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Tracheostomy

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In this paper a comparison has been made between excision-type window tracheostomies and classical Björk flap and modified flap tracheostomies, based upon a review of all tracheostomies performed at Harare Hospital, Salisbury, over a 20-month period, together with bronchoscopic follow-up whenever possible.

The modified flap type of tracheostomy is constructed by means of a broad-based flap dividing two tracheal rings and having rounded corners. It produces a good stoma through which tube changing can be performed with ease and safety. Any form of permanent defect in the trachea left by merely extubating a tracheostomy will almost always produce a narrowing at the level of the stoma, which is probably most severe if a flap-type of stoma has been made. Routine replacement of a modified flap will nearly always avoid this.

A serious stricture was produced in three (3%) patients in the series. In two, this was at the level of the tube tip in patients who had been on prolonged artificial ventilation; one required resection. These strictures are probably due to movement of the tube tip during ventilator therapy, and it is suggested that some method of coupling the ventilator to the tube might be devised to avoid this.

The relative frequency with which tracheostomy has to be performed in an African community in Salisbury has led us to re-evaluate the methods and to introduce modifications designed to improve the stoma and reduce the incidence of tracheal narrowing. The purpose of this paper is to describe these modifications and to show how they improve the long-term results of tracheostomy.

In the past, fashion has varied between transverse and vertical skin incisions, high and low operations, slitting the trachea, forming a window or making a flap. Jackson (1963) discredited the high operation and it is seldom performed now. However, all the other variations are still practised.

METHODS

The investigation was carried out in two parts:

(*a*) All tracheostomies performed over a period of 20 months (January 1968 to August 1969) in Harare Hospital, Salisbury, Rhodesia, were reviewed retrospectively.

(*b*) Bronchoscopy was carried out after extubation on all patients wherever possible.

The following types of operation were performed:

1. vertical skin incision with excision-type window in 16 patients;
2. transverse skin incision with excision-type window in 64 patients;
3. transverse skin incision with classical, although shorter and wider, Björk-type flap in 16 patients;
4. transverse skin incision with modified flap in 14 patients.

No selection of patients occurred; the procedure adopted was entirely a matter of the individual surgeon's choice.

Types 1 to 3 have been described previously.

TYPE 4 THE MODIFIED FLAP TRACHEOSTOMY (Fig. 1) The essential differences between the classical Björk flap and the modified one are shown in the diagrams. Whereas Björk incised tracheal rings 2, 3, and 4, we incise only 3 and 4 but make a wider base of 12–15 mm. against his base of 5 mm. This, together with rounding off the corners, ensures a better blood supply to the flap and a better opening for the passage of the tube. The upper corners of the flap are anchored by fine chromic catgut (3/0) to the subepidermal tissues somewhat further apart than the width of the top of the flap in order to hold the stoma wide open with the soft tissues of the neck displaced laterally. A clear opening is ensured by routine division of the thyroid isthmus.

When extubation can be successfully accomplished and the patient has proved that his upper airways are clear by digital occlusion of the tracheostome, then the flap is formally replaced in the trachea.

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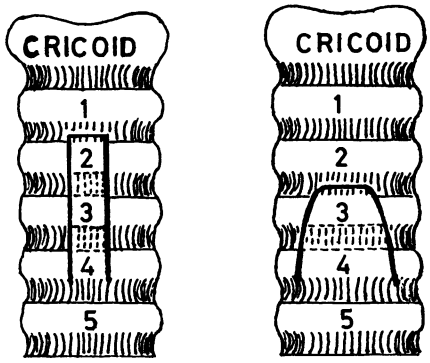

FIG. 1. *Types of flap tracheostomy: (left) classical Björk flap; (right) modified flap.*

The flap is freed from its subepidermal attachment by sharp and blunt dissection, for which the original catgut sutures of recent tracheostomies are often a useful guide. The trachea is exposed and the edges of the stoma clearly defined. The flap is elevated, rotated into the stoma and secured in place with three 3/0 chromic catgut sutures along the upper edge of the flap. The strap muscles are approximated by a single catgut suture placed below the tracheal repair and the ends only of the skin wound are approximated, leaving a piece of Paul's tubing centrally in case of air leaks; this is removed after 24 to 48 hours.

Bronchoscopy is now carried out routinely at the time of replacement of a type 4 flap, but for the types 1 and 2 and the earlier types 3 and 4 it was performed within one week of extubation. It is repeated within two months and again within six months where possible.

RESULTS

A 'narrowing' of the trachea is a bronchoscopic finding for the purposes described here, whereas a 'stricture' is a narrowing of sufficient degree to cause signs and/or symptoms.

One hundred and ten patients had tracheostomies performed during the period of investigation; 50 of these died, but none as a result of the tracheostomy.

The bronchoscopic findings after tracheostomy are given in Tables I and II. Two of the patients had strictures at both the stomal level and the level of the tracheostomy tube tip. The reduction in the incidence of strictures seen at the stomal level in the later bronchoscopies as compared with the initial bronchoscopies is considered to be the result of flap replacement. The one type 4 case with a persisting stricture had been on prolonged ventilator therapy and developed strictures at both the stomal level and the tube tip.

Only a limited number of patients with types 1 and 2 tracheostomies have been available for bronchoscopy. All but one of the patients had a narrowing at the level of the stoma at the first bronchoscopy (Fig. 2) which persisted at eight

TABLE I

STRICTURES AND NARROWINGS AFTER TRACHEOSTOMY

Type of Tracheostomy	No. Performed	No. Broncho-scoped	Strictures		Bronchoscopic Narrowings at First Broncho-scopy (within 7 days of extubation)	Bronchoscopic Narrowings at 8 weeks after Closure of Stoma	
			At Stomal Level	At Tube Tip		At Stomal Level	At Tube Tip
1	16	5	1	0	5	5	0
2	64	15	1 (both in same case)	1	14	14	1
3	16	16	0	0	10[1]	2	0
4	14	14	1 (both in same case)	1	4[1]	1	1

[1]First bronchoscopy of later cases performed at the time of flap replacement.

