TRACHEOSTOMY IN THE MANAGEMENT OF RESPIRATORY PROBLEMS IN A DEVELOPING COUNTRY: A STUDY AT THE LAGOS UNIVERSITY TEACHING HOSPITAL

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ALTHOUGH TRACHEOSTOMY was practised by the ancient Greeks before 100 B.C., it became firmly established in the 19th century as a life-saving procedure largely for the relief of upper respiratory tract obstruction due to diphtheria.¹ During the past 30 to 40 years the operation has found broader clinical application in the management of other causes of respiratory insufficiency.²⁻⁴ In spite of its long history, the complication rate of the operation has remained rather high, especially when performed under emergency conditions, even in present day well equipped and well staffed centres.⁵

In our environment, where facilities for intensive patient care are still deficient, the need for tracheostomy frequently arises in the management of patients with respiratory embarrassment during the course of acute infective diseases.

We aimed in this study to review in some detail the usage and complication rate of the operation and to assess its value to patients so treated.

METHOD OF STUDY

The records of patients on whom tracheostomy was performed at the Lagos University Teaching Hospital, during the period 1962-1969, were studied. Information about age, sex and primary disease of the patient, indications for tracheostomy, postoperative care and complications and results of tracheostomy were extracted from individual case notes. This information was supplemented where necessary from ward and operating theatre records.

RESULTS

There were 359 tracheostomy operations performed in the seven-year period of the review.

Table I shows the numbers of tracheostomies performed compared with the total number of surgical operations carried out in the hospital. The period August 1962 to July 1963 represented the first year of the inception of the hospital. Thereafter there did not appear to be any significant change in the frequency of practice of tracheostomy. In the last year of the period reviewed the number of tracheostomies declined noticeably, even though the total number of operations increased, so tracheostomies are less often performed in the hospital now.

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TABLE I
FREQUENCY OF PRACTICE OF TRACHEOSTOMY

Period	No. of Tracheostomy	Total No. of Operation
62-63	21	1,327
-64	53	2,583
-65	67	2,830
-66	72	2,697
-67	60	2,503
-68	50	2,379
-69	36	2,614
'62-'69	359	16,933

Clinical details were available for 301 tracheostomies performed on 293 patients. The youngest patient was 26 days of age and the oldest 60 years. There were seven young adults whose ages were not stated. Table II shows the number of tracheostomies done in each age group. The figures in brackets represent the number of repeat tracheostomies. Sixty-seven tracheostomies were done in 63 children under 2 years of age. There were no striking sex differences in the number of subjects in the different age groups.

TABLE II
AGE DISTRIBUTION OF TRACHEOSTOMIES

Age Group	Number of Tracheostomies
0-4	105 (4)
5-9	30 (1)
10-19	71 (3)
20-29	45
30-39	20
40-49	14
50-59	7
60-69	2
Adult - Ages Unknown	7
Total	301

Presenting Diagnoses and Indications for Tracheostomy

The presenting diagnoses of the subjects on admission are classified into four main groups in Table III. Neurological diseases formed by far the most common presenting group, and tetanus alone accounted for 154 of the 179 patients in this group. The group also included patients with severe head injuries, poliomyelitis, meningo-encephalitis, convulsive disorders and polyneuropathy. Forty of the 100 patients with airway disease or obstruction were children with acute laryngo-tracheo-bronchitis. There were 11 children with diphtheria.

The indications for tracheostomy fell into seven groups (Table IV). Six of these indications occurred alone. The seventh, which occurred second in the order of frequency, comprised different combinations of the other six groups. For example, tracheostomy in the tetanus patient was often needed not only to overcome in-

TABLE III
DIAGNOSTIC CLASSIFICATION OF SUBJECTS

Diagnosis	Number
Neurological Diseases	179
Airway Disease and/or Obstruction	100
Lung Parenchymatous Disease	11
Chest Injuries	3
Total	293

TABLE IV
INDICATIONS FOR TRACHEOSTOMY
IN 301 PATIENTS

Airway Obstruction	138
Tracheal and Bronchial Toiletting	23
Protection of Airway	11
Establishment of I.P.P.V.	9
Reduction of Dead Space	5
To isolate airway	1
Mixed Indications	114
Total	301

termittent airway obstruction and to facilitate intermittent positive pressure ventilation following curarisation, but also to aid suction removal of accumulated bronchial secretions.

