TRACHEAL STENOSIS FOLLOWING TRACHEOSTOMY
A Case Report

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SUMMARY
A case of tracheal stenosis following tracheostomy is reported. Evidence is presented that the lesion was caused by a red rubber tracheostomy tube. The anaesthetic technique used for resection of the trachea is described. It is suggested that rubber should be avoided for any intubation of the respiratory tract lasting more than a few hours.

Tracheal stenosis is one of the most serious complications of tracheostomy, and fortunately is relatively rare. This paper describes a stenosis occurring just above the carina, and discusses the mechanism of its causation.

CASE REPORT
A soldier aged 20 was knocked down by a car in Germany, receiving multiple injuries, and was admitted to British Military Hospital, Munster. Despite craniotomy, his condition deteriorated and on November 15, 1965, tracheostomy was necessary. A cuffed red rubber tube (James, 7.0 mm) was used, the cuff being deflated at frequent intervals. The tube was changed on several occasions, and on November 23 was replaced by a silver one. He was then transferred to the Army Neurosurgical Unit at Colchester.

On January 7, 1966, six weeks after removal of the rubber tube, the silver tube was removed. Some hours later, severe respiratory distress developed and the tube was replaced. His symptoms were only partly relieved, however, and a bronchoscopy was performed, revealing a stenosis of the trachea just above the carina, 3 mm in diameter. The stenosis was dilated with Hegar’s dilators and a red rubber endotracheal tube with a window cut in its left side was passed through the tracheostomy, through the stenosis, and into the right main bronchus. The window permitted air entry to the left main bronchus. Forty-eight hours later, this tube was changed for one of polyvinyl chloride with a similar window. Bronchoscopy at this time showed granulations in the right main bronchus, but these disappeared within a few days. Shortly after this, it was possible to remove the endobronchial tube, replacing it by a normal uncuffed polyvinyl tracheostomy tube. Thereafter, adequacy of the airway was maintained by repeated dilatation of the stenosis, a procedure carried out a total of seventeen times in 2½ months. By this time it was evident that more radical treatment was required, and he was now sufficiently recovered from his injuries to be transferred to the Army Chest Unit at the Cambridge Military Hospital. Here, a final bronchoscopy was performed and a biopsy specimen taken. Histological examination showed chronic inflammatory tissue. It was decided to perform resection of the stenosed portion of the trachea on April 19, 1966.

Operation.
Anaesthesia was induced with halothane and oxygen through the tracheostomy. After suxamethonium 100 mg, an uncut 8.0 mm orotracheal cuffed tube was passed as far as the upper end of the stricture, leaving about 10 cm protruding from the mouth. Anaesthesia was maintained with nitrous oxide and oxygen, tubocurarine and intermittent positive-pressure ventilation. The patient was placed on the table in the supine position, the sternum split and the stricture mobilized. A 2 cm length of trachea was then rapidly resected. A sterile 8.0 mm cuff armoured tube was passed through the wound into the distal trachea and connected to a second ventilator. Sterility was maintained by passing the ventilator tubes through a sterile cotton sleeve, normally used to cover the flexible driving cable of a dental drill. The tracheal stump being very short, it was necessary to advance the tube into the right main bronchus, where the cuff occluded the upper lobe bronchus. A tape was passed round the trachea immediately proximal to the inflated cuff, the ends being gripped together close to the trachea by Moynihan’s forceps, in the way that a piece of rubber is sometimes held on an arm to act as a venous tourniquet. As it was armoured, the tube could be bent to an acute angle, giving good access to the posterior tracheal margins. For the next 30 minutes, two-thirds-lung anaesthesia was maintained while the posterior part of the anastomosis was carried out. The armoured tube was then removed, and the orotracheal tube advanced across the suture line. The tip of this tube now lay just inside the right main bronchus, so that the right upper lobe could be inflated. The anterior anastomosis was completed in the following 30 minutes. The oral tube was removed and a cuffed latex tracheostomy tube inserted through the refashioned tracheostome, its distal end lying across the tracheal suture line. Both lungs were inflated and the chest was closed. Total duration of anaesthesia was 4½ hours.

There were no postoperative complications, and on the fourth day the tracheostomy tube was removed, allowing the stoma to close.
DISCUSSION

Cause of stenosis.

Tracheal stenosis may result from operative damage to the first tracheal ring, or from erosion of lower rings by the pressure of an inflatable cuff (Bradley, Spencer and Semple, 1964). Damage to the first ring was certainly not involved in this case. Our examination of the patient, and of a James tube, showed that the position of the lesion corresponded to the distal centimetre of the original tube, and that the cuff would have been just above the stenosis.

It seems likely, therefore, that this stenosis was due to the tip of the rubber tube used for the first 8 days. Salt, Parkhouse and Simpson (1960) have discussed the abrasive properties of rubber tracheostomy tubes, with particular reference to fillers. Further evidence that rubber was irritating to this patient lies in the observation of granulation in the right main bronchus when this too was intubated with a rubber tube. Respiratory rate and depth may be factors in the production of this type of trauma.

