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Paediatric tracheostomy
Fifty-seven operations on fifty-three children

by

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Abstract

Fifty-seven operations on 53 patients represents the total experience of tracheostomy in children under 13 years during 1964–1985 in an area with half a million inhabitants. No complications occurred during surgery and no deaths were related to the operations. Complications followed 16 out of 30 (53%) operations on children under three years and four out of 27 (15%) of the remainder, an overall complication rate of 35%. Many fewer operations have been required since 1973 because of the successful employment of nasotracheal intubation in the treatment of upper and lower airway obstruction caused by acute infection. Obstruction by-pass remains the commonest function of tracheostomy, with congenital lesions and trauma now the commonest causes of obstruction as opposed to acute infection in the earlier years. Despite the successful use of nasotracheal intubation there were absolute indications for tracheostomy—blockage of the nasotracheal tube; inability to intubate a child with epiglottitis; and necessity for an artificial airway of long duration.

Introduction

In paediatric practice the tracheostomy operation and its management require particular care and expertise—the younger the patient the higher the complication rate and the greater the mortality (Oliver *et al.*, 1962; Chew and Cantrell, 1972). With the widespread acceptance of nasotracheal intubation in preference to tracheostomy in many situations, the opportunities for gaining experience of tracheostomy have been considerably reduced. Absolute indications for the surgical approach remain, however, and it is therefore essential that the laryngologist be thoroughly familiar with the tracheostomy procedure.

In order to gain information generally about the operation in the paediatric patient, this paper presents the experience over 22 years of a Regional Otolaryngological Unit serving a well-defined geographical area.

Material

A retrospective study was made of the clinical records of 53 children under 13 years of age who had undergone tracheostomy and were treated at the Royal Aberdeen Children's Hospital and at Aberdeen Royal Infirmary during the years 1964–1985. The catchment area of these hospitals (North East of Scotland with the Orkney Islands and the Shetland Islands) is a well-defined area with a total population of half a million people whose otolaryngological service is provided solely by one team based in Aberdeen.

Findings

Fifty-seven tracheostomy operations were performed on 53 children (32 males and 21 females). Fifty-three operations were per-

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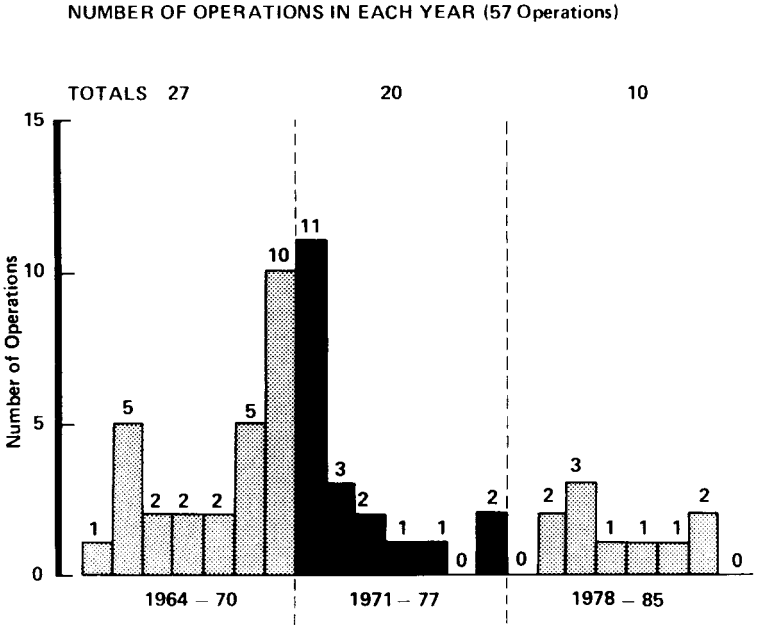


FIG. 1
Number of operations in each year.

formed at the Royal Aberdeen Children's Hospital and two operations at Aberdeen Royal Infirmary. Two children underwent tracheostomy elsewhere (Gilbert Bain Hospital, Shetland and the Royal Hospital for Sick Children, Edinburgh) and were transferred to RACH.

Basic information is presented in Figures 1–3 and Table I. The youngest patient in the series underwent tracheostomy several hours after birth. The longest tracheostomy was present for more than seven years.

Complications followed 20 (35%) of the operations. There were nine deaths in the series—all the result of the illness or injury which necessitated the hospital admission and no death was attributable to the tracheostomy operation.

Fifty-four operations were performed with general anaesthesia through an endotracheal tube, two operations were performed with local anaesthesia over an endotracheal tube and one operation was performed using local anaesthesia without intubation.

