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Use of the carbon dioxide laser with the Montgomery T-tube in the management of extensive subglottic stenosis

EDWARD WHITEHEAD, F.R.C.S.Ed., M. A. SALAM, F.R.C.S.Ed. (Hull)

Abstract

Subglottic and tracheal stenosis frequently present difficulties in management.

Two cases of subglottic stenosis occurring after prolonged endotracheal intubation are presented where the vertical length of complete obstruction by scar tissue was greater than 2.5 cm. One case was successfully managed by the use of the laser and immediate insertion of a stent. The other case still requires subglottic stenting, although an excellent lumen was established by laser vaporization of the stenosed segment.

Introduction

Intubation is frequently required in the management of the critically ill, a measure that saves many lives.

Endotracheal intubation may however, result in pressure injuries to the posterior glottis, as is seen in the intubation granuloma, but prolonged intubation may lead to severe damage to the posterior glottic, subglottic, and tracheal areas. High volume, low pressure cuffs have substantially reduced the incidence of tracheal stenosis, but the occurrence of glottic stenosis remains almost unchanged, according to a study by Weymuller (1988).

Friedman *et al.* (1983) showed that positive pressure ventilation increases the risk of stenosis; it creates direct pressure at the site of endotracheal tube cuff as well as a shearing stress on the tracheal mucosa, with each inspiratory and expiratory effort.

Two cases are presented who, after prolonged intubation followed by tracheostomy, developed severe subglottic stenosis.

Case reports

Case 1

A 19-year-old male was admitted with extensive skull fractures following a road traffic accident. He required immediate intubation with assisted ventilation, and remained in the Intensive Care Unit for two weeks. Three attempts at extubation were unsuccessful, and a tracheostomy was performed. Endoscopy showed the subglottic and the upper trachea to be totally obstructed by granulations and scar tissue. A carbon dioxide (CO_2) laser was used to vaporize the scar tissue, which extended for 2.5 cm. Multiple laser applications were required, and although the length of the stenosed segment was reduced, it reformed, even after establishing a good lumen down to the tracheostomy site. (Fig. 1). After further treatment, a Montgomery silicone T-tube was inserted, with the upper limb situated just below the vocal folds. Although an excellent subglottic lumen was achieved, it quickly restenosed above the tracheostomy site, within seven days on one trial removal of the T-tube. At the time of writing, the patient is able to breathe and speak normally with the T-tube corked off.

Case 2

A 45 -year-old school teacher presented with a subarachnoid

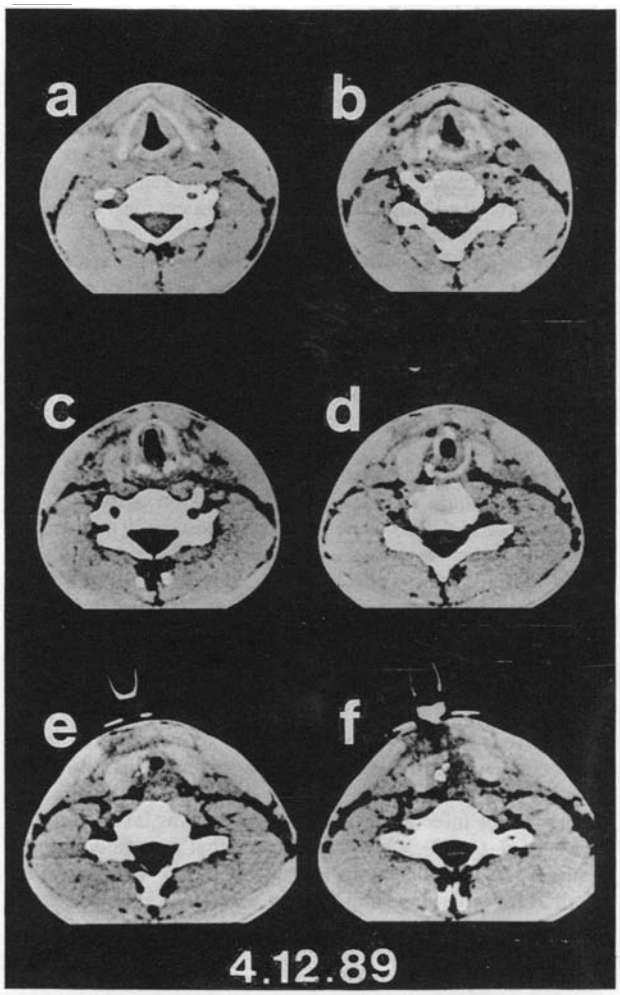

FIG. 1

This shows increasing stenosis from the glottic at (a) to complete obstruction at (f) following several laser applications.

