GENERAL ANAESTHESIA FOR TRACHEOSTOMY IN ACUTE LARYNGEAL OBSTRUCTION IN CHILDREN

BY

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The commonest forms of acute inflammatory laryngeal obstruction in childhood are acute laryngitis and acute laryngo-tracheo-bronchitis. Both infections are of remarkably sudden onset, though there may be a history of an insignificant infection of the upper respiratory tract. In both conditions there is rapidly increasing respiratory embarrassment, with inspiratory stridor, a harsh irritating cough, a hoarse muffled cry, intercostal recession, cyanosis, and a very considerable fear and distress. Signs of increasing obstruction are a rising pulse rate and restlessness.

In acute laryngitis the epiglottis and the subglottic region are particularly inflamed and swollen, because in these areas the submucosa is lax. Acute epiglottitis has been described as a separate entity. In such cases, once the obstruction has been bypassed by tracheostomy, recovery should be uneventful. It is often possible to remove the tube within three days.

In acute laryngo-tracheo-bronchitis the inflammation of the larynx may not be so severe, but an inflammatory oedema with exudation affects the whole lower respiratory tract. The problem here is to provide for the removal of somewhat viscid secretions in a child with a cough that is inefficient because of laryngeal inflammation. Tracheostomy not only affords a way of bypassing the inflamed larynx but also allows for aspiration of the secretions from trachea and bronchi and reduction of dead space. Recovery is not usually as rapid as in the first group. It may be a week or more before the tracheostomy tube can be removed.

Choice of Anaesthesia or Analgesia

When the decision has been made that tracheostomy is necessary it can be performed under local analgesia or general anaesthesia.

At the end of the nineteenth century anaesthesia by chloroform was used for tracheostomy in children suffering from diphtheria (Beaupère, 1888; Broca and Hartmann, 1887; Weiss, 1888), but a number of fatalities were reported, often due to fatal respiratory obstruction developing before tracheostomy could be performed. General anaesthesia in these circumstances acquired an evil reputation, and the use of local analgesia became customary.

A review of the literature suggests that this prejudice in favour of local analgesia is still widespread (Neffson, 1942; Briggs and Heseltine, 1952; Leegaard and Lindeman, 1954; Nelson, 1958; Forbes, 1961). Operative conditions under local analgesia alone, especially in infants, are often unsatisfactory because of struggling and congestion. The value of using general anaesthesia for tracheostomy with an airway assured by preliminary bronchoscopy or intubation was emphasized by Ibsen

(1954). His experience was with patients suffering from poliomyelitis. Davenport and Rosales (1959) recommend intubation followed by general anaesthesia.

Bryce-Smith (1957) has pointed out that improvement of the airway before tracheostomy allows the operation to be carried out peacefully and without undue venous congestion. An emergency operation is relieved of several hazards and the complications are reduced to those of elective tracheostomy. Booth, Nisbet, and Wilson (1960), in discussing the practical problems encountered in anaesthesia for paediatric surgical emergencies, endorsed the value of general anaesthesia for tracheostomy, especially in infants. They recommended an apnoeic technique using intravenous thio-pentone, suxamethonium, and intubation, preceded by five minutes' oxygen given through a face-mask. In cases where intubation was likely to be difficult a non-apnoeic technique was used.

Clinical Experience

In the Amersham General Hospital and associated hospitals, over the 10 years 1951-60, 57 patients with acute laryngitis or laryngo-tracheo-bronchitis were treated, eight of them under 2 years of age. Tracheostomy was performed in 17 of these cases (see Table). In six cases local analgesia was used and two of these patients subsequently died. In the remaining 11 cases a general anaesthetic was given for the tracheostomy.

Details of Cases

Age in years:	<1	1	2	3-5	>5	Total
No. of cases:	2	6	2	5	2	17
Tracheostomy under local analgesia	1 (died)	3 (1 died)	1		1	6
Tracheostomy under general anaesthesia	1	3	1	5	1	11
Year:						
1951					1	1 (L.A.)
1952	1					1 (L.A.)
1953		1	2			3 (2 L.A., 1 G.A.)
1954	1					1 (G.A.)
1955						
1956						
1957				1		1 (G.A.)
1958					1	1 (G.A.)
1959		3				3 (2 L.A., 1 G.A.)
1960		2		4		6 (G.A.)

All cases occurred between October and February with the exception of a child of 2 years suffering from acute epiglottitis in August. Most of the children in this series were admitted to the children's ward under the paediatrician. They were seen as soon as possible after admission by an E.N.T. surgeon and the decision was made whether immediate tracheostomy was necessary or not.

General anaesthesia was used at the suggestion of the paediatrician, Dr. D. MacCarthy, who was appalled at the terror and struggling which can occur when a tracheostomy is performed for this condition in a small child under local analgesia. The child is seriously ill and usually distressed. Some patients have a degree of heart failure, as the right side of the heart is working against raised pulmonary capillary resistance due to the high alveolar pressure created by the forced expiration which follows each inspiratory effort. The violent struggling which is apt to occur when tracheostomy is performed under local analgesia may precipitate cardiac failure.

General anaesthesia can usually be induced without a struggle, and in all the cases in this series an endo-

tracheal tube was passed under direct vision. The resulting motionless oxygenated patient, with reduced venous congestion, enables the surgeon to perform the tracheostomy deliberately at the site of election and to obtain haemostasis.