The transverse or collar skin-crease incision was employed in at least 42 operations and the vertical midline incision in at least five operations; no information was provided about the skin incision in 10 operations. A vertical midline slit into the anterior tracheal wall through two or three rings was the usual mode of tracheotomy (at least 37 operations), a flap technique using anterior tracheal wall was described in three operations, a horizontal incision between two tracheal rings was used in at least three operations; no information about the mode of tracheotomy was provided in 14 operations.

There is no record that the left brachiocephalic vein, described by some anatomy texts as crossing the infant trachea at a high level, or any other major vessel was encountered during any of the operations.

In all cases of long-term tracheostomy provision was made for the patients to spend at least some time at home unless their general condition precluded this.

Forty-five (79%) of the operations were performed by ear, nose and throat surgeons, the remaining operations being performed by surgeons from several other disciplines.

Conditions requiring tracheostomy

(a) Tracheostomy was performed 12 times to

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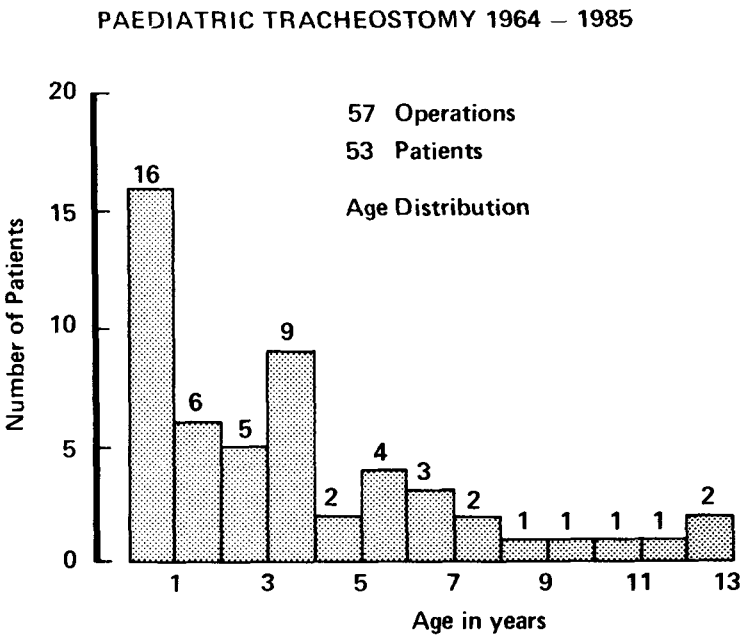


FIG. 2
Age distribution of children.

facilitate lower respiratory tract toilet in 12 patients with laryngotracheitis or laryngotracheobronchitis. In some or all of these patients the tracheostomy also served to by-pass variable degrees of obstruction in the subglottic region caused by inflammatory mucosal swelling. In 11 children the operation was performed as the primary measure to provide access to the lower respiratory tract. In one child, a three-year-old boy, nasotracheal intubation was employed as the primary measure but proved unsatisfactory due to repeated blockage of the tube with thick secretions. A tracheostomy performed several hours after the intubation provided good access and the child's subsequent course was problem free.

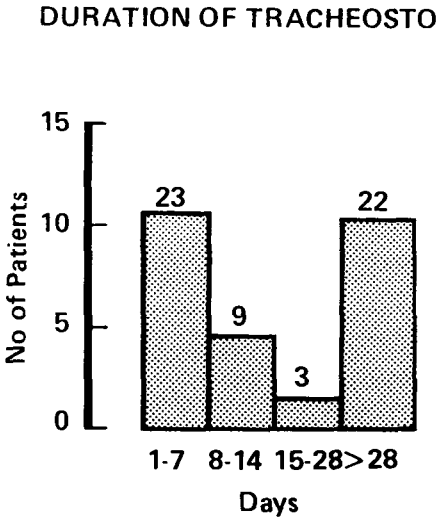


FIG. 3
Duration of tracheostomy.

(b) Eight operations were performed on eight children to permit use of the ventilator and also lower respiratory tract toilet. Six children were deeply unconscious following head injury and one also had a chest injury. The seventh child suffered from a progressive severe muscular hypotonia and developed recurring attacks of tachypnoea and also apnoeic episodes, and underwent nasotracheal intubation at the age of 11 weeks to facilitate ventilation. The infant's condition did not improve and he became ventilator-dependent and tracheostomy was performed at

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TABLE I
MAIN PURPOSE OF TRACHEOSTOMY

	Operations
Lower airway toilet	12
Ventilation and toilet	8
Obstruction by-pass	37

the age of five months. The eighth child developed laryngeal incompetence and aspiration problems in association with an astrocytoma involving the midbrain.