It is generally agreed that plastic polymers are less irriitant than rubber. Thus Ross, Gibbon and Damanski (1957) consider that polythene urethral catheters cause less urethritis than rubber ones. Jeffcoat (1962) states that vaginitis, cervicitis and vaginal ulceration are more likely with rubber pessaries than with plastic appliances. Matheson et al. (1963) and Bradfield (1964) advocate polyvinyl tracheostomy tubes for similar reasons. Rubber Ryle's tubes have been virtually abandoned.

In the present case, the fact that the granulations in the right main bronchus disappeared when the rubber endobronchial tube was replaced by a polyvinyl one, suggests that the stenosis might not have occurred if a polymer tracheostomy tube had been used at the beginning.

On the other hand, polymers are not completely free from danger, as Little and Parkhouse (1962) showed by implanting discs of various materials into guineapigs. Taylor, Nightingale and Simpson (1966) have described a child aged 5 who developed subglottic stenosis after nine days intubation with a polyvinyl nasal tube, although this case is not quite comparable, since the subglottic tissues, especially in children, are said to be particularly intolerant of contact (Crul and Wolffensperger, 1965).

Another material commonly used for tracheostomy tubes is latex. Salt, Parkhouse and Simpson (1960) have described a patient with stomal irritation which improved when his rubber tracheostomy tube was replaced by a latex one, only to relapse on returning to rubber.

Considering all the evidence, it is suggested that red rubber should be avoided for any intubation of the trachea lasting more than a few hours. Pending the production (and standardization) of a completely satisfactory polymer, latex may be the best material for tubes intended for this purpose.

Anaesthesia for resection.

Since resection of the intrathoracic trachea was first successfully performed (Belsey, 1950) it has become an established procedure. The technique of distal endobronchial intubation has evolved gradually (Friedmann and Emma, 1951; Cotton and Penido, 1952; Stephen, Nowill and Sealy, 1954) and is now the accepted method of dealing with the problem of this type of lesion (Grigor and Shaw, 1958; Grillo, Bendixen and Gephart, 1963; Mathrey et al., 1966). While there have been many minor variations of technique, the combination described here, of cuffed armoured tube held in place by tape, and used as traction for the distal trachea, was found to be extremely satisfactory.

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STENOSE TRACHEALE APRES
TRACHEOSTOMIE

Rapport d'un cas de sténose trachéale survenue après
trachéostomie. On démontre que la lésion en cause
était manifestement à l'usage d'un tube en caoutchouc
rouge pour la trachéostomie. La technique anesthésique
utilisée pour la résection de la trachée est décrite. On
recommande de proscrire l'usage du caoutchouc pour
toute intubation se prolongeant pendant plus de
quelques heures.

LUFTRÖHRENVERENGUNG NACH
TRACHEOTOMIE

Ein Fallbericht

Zusammenfassung

Es wird über einen Fall von Luftröhrenverengung nach
Tracheotomie berichtet. Dabei wird aufgezeigt, daß
diese Veränderung durch einen Tracheotomie-Tubus
aus rotem Gummi verursacht war. Daran schließt
sich eine Beschreibung der Narkosetechnik zur Resek-
tion der Trachea an. Es wird empfohlen, daß für
jegliche Intubation des Respirationstraktes, die mehr
als einige Stunden dauert, die Verwendung von
Gummimaterial vermieden wird.

BOOK REVIEW

Anesthesia from Colonial Times. A History of Anaes-
thesia at the University of Pennsylvania, by James
E. Eckenhoff. Published by J. B. Lippincott Co.,

This delightful little book traces the development of
anesthesia in Philadelphia and in particular of the
now well-known department at whose head is Robert
D. Dripps. The struggle was a long one. Dr. Ivan
Taylor, the first anesthesiologist at the University of
Pennsylvania, was not appointed until 1938. Among
the several restrictive, and to us amusing, conditions
of his appointment was the requirement that no patient
was to be examined except at the request of the
operating surgeon. He left within three years because
of frustration and inability to get security of tenure.
Dripps was appointed Director of the Department in
1942. The author attributes this important event to a
stimulus from Beecher who is alleged to have said at
the time, “I am scarcely dry behind the ears and I
have written a book, got a Professorship, $8,000 salary,
and ought to be getting more!” Under the leadership
of Dripps the Department flowered, owing no little
of its prosperity and its ultimate fame to the appoint-
ment of Eckenhoff himself.

The book will give great pleasure not least to those
many British friends of the author who came to value
his deep knowledge of anaesthesia and his warmth of
character during his sabbatical stay in Britain. They
will also admire the loyalty and affection which Ecken-
hoff has for Dripps his former Chief.

The impressive list of publications from the Depart-
ment of Anesthesia of the University of Pennsylvania
from 1943 to 1965 will convince anyone who still
doubts if anaesthesia has anything to contribute to
medicine, or whether the institution of University
Departments of Anaesthetics are justified.

W. W. Mushin