Method of General Anaesthesia

It cannot be overemphasized that in any surgical procedure involving the airways there must be complete understanding between surgeon and anaesthetist. They must know exactly what they will do in every eventuality. In each case anaesthesia was induced with the surgeon scrubbed up and standing beside the patient, ready to perform tracheostomy as an emergency procedure if required. In this series of cases it has not been necessary.

All cases except the last two were given premedication with atropine in the following dosage: aged 3-12 months, 0.4 mg. (1/150 gr.); over 1 year, 0.6 mg. (1/100 gr.). In the last two the atropine was omitted deliberately because of marked tachycardia. No embarrassment resulted from the omission.

Induction of anaesthesia was in each case by inhalation; in one case oxygen, cyclopropane, and ether were used; in two cases oxygen, halothane, and ether; and in the rest oxygen, ethyl chloride, and ether. Oral intubation was performed under direct vision in all cases, and anaesthesia was maintained with nitrous oxide, oxygen, and ether.

Discussion

Choice of Anaesthesia

The danger of inducing general anaesthesia in a patient with partial respiratory obstruction due to inflammatory glottic oedema has been described by Macintosh (1949). It has become an accepted principle in anaesthetic teaching that in such cases the airway is secured (usually by blind nasal intubation helped by topical analgesia) prior to the induction of general anaesthesia. This method is impracticable in small children with laryngo-tracheo-bronchitis.

The induction of anaesthesia in these cases without first securing the airway involves the risk that the partial respiratory obstruction may become complete before tracheostomy can be performed. This calculated risk is considered worth while. General anaesthesia before tracheostomy offers advantages to both patient and surgeon. First, the patient avoids the psychological trauma of an operation which must be terrifying to a child under local analgesia. Secondly, in the absence of struggling under general anaesthesia, no further load is placed on an embarrassed circulation.

The cardiac reserve in these patients is lowered if the respiratory obstruction has been prolonged. Respiration is usually rapid and shallow, ventilation is inadequate, and the effective tidal volume is reduced towards the volume of the dead space, causing anoxia and retention of carbon dioxide in spite of forced expiration. The alveolar expiratory gas pressure is greatly raised and the negative pressure developed in inspiration is increased. This in turn causes pulmonary congestion and oedema, and the right side of the heart has to work against a raised pulmonary capillary resistance. The increased expiratory alveolar pressure causes generalized venous congestion and lowered venous return to the heart and thus a lowered cardiac output.

Under these conditions prolonged struggling could prove fatal. The induction of general anaesthesia can usually be achieved smoothly and without struggling. Restoration of the airway on intubation relieves the anoxia, reduces dead space, and reverses the chain of events which has led to the deterioration of the pulmonary circulation.

The surgeon operates on a still, adequately oxygenated patient; he can carry out a planned instead of an emergency tracheostomy and he does not have to combat the excessive bleeding associated with engorgement of the neck veins. Relief of the respiratory obstruction before operation diminishes the risk of mediastinal emphysema and pneumothorax.

In this series the impression has been gained that the post-operative condition and subsequent progress of children who have had general anaesthesia for the tracheostomy has been most satisfactory. It is not reasonable to draw a sharper comparison between the results of the local and general anaesthetic cases in this series. This decade brought great advances in the management of patients with tracheostomy and in antibiotics. The mortality from the disease is steadily falling.

Technique

Induction by inhalation has been preferred because intubation can sometimes be very difficult. The inflammation and oedema may produce asymmetrical distortion of the anatomy, and a direct view of the cords may be impossible. The use of a relaxant drug makes intubation easy, but in these cases one often needs more time than in a normal child and a long period of apnoea could be fatal.

All the agents used provided a smooth rapid induction for ether anaesthesia, which was maintained at a light level. It will be generally agreed that these are not cases for the occasional or inexperienced anaesthetist.

Summary

A series is reported of 57 cases of acute inflammatory laryngeal obstruction in children. Tracheostomy was performed in 17. General anaesthesia was used in 11 cases and local analgesia in 6. There were two deaths, each after tracheostomy under local analgesia.

The relative merits of general anaesthesia and local analgesia for the tracheostomy are discussed.

A preference for general anaesthesia is expressed.

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REFERENCES

- Beaupère, E. (1888). *Anesthésie par le chloroforme dans la trachéotomie chez les enfants atteints de diphtérie laryngée*. Lyons.
- Booth, A. J., Nisbet, H. I. A., and Wilson, F. (1960). *Anaesthesia*, 15, 361.
- Briggs, J. N., and Heseltine, J. R. (1952). *Brit. med. J.*, 2, 1064.
- Broca, A., and Hartmann, H. (1887). *Rev. chir. (Paris)*, 7, 390.
- Bryce-Smith, R. (1957). *Anaesthesia*, 12, 152.
- Davenport, H. T., and Rosales, J. K. (1959). *Canad. Anaesth. Soc. J.*, 6, 65.
- Forbes, J. A. (1961). *Brit. med. J.*, 1, 389.
- Ibsen, B. (1954). *Proc. roy. Soc. Med.*, 47, 72.
- Leegaard, T., and Lindeman, H. (1954). *Acta oto-laryng. (Stockh.)*, Suppl. 118, p. 130.
- Macintosh, R. R. (1949). *Brit. J. Anaesth.*, 21, 107.
- Neffson, A. H. (1942). *Arch. Otolaryng. (Chicago)*, 36, 773.
- Nelson, T. G. (1958). *Tracheotomy*. Williams and Wilkins, Baltimore.
- Weiss, T. (1888). *Rev. méd. Est*, 20, 689.