Conditions under which Tracheostomy was Performed

All except five of the tracheostomies were performed under endotracheal general anaesthesia. Two patients had general anaesthesia by mask because the presence of extensive laryngeal papillomata made intubation very difficult. One patient was given local anaesthesia, and the remaining two patients had emergency tracheostomies performed without anaesthesia in the Casualty Department and in the ward.

Complications - Frequency and Type

Complications likely to follow any operation under general anaesthesia, and minor incidents like gentle oozing from the tracheostomy site were not considered. Some complications occurred more than once in the individual patient and on each occasion they were counted as separate complications.

In all, 192 complications followed 146 tracheostomies in 139 patients (Table V). Eighty-two complications resulted from 59 of the 135 tracheostomies done on 130 subjects under ten years of age. Thirty-eight of the 67 tracheostomies in infants up to 2 years of age were uncomplicated; 40 complications were recorded in the remaining 29. No sex differences were observed in complication rates in all age groups.

Following the tracheostomy, 202 of our patients were nursed in an intensive care unit which had a much higher staff/patient ratio than obtained in the general wards of the hospital. Ninety-one of these patients did not have complications.

Complications were recorded on 102 occasions in this unit. Fifty-nine of the 91 patients nursed in the general wards were free from complications.

TABLE V
FREQUENCY OF COMPLICATIONS OF TRACHEOSTOMY

Age Group	No. of Tracheostomies with Complications	No. of Complications
0-4	45	62
5-9	14	20
10-19	38	52
20-29	24	30
30-39	11	13
40-49	7	8
50-59	4	4
60-69	2	2
Adult - Ages Unknown	1	1
	146	192

Table VI shows the types of complications encountered and the relative frequency of each type. Pulmonary infection within the first week of the tracheostomy (32.4 per cent) and wound infection (20 per cent) were the commonest complications, but they occurred together in only 10 patients. One of the patients with pulmonary infection developed a pyopneumothorax which was fatal. The organisms most frequently found on culture were *Pseudomonas Pyocyaneus*, *Escherichia Coli* and *Proteus Vulgaris*.

TABLE VI
TYPES OF COMPLICATIONS OF TRACHEOSTOMY

Complications	Number
Pulmonary Infection	62
Wound Infection	38
Blockage of Tube	31
Structural Deformity	28
Displaced Tube	14
Surgical Emphysema	5
Haemorrhage	4
Paraesthesia in Scar	3
Cardiac arrest at Tracheal Toilet	2
Hoarseness	2
Cardiac arrest at change of Tube	1
Endobronchial Intubation	1
Emotional Disturbance	1
Total	192

Blockage of the tracheostomy tube occurred on 31 occasions and displacement on 14 occasions. Most of these occurred in children under ten years of age. The blockage was by bronchial secretions which could not be easily sucked out. It often necessitated the removal for cleaning of the inner or both tubes of the Jackson's tracheostomy tube, or a complete replacement of the plastic types of tracheostomy tubes. Displacement of the tube as a result of its conscious removal by the patient

was surprisingly rare, even in children. Often violent coughing together with inadequate securing of the tube were enough to dislodge the tube completely; on a few occasions the tube came out when the patient's position in bed was being changed.

Structural deformities which included stenosis (25 instances in 23 patients), granulation tissue (1), polyp formation (1) and tracheal collapse (1) accounted for 28 of the complications, which nearly always gave rise to decannulation difficulties. Two male patients aged 10 and 15 respectively each developed stenosis at two tracheal levels. Eighteen of the instances of tracheal stenosis occurred in children under ten years of age. Tracheal stenosis led to repeat tracheostomies in eight patients.

Surgical emphysema was encountered in five of the subjects, all of them children. This was due to poor fit between the tracheostomy tube and the tracheal opening or to blockage of the tube. Four patients developed haemorrhage, which proved uncontrollable in two of them. On laryngoscopy, one of the patients with hoarseness had a fixed left vocal cord, which was probably paralysed as a result of operative injury.

Mortality.

The overall mortality rate among the patients under ten years of age (42.2 per cent) was not significantly different from that among the adults (47.8 per cent); 137 of the 293 patients in this review died (Table VII), but in only 15 of them was death directly attributable to the complications of tracheostomy.