(c) The remaining 37 operations (on 34 children) were performed to by-pass airway obstruction. One child, with laryngotracheobronchitis, and described below, is also classified under section (a). The conditions causing obstruction are presented in Table II. In one patient, a five-year-old haemophiliac with a sublingual haematoma, nasotracheal intubation was initially employed to relieve the obstruction caused by the displaced tongue. Blockage of the tube occurred on the third day, however, and tracheostomy was then performed using local anaesthesia. In the children with laryngitis the epiglottis was congested but not significantly swollen and the obstruction was caused by gross swelling of the false and true vocal cords. Tonsillar enlargement causing obstruction was associated with infectious mononucleosis. Thermal endolaryngeal trauma (three children) was associated in each case with smoke inhalation during house fires, and in one there was also explosion of a gas cylinder. Both cases of mechanical endolaryngeal trauma are of particular interest as they followed surgical procedures and the obstruction could be termed iatrogenic. In one, a three-year-old boy, stridor developed shortly after a prolonged bronchoscopy for removal of a peanut from the right main bronchus. In the other, a two-year-old girl, stridor developed in the recovery room after a nasopharyngeal pack had been inserted to control a primary post-adenoidectomy haemorrhage and the laryngeal swelling was caused by the use of the sucker or by the reinsertion of the endotracheal tube.

The infants with tracheomalacia had associated (repaired) tracheo-oesophageal fistulae.

An emergency tracheostomy was life-saving in the case of a six-month-old infant with acute epiglottitis where an experienced anaesthetist found it impossible to insert an endotracheal tube because of the swollen tissues. In all the other children with upper airway blockage, the obstruction was relieved by endotracheal intubation prior to tracheostomy.

A second tracheostomy operation was required in four children. In three this was to relieve recurrence of airway obstruction caused by the process which had necessitated the first tracheostomy. The second operation was performed on the seventh and eighth days after extubation in the children with tracheomalacia and on the twenty-sixth day after extubation in one of the children with a thermal endolaryngeal injury. The fourth child had been admitted with laryngotracheobronchitis, and tracheostomy had been

TABLE II
CONDITIONS REQUIRING BY-PASS
(34 PATIENTS)

Congenital		Acquired	
Subglottic haemangioma	3	Epiglottitis	9
Tracheo malacia	2	Laryngitis	3
Subglottic stenosis	2	Tonsillar enlargement	1
Pierre Robin syndrome	2	Endolaryngeal trauma	5
Supraglottic cyst	1	Fractured facial bones	2
		Multiple laryngeal papillomatosis	2
		Sublingual haematoma	1
		Subglottic oedema	1

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performed primarily to permit lower respiratory tract toilet. Decannulation was undertaken after a tracheal polyp had been removed from just above the stoma on the fifteenth day and a Portex nasotracheal tube was inserted to dilate the subglottic and upper tracheal regions. Seven days later the nasotracheal tube was removed but persisting subglottic oedema caused obstruction and the original tracheostomy was reopened. It is quite likely that the original operation on this patient also served to by-pass oedema in the subglottic region.

Complications

No complications occurred during any of the operations.

Complications followed 20 (35%) of the operations and in ten operations there were multiple complications (Table III).

The complication rate was particularly high in children under three years of age, following 16 out of 30 (53%) of the operations which were performed in this age group as opposed to four out of 27 (15%) of the operations performed on the remaining children.

In no case was there any persisting problem with respiration or phonation once the tracheostomy had healed (in the early weeks following decannulation exertional stridor occurred in the children with persisting tracheocutaneous fistulae. In each case the fistula contracted down to a very small size, about 1 mm. in diameter, and was surgically closed without difficulty).

A degree of upper airway obstruction, due to the original lesion, was present in all seven cases where there was more than one attempt at decannulation. Once the airway was adequate, decannulation was accomplished in all without difficulty.

TABLE III
COMPLICATIONS OF TRACHEOSTOMY

	Operations
Tube dislodgement	5
Wound infection	4
Wound infection; tracheocutaneous fistula	4
Wound infection; tube dislodgement	2
Subcutaneous emphysema; tube dislodgement	1
Wound haemorrhage; tube blockage	1
Tracheocutaneous fistula	1
Tracheal granulation; wound infection; Tube dislodgement	1
Tube dislodgement; subcutaneous emphysema; wound infection; stomal stenosis	1

Discussion

With the assistance of information provided by the Common Services Agency of the Scottish Health Service, we have established that all children under 13 years of age who underwent tracheostomy within the catchment area during the years under survey are included in the study. This paper thus presents the total experience of paediatric tracheostomy over 22 years in an area with half a million inhabitants who are more or less equally divided between urban and rural. The series conforms with the observation by Tucker and Silberman (1972) that the ratio of three males to two females remains almost constant in all tracheostomy series.

A tracheostomy operation record should provide information about the anaesthetic procedure, the skin incision, the management of the thyroid gland, the opening into the trachea, the type and size of tracheostomy tube used and how it was secured and whether the wound was sutured at operation and at decannulation. Any unusual features or complications should be clearly documented. In the present series, most of the records provided much of the above information but in some the operation was dismissed in one word.