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haemorrhage, requiring clipping of an aneurysm. She remained in the Intensive Care Unit on a ventilator for 12 days, and was then extubated. Her condition remained stable for 10 days, with no airway difficulty, but she then developed increasing difficulty in breathing, associated with stridor and had a tracheostomy. Later a microlaryngoscopy showed granulations and polypoid mucosa obstructing the laryngeal lumen at a glottic and subglottic level. A CO_2 laser was used to vaporize the granulations and scar tissue, until a lumen was established down to the tracheostomy site. A T-tube was introduced and trimmed, with the upper limb situated just below the vocal folds. Endoscopy was repeated after two and six weeks, when the glottic and subglottic areas were found to be stable, with no further granulations or scar tissue formation. The patient was able to breathe through her larynx with the tube plugged, and recovered her speaking voice. At the time of writing, she has now, for six months, had the T-tube removed, the tracheostomy closed, and maintains an excellent voice with no difficulty with her airway.

Discussion

Endotracheal intubation has been implicated as a cause of subglottic and tracheal stenosis, especially where this has been prolonged or repeated. Until the mid-1970s, treatment usually consisted of by-passing a stenosed segment by a tracheostomy, and treating the stenosis by dilatation.

Suspension microlaryngoscopy with CO_2 laser excision of the subglottic scar tissue is at present the preferred method of treatment in adults and infants (Halstead and Bowles, 1989). It enables accurate and unhurried examination of the larynx and subglottic areas using the binocular microscope and has been used in most centres for at least the last 20 years. Combined with venturie ventilation, it enables an excellent view of the larynx and subglottic areas.

In the larynx it enables the surgeon to vaporize scar tissue with precision, producing minimal damage to healthy areas and insignificant blood loss. Successful treatment often requires multiple laser procedures, with or without stenting of the airway (Shapshay *et al.*, 1987).

Strong *et al.* (1979) and Simpson *et al.* (1982) used a stent after CO_2 laser vaporization of the subglottic scar in nearly all of their cases.

Healy's (1982) basic study using a dog model supported the efficacy of using a stent until epithelialization occurs.

Schmidt *et al.* (1986) concluded from their study that smaller segmental excisions of scar with epithelial covering or a stent would be effective in preventing reformation of the scar. Factors contributing to poor results or failure of laser treatment are: circumferential scarring with cicatricial contracture; tracheomalacia with loss of cartilaginous support; and scarring greater than 1 cm in the vertical dimension (Simpson *et al.*, 1982).

McGovern *et al.* (1971) showed that the incidence of laryngeal complications increases twofold when intubation is followed by tracheostomy.

The role of infection in airway stenosis was investigated by Sasaki *et al.* (1979), when they showed that the amount of scar tissue produced, is directly influenced by the length of time required for wound healing, and by the presence or absence of infection.

Scar tissue is increased by infection and the risk of infection is increased by a tracheostomy. Cases with tracheal wall collapse are possibly best treated with resection and anastomosis, but the outcome is sometimes uncertain (Ossaff *et al.*, 1985). In both of the two cases described, the subglottic stenosis was complete and the vertical dimension of the scar more than 2.5 cm. Therefore, the insertion of a Montgomery T-tube was an essential part of the treatment.

In the first case, the stenosis was of such a degree that a lumen was not established until after several laser applications, and not for some time after his initial tracheostomy. Unfortunately, his social environment and attitude is such that it would at this stage, be somewhat hazardous to consider an open operation. He has at the time of writing, a T-tube in position with a good speaking voice and airway.

In case 2 it was possible to vaporize all the scar tissue with laser, and insert the T-tube in the same session. She has, at the time of writing, an excellent speaking voice, and no airway problems with her tracheostomy closed.

The Montgomery silicone T-tube initiates little or no tissue reaction. It serves as both a stent and a tracheostomy tube. The intraluminal portion is of sufficient density and thickness to support a reconstituted stenotic larynx and trachea. Mucus and crusts do not readily adhere to the smooth surface of the silicone material. Most of the time, the soft T-tube remains plugged, thus allowing respiration and phonation while maintaining the airway (Montgomery and Montgomery, 1990).

Conclusion

Certain patients may on extubation, experience immediate difficulties with their airway, but sometimes this may be delayed. We would suggest that these patients should have their larynx and subglottic areas assessed by microlaryngoscopy.

The CO_2 laser plays a major role in treating subglottic and tracheal stenosis, but when the length of the stenosis is greater than 1 cm some form of intraluminal stenting is also usually required.

In the illustrated cases, the Montgomery silicone T-tube was used as a stent. It initiates little or no tissue reaction, serving as both a stent and a tracheostomy tube. The intraluminal portion is of sufficient density and thickness to support a reconstituted stenotic larynx and trachea. Mucus and crusts do not readily adhere to the smooth surface of the silicone material. Most of the time, the soft T-tube remains plugged, thus allowing respiration and phonation, while maintaining the airway. (Montgomery and Montgomery, 1990).

The segment above any tracheostomy site is more liable to become infected, which increases scar tissue formation. Any scar tissue or granulations may be managed and treated by laser vaporization, thus probably avoiding a tracheostomy.

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Address for correspondence:
Edward Whitehead, F.R.C.S., Ed.,
Department of Otolaryngology—Head and Neck Surgery,
Hull Royal Infirmary,
Anlaby Road,
Hull,
North Humberside.

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