TABLE VII
ANALYSIS OF MORTALITY RATES BY AGE

Age Group	No. of subjects studied	No. died	Deaths due to complication of Tracheostomy
0-4	101	37	3
5-9	29	18	2
10-19	68	30	3
20-29	45	24	5
30-39	20	10	2
40 and above	23	13	—
Ages Unknown	7	5	—
Total	293	137	15

Respiratory infection (5), blockage and displacement of tracheostomy tube (4), haemorrhage (2), cardiac arrest at bronchial toilet or change of tube (2), septicaemia from wound infection (1) and tracheal stenosis (1) were the complications that led to death in the 15 subjects.

DISCUSSION

The age distribution of the patients was young, and is probably a reflection of the age structure and morbidity patterns in the general population of our developing community. Of the 130 patients under 10 years of age, 101 were under 5 years of age, which represents 34.4 per cent of the total number of subjects studied. Only

3.1 per cent of our subjects were 50 years of age and over. This contrasts with the older age distribution of tracheostomised patients reported from similar centres in developed communities.^{2,5}

Tetanus accounted for the largest number of tracheostomy cases in our series. Airway obstruction was commonest in children under 10 years of age. The most frequent cause of the obstruction in children under the age of 5 years was acute respiratory tract infection. Congenital malformations like choanal atresia, and Pierre-Robin syndrome were seen, but they played little role in this study. In children aged between 5 and 10 years, the main cause of airway obstruction was tetanus.

The decline in the number of tracheostomies over the latter part of the period under review was probably due to an actual decrease in the number of patients needing tracheostomy, but was certainly also the result of a reappraisal of tracheostomy in the management of parenchymatous lung disease and upper respiratory tract obstruction due to airway disease. Prolonged nasotracheal intubation became an alternative method as the first line of treatment for securing the airway, particularly in children. This practice has been previously advocated by others.⁶

Although the presenting diseases were somewhat different from those recorded in similar series in developed communities, the indications for tracheostomy in our study were those that are described in other studies.^{2,3,5,7}

The commonest indication for tracheostomy was mechanical obstruction. In his review of 212 tracheostomies Watts⁴ reported a changing pattern in the order of frequency of indications in an eight-year-period. In each year of our review period, mechanical obstruction alone or in combination regularly topped the list of indications, and no other disease replaced tetanus as the commonest presenting disease.

The complication rate of 47.1 per cent reported here could be compared with those of some previously reported series in Table VIII. In the most recent of these studies McClelland⁵ found a higher complication rate in emergency tracheostomy than in elective operations. In his series 89 of 389 tracheostomies were carried out as an emergency procedure. Other authors have commented on the difficulties attending urgent tracheostomy.⁴

All the 301 tracheostomies in this study were established as emergency procedures, for once the operation was decided on, it was carried out within the next one or two hours.

The fact that all but five of the tracheostomies in our study were carried out as

TABLE VIII
COMPLICATION AND MORTALITY RATES OF TRACHEOSTOMY

Author/s	No. of Cases reviewed	% Complication	Mortality rates
Davis <i>et al.</i> 1953	155	100.0	3.9
Meade 1961	212	33.0	2.8
Head 1961	462	44.5	0.9
Watts 1963	212	—	1.4
McClelland 1965	389	49.3	3.4
Present Series 1971	301	47.1	5.0

planned procedures under endotracheal general anaesthesia probably influenced favourably the complication rate recorded, since such conditions allow for deliberate surgery and for careful attention to technique.⁸ Complication rates in children and infants were not higher than in adults.

The higher complication rate in the intensive care unit was due to the fact that these were the more seriously ill patients, most of them on assisted respiration or intermittent positive pressure breathing.

Infection was the commonest complication, whether in the intensive care unit or in the general wards. The organisms responsible here, *Pseudomonas Pyocyaneus*, *Proteus Vulgaris*, *Escherichia Coli* and *Staphylococcus aureus*, have been incriminated also in other reviews.^{4,9} Strict adherence to aseptic techniques in the management of tracheostomy, sterilisation of tubing and respirators, barrier nursing in intensive care units and the employment of specially trained staff will serve to minimise the rate of these complications.

Stridor in children due to stenosis or tracheal collapse resulted in decannulating difficulties. It was sometimes possible to decannulate and to discharge the patient in the presence of a mild degree of stridor. This complication usually disappeared in the course of 6 to 12 months, but during this period the patients were often prone to repeated attacks of upper respiratory tract infection. A high tracheal opening predisposed to stenosis.