TABLE II

'STOMAL' STRICTURES AND NARROWINGS AFTER TRACHEOSTOMY

Type of Tracheostomy	No. Performed	No. Bronchoscoped (% of cases done)	Strictures (% of cases done)	Narrrowings at Stomal Level	
				On Initial Broncho-scopy (% of those bronchoscoped)	Later (% of those bronchoscoped)
1 & 2	80	20 (25%)	2 (1·6%)	19 (95%)	19 (95%)
3	16	16 (100%)	0 (0%)	10 (62·5%)	2 (12·5%)
4	14	14 (100%)	1 (7·1%)	4 (28·6%)	1 (7·1%)

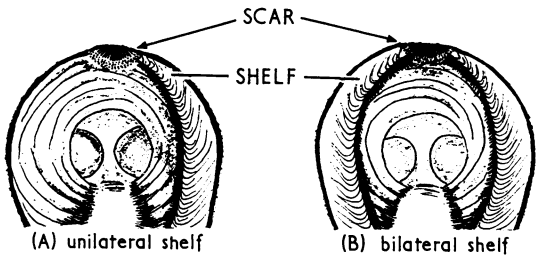

FIG. 2. *Side-to-side narrowing in the trachea at the tracheostomy, as seen through the bronchoscope.*

weeks and also at three months in those patients who had a further bronchoscopy. The fact that one patient developed a 'stomal'[1] narrowing after the first bronchoscopy appears to be explained by the fact that the first bronchoscopy was performed on the day of extubation and narrowing occurred subsequently. Only in those patients with a narrowing of less diameter than the normal glottic space was stridor precipitated by forced respiration. This occurred in three patients.

The incidence of 'stomal' narrowing was significantly greater with types 1 and 2 than with types 3 and 4 (Table II) ($\chi^2=10{\cdot}43$, $0{\cdot}01>P>0{\cdot}001$).

Fewer narrowings were found at first bronchoscopy on patients who had a type 4 tracheostomy as compared with a type 3 (Table II), but the difference between types 3 and 4 was not statistically significant ($\chi^2=2{\cdot}15$, $P>0{\cdot}05$). All four narrowings in type 4 tracheostomies were at the level of the stoma, with one also at the tube tip in one case. In all cases the narrowings were more severe than in any of the type 1 or 2 cases (except two of these which became clinically evident), but in all but one of the type 4 cases the stomal narrowings were cured by replacement of the flap.

DISCUSSION

Complications common to all types of tracheostomy include infection (Gotsman and Whitby, 1964) and tracheal obstruction due to tracheal weakness or stenosis (Jackson, 1963; Ardran and Caust, 1963; Buchmann and Sandberg, 1964; Pracy, 1966; Abbott, 1968). Prolonged intubation is more likely to produce tracheal stenosis, particularly with prolonged ventilator therapy. Campbell (1968) gave an incidence of 2 to 4% of clinical stenosis in most tracheostomy series, with which our incidence agrees (3%). It is likely that the majority of these are tube-tip strictures, following the continual movement of the tip during ventilator therapy. Two of our patients who developed severe circumferential tube-tip strictures, necessitating excision in one, had been on prolonged ventilator therapy (for 20 days and 25 days respectively). Perhaps some method of coupling the ventilator to the tube might be devised to avoid this.

The original method of stoma production by spreading the incised trachea may produce pressure necrosis of the cartilages, and hazardous and even fatal attempts at replacement of the tube are recorded during the first few days. In adults, adequate spreading of the trachea may produce transverse tears.

The excision-type window produces the same difficulty in early tube replacement, but to a lesser degree. The main objection here is that the opening must close by scar tissue with a probable reduction in tracheal lumen, which is particularly important in children (Watts, 1963; Hunter, 1967). The persistence of the narrowing at the level of the stoma, which we have found bronchoscopically in all cases with types 1 and 2 tracheostomies, supports this view, as does the occurrence of even more severe narrowing resulting from the wider opening produced by the modified flaps. Routine flap replacement virtually abolishes this narrowing, however. The evidence for this statement is set out in Table II.

Björk's classical flap method (Björk, 1960) has the disadvantage that the aditus in the trachea is small and tube replacement may be difficult but should not be dangerous as a hole is always present even when no tube is *in situ*. A leading article in the *British Medical Journal* (1969) cites retropulsion of the flap during tube replacement as a cause of dangerous obstruction; but there have been no instances of this in three and a half years on our Unit whether classical or modified techniques have been used.

Our modification of Björk's flap reduces the possibility of obstruction of the trachea proximally due to pressure of the tube on the anterior wall of the trachea above the stoma, by creating an adequate opening. This can also be done in the excision type. Jackson (1963) considered that inspiratory collapse due to weakening of the trachea following excision of cartilage contributed considerably to delay in decannulations. This would occur in a flap or excision window

[1]Narrowings which occurred in the trachea at the level of the stoma are referred to as 'stomal' for simplicity, although they do not, in fact, refer to the actual stoma itself.

type, but where the flap is replaced the weakness should be remedied and the tracheal lumen maintained. We have found this to be so, but decannulation is not normally performed (except as a test procedure) until operative closure of the tracheostomy. The main advantages of the modified flap method are the ease and safety with which tube changing may be performed and the virtual elimination of post-tracheostomy tracheal narrowing at the level of the stoma.

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