It is not clear why the transverse skin-crease incision should enjoy such popularity as it confers no special benefits. It is quite fallacious to assume that it leads to less scarring than the vertical midline incision (Putney, 1955; Tucker, 1979) and indeed Kenan (1979) states that there may be more scarring with the transverse incision because of the flange of the tube receding into the wound. This does not occur with the vertical incision as the flange is perpendicular to the wound.

Generalizations can be made with refer-

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ence to the duration of the tracheostomy and the nature of the condition leading to tracheostomy. Obstruction caused by congential lesions almost always required by-pass for a long period—nine of the 10 children with such lesions required tracheostomy for longer than four months and three required tracheostomy for longer than three years. On the other hand, obstruction (of either the upper or the lower airway) caused by acute infection usually required tracheostomy for a relatively short period measured in days rather than weeks. This, of course, is of relevance concerning the feasibility of nasotracheal intubation—in the hands of the skilled paediatric anaesthetist a safe, effective and less traumatic alternative to tracheostomy in many situations provided there are adequate facilities and skilled personnel for its management. Thus, many fewer tracheostomy operations were performed in the last half of the series because of the successful employment of intubation in the treatment of epiglottitis and other forms of obstructive laryngitis and laryngotracheobronchitis, and in the 12 years since 1973, 53 children with these conditions have been managed by nasotracheal intubation and none has required tracheostomy. Other causes of airway obstruction encountered in the earlier years would also be managed nowadays by nasotracheal intubation. The post-operative placement of a nasotracheal tube for two or three days would have obviated the need for tracheostomy in the child subjected to prolonged bronchoscopy and in the infant who underwent removal of a cyst of the aryepiglottic fold.

There has been an increase, both relative and absolute, in the number of tracheostomy operations performed in the last half of the series to facilitate attachment to the ventilator in children requiring long-term ventilation. Obstruction of the upper airway, however, remains the commonest indication for tracheostomy, with congenital lesions and trauma now the commonest causes of obstruction as opposed to acute infection as the commonest cause in the earlier years. Indeed tracheostomy has been employed only once since 1973 to by-pass obstruction caused by infection (massive tonsillar enlargement in a five-year-old boy with infectious mononucleosis).

In paediatric practice the tracheostomy operation and its management require particular expertise and care—the younger the patient the higher the complication rate and the greater the mortality (Oliver *et al.*, 1962; Chew and Cantrell, 1972). The particular liability of the younger patients to develop complications is well-illustrated in the present series. Wound infection was especially common in those under the age of 12 months, with immaturity of the immune system no doubt a major predisposing factor.

The two cases of tracheomalacia with repaired congenital tracheo-oesophageal fistulae require special mention, the tracheostomy tube in each clearly acting as a splint to keep the soft trachea patent. Benjamin *et al.* (1976) recommend a tracheopexy operation for such infants when they have stridor at rest and frequent attacks of bronchitis with sputum retention, often with cyanotic attacks and apnoeic episodes. Less severe cases can be managed conservatively with chest physiotherapy. Two of Benjamin's earliest cases were treated with tracheostomy but writing in 1981 he considers that tracheostomy should not be necessary unless there is some unrelated laryngeal or upper respiratory tract anomaly which itself necessitates tracheostomy. In the light of Benjamin's considerable experience and our own limited experience we would certainly agree that the surgical management of severe cases of tracheomalacia with tracheo-oesophageal fistula should be tracheopexy and not tracheostomy.

With the widespread acceptance of nasotracheal intubation as an alternative, the opportunities for gaining experience of paediatric tracheostomy have been significantly diminished. Situations exist, however, where the surgical approach is essential and absolute indications for tracheostomy are illustrated in the present series—there may be difficulty in aspirating thick secretions along a narrow nasotracheal tube; an artificial airway may be required for weeks or longer; it may prove impossible to pass an endotracheal tube in a case of severe upper airway obstruction. In order to minimize the chances of a disas-

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trous outcome in this last situation, co-operation between anaesthetist and laryngologist is essential and it has always been our policy in Aberdeen to have a consultant laryngologist present when a child with airway obstruction is being intubated, and when the obstruction is due to epiglottitis, laryngitis or laryngotracheobronchitis a consultant paediatrician is also present.

It is essential that all laryngologists be thoroughly familiar with the tracheostomy operation and its management in the paediatric patient. Experienced surgeons must give trainee surgeons every opportunity to perform the operation under supervision and must ensure that nursing staff are fully familiar with all aspects of post-operative care. Equally, trainee surgeons must actively interest themselves in the management and progress of all children within their area who have undergone tracheostomy.

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