Tube blockage occurred in 9.4 per cent of the 202 patients nursed in the intensive care unit, where humidification was always used and in 13.2 per cent of the 91 patients in the general wards, where humidification was not employed following tracheostomy. In this environment, where the relative humidity of the atmosphere is as high as 76 per cent to 91 per cent, the need for further humidification might therefore appear debatable or questionable.

The mortality rate from tracheostomy in our study was high (5 per cent) both in comparison with mortality figures from similar centres as recorded in Table VIII and because the operation itself is regarded as a life saving procedure. This finding, however, should be judged in relation to the value of tracheostomy to the patients in the series. Thirteen of the 15 patients who died as a result of tracheostomy complications were admitted with severe tetanus, which of itself carries a very high mortality in this environment. In all, 153 patients were admitted with moderate to severe tetanus and 53.6 per cent of them including the 13 mentioned above died. We have no doubt that tracheostomy was an essential procedure which greatly reduced the over-all mortality amongst tetanus patients and most of the patients with other disease groupings encountered in this review.

SUMMARY

A retrospective study was carried out of 301 tracheostomies performed in the Lagos University Teaching Hospital over a seven year period with the object of determining the usage, complication rate and therapeutic value of this operation. In their order of frequency during the period under review, the main indications for the operation were (1) relief of upper airway obstruction, (2) facilitation of intermittent positive pressure ventilation, (3) for tracheal and bronchial toilet

and (4) for the protection of the airway. The number of tracheostomies performed declined in the latter part of the period under review. 192 complications occurred following 146 tracheostomies – an incidence of 47.1 per cent.

The most common cause of complication was infection. Fifteen deaths were directly due to the complications of tracheostomy, being a mortality rate of 5 per cent. The value of tracheostomy outweighed the chances of complications.

RÉSUMÉ

Nous avons fait une étude rétrospective de 301 cas de trachéostomie pratiqués dans un hôpital d'enseignement de l'Université de Lagos, durant une période de 7 ans, dans le but de préciser l'utilité de cette opération, son taux de complications et sa valeur thérapeutique. Durant les années que couvre cette étude, voici, par ordre de fréquence, quelles ont été les principales indications de cette opération: (1) enlever l'obstruction des voies respiratoires supérieures, (2) rendre plus facile la ventilation avec pression positive intermittente, (3) faciliter l'aspiration de la trachée et des bronches, (4) protéger les voies respiratoires. Au cours de cette période, le nombre des trachéostomies a diminué durant les dernières années. A la suite de 146 trachéostomies il est survenu 192 complications; un taux de 47.1 pour cent.

La complication la plus fréquente a été l'infection. Quinze morts ont été attribuables directement à des complications de trachéostomie, soit un taux de mortalité de 5 pour cent. La valeur de la trachéostomie dépasse les chances de complications.

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REFERENCES

1. CHERNIAK, R.M. Tracheostomy and its management. *Canad. Anaes. Soc. J.* 12: 386 (1965).
2. MEADE, J.W. Tracheostomy – its complications and their management. A study of 212 cases. *New Eng. Med. J.* 265: 519 (1965).
3. HEAD, J.M. Tracheostomy in the management of respiratory problems. *New Eng. J. Med.* 264: 587 (1961).
4. WATTS, MCK.J. Tracheostomy in modern practice. *Brit. J. Surg.* 50: 954 (1963).
5. MCCLELLAND, R.M.A. Complications of tracheostomy. *Brit. Med. J.* 2: 567 (1965).
6. ALLEN, T.H. & STEVEN, I.M. Prolonged endotracheal intubation in infants and children. *Brit. J. Anaes.* 37: 566 (1965).
7. TURNER, H., BERDNIKOFF, K., & CHAREST, Y. A study of tracheostomy at St. Justine's Hospital, Montreal. *Canad. Anaes. Soc. J.* 2: 574 (1964).
8. *Brit. Med. J.* 1: 734 (1969).
9. ROBBIE, D.S. & FELDMAN, S.A. Humidification in artificial ventilation. *Brit. J. Anaes.* 35: 771 (1963).
10. DAVIS, H.S., KRETCHMER, H.C., & BRYCE-SMITH, R. Advantages and complications of tracheotomy. *J.A.M.A.* 153: 1156 (1953).