea together using laterally placed traction sutures. Mobilization is achieved by dissecting anterior and posterior to the trachea while taking care to preserve soft tissue between the innominate artery anteriorly and avoid damage to the esophagus posteriorly.

Lateral dissection is carried out with two principles in

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mind: first, the blood supply to the trachea arises laterally and should not be disrupted more than a centimeter away from the anastomosis, and second, damage to the recurrent laryngeal nerves is prevented by keeping dissection as close to the trachea as possible. The anastomosis is performed using interrupted 4-0 oiled vicryl sutures placed posterior to anterior and spaced every 0.4–0.5 cm.

The neck is then flexed, the oral endotracheal tube is advanced into the distal airway, and the traction sutures are tied to minimize tension on the anastomosis. Anastomotic sutures are tied anterior to posterior. When complete, the integrity of the anastomosis is tested underwater. A strap muscle is mobilized and affixed to the anterior anastomosis. Excessive anastomotic tension should prompt the addition of a Montgomery suprahyoid release maneuver (1), though this is seldom necessary.

### Completion

A closed suction drain is placed deep to the platysma, which is then closed with running vicryl suture. The skin is closed with running subcuticular suture. A heavy ethibond "guardian suture" is placed between the submental and presternal fascia and tied with sufficient tension to keep the patient's neck in a neutral position and prevent an episode of inadvertent hyperextension. The patient should be extubated at the end of procedure.

## Comments

### Clinical results

The largest series of tracheal and laryngotracheal resection and reconstruction was published by Wright *et al.* (2) and includes 901 patients operated on at Massachusetts General Hospital between 1975 and 2003. In the series, 95% of patients ultimately had a satisfactory airway without the requirement for an airway appliance. Complications occurred in 18.2% of patients, of which half were anastomotic complications. These included granulation tissue formation (1%), restenosis (4%) and anastomotic separation (4%). Tracheoesophageal and tracheoinnominate fistula formation were rare but devastating complications. Mortality was 1.2%, with most deaths occurring early in the study period. An anastomotic complication increased the risk of death by a factor of thirteen. These results are similar to those observed in other series (3-5).

### Advantages

We favor cross-field ventilation and an interrupted suturing technique because it is precise and consistently reproducible. The short and long-term success of tracheal resection depends heavily on that precision, and the conduct of operation is sufficiently complex that is worthwhile to keep certain elements—namely the patient's physiology—as stable as possible. Other centers have described success with a variety of different anastomotic and ventilation techniques, including running sutures, hybrid running/interrupted sutures, jet ventilation, spontaneous breathing, and even extracorporeal membrane oxygenation. These techniques appear to value speed over precision and therefore have not gained favor in our institution.

### Caveats

Tracheal surgery is inherently complex and requires a multidisciplinary approach. The availability of skilled anesthesiologists, respiratory therapists and speech-language pathologist is crucial to the success of the operation. Postoperative care must be delivered by a team of physicians and nurses that are trained to recognize and respond to the early signs of an anastomotic complication before they result in substantial morbidity or death. For this reason we believe that tracheal surgery is best performed in a high-volume tertiary medical center.

## Acknowledgements

None.

## Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

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