CRICOID STENOSIS COMPLICATING TRACHEO-OESOPHAGEAL FISTULA IN THE NEWBORN

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CONGENITAL stenosis of the cricoid cartilage is a rare condition. Thus Potter (1952) from over 6,000 neonatal autopsies records only three cases (one complete), in none of which tracheo-oesophageal fistula was present. Tracheal atresia rarely accompanies tracheo-oesophageal fistula though oesophageal atresia frequently does (Fluss and Poppen, 1951).

We report the occurrence of cricoid stenosis in two patients within ten days. This was discovered in both instances on attempted intubation during anaesthesia for the repair of tracheo-oesophageal fistula and oesophageal atresia.

CASE REPORTS

Case 1. (Anaesthetist G.G.F.). Patient E.C., female, aged 24 hours, weight 6 lb. 13 oz. (3.2 kg). Soon after birth this patient had a cyanotic attack and was found to have excess mucus secretion. Atresia of the oesophagus was suspected and was confirmed by the failure to pass a tube into the stomach. The patient was admitted to the Royal Hospital for Sick Children on January 23, 1960. Anaesthesia was started with nitrous oxide, oxygen and cyclopropane. Intubation with a No. 00 Magill armoured endotracheal tube was attempted. The endotracheal tube was passed through the vocal cords without difficulty but was arrested at the cricoid level. A diagnosis of subglottic obstruction was made.

Radiographs taken before the operation had shown a blind upper pouch of the oesophagus and air in the bowel due to a fistula between the trachea and lower segment. The upper lobe of the right lung was collapsed but no abnormality of the cricoid region could be detected. Because of the tracheo-oesophageal fistula and a further cyanotic attack immediately prior to the anaesthesia it was decided to carry on with the operation in spite of the tracheal obstruction. Anaesthesia was therefore continued with nitrous oxide, oxygen and cyclopropane. Intubation with the tube resting above this extremely narrow aperture the question of performing a preliminary tracheotomy was discussed with the surgeon. However, a decision was taken against this on the grounds of the close proximity of a tracheotomy to the probable site of the oesophageal anastomosis, with consequent difficulty in management.

Anaesthesia was therefore continued, using a face-mask, with oxygen, nitrous oxide and cyclopropane. The tracheotomy set was kept at hand. During the thoracotomy (which lasted 1 hour) it was found impossible to keep the baby well oxygenated using assisted respiration. Although the operative field was not as quiet as would have been obtained using suxamethonium and controlled respiration, it was felt undesirable under the circumstances to abolish respiration.
Fio. 1
Patient E.C. Posterior aspect of the larynx and trachea. A No. 00 Magill armoured endotrachial tube is placed behind the epiglottis. The tip of the tube with stilette showing lies between the vocal cords. Below this the narrowed cricoid ring and the trachea are divided in the midline posteriorly. (Scale shown is in centimetres.)

FIG. 2
Patient E.C. Cross-section through the cricoid cartilage. The narrowed cricoid aperture (2.5 mm in diameter) and thickened cartilage are shown. The cartilage has been divided posteriorly in the midline at autopsy. A cross section of the end of a No. 00 Magill armoured endotracheal tube is included for comparison. (Scale shown is in centimetres.)

FIG. 3
Patient D.R. Sagittal section of the larynx and trachea. The narrowed passage (2 mm in diameter) through the cricoid cartilage is shown by the arrow. (Scale shown is in centimetres.)

FIG. 4
Patient D.R. Laryngoscopic view of postero-superior aspect of the tongue and the glottis. The narrowed aperture through the cricoid is identified by the tip of a probe. A cross section of a No. 00 (plain) endotracheal tube is shown on the same scale.
entirely. No tracheo-oesophageal fistula was found and the continuity of the oesophagus throughout the mediastinum was demonstrated. The neck was then opened along the anterior border of the left sternomastoid and dissection revealed a large upper pouch and a lower segment extending into the root of the neck, together with a tracheo-oesophageal fistula between the distal oesophagus and trachea close to the end of the upper pouch. The fistula was closed and the oesophagus anastomosed in the neck. The total operating time was 2½ hours and the anaesthetic time 3½ hours, during which 55 ml of blood were given.

Postoperative laryngoscopy revealed no further diminution in the size of the airway at the cricoid ring.

The child's postoperative condition was remarkably good. He awoke quickly and was quite active. The character of the respiration was satisfactory and there was no stridor. He was returned to the ward in an incubator with 50 per cent oxygen and 100 per cent humidity and instructions were given to keep a close watch for the development of any signs of respiratory obstruction. In view of the very narrow (2 mm) airway at the cricoid ring and the repeated, albeit gentle, attempts at intubation it was felt that oedema glottis might occur. However, no further respiratory obstruction developed and the child maintained a good colour on oxygen, the percentage of which was gradually reduced to 25.

On the second postoperative day a transverse colostomy was performed under local analgesia and opened the following day (without anaesthesia) for the relief of the obstruction due to the imperforate anus. The child's condition continued to improve gradually until the morning of the fourth day and, although apparently well when fed at 6 a.m., he suddenly collapsed and died at 6.50 a.m.

Postmortem examination confirmed the laryngoscopic findings; the aperture of the cricoid ring only just admitted a probe of 2 mm diameter. This was a striking stenosis and was localized to the region of the cricoid cartilage. Below this the trachea was of normal calibre and length. The lungs and pleura were normal and no pneumonia was identified. The liver showed severe necrosis. The right kidney and ureter were absent. The heart and the brain were normal.

Photographs of the postmortem specimens are shown in figures 3 and 4. A cross section of a No. 00 armoured Magill endotracheal tube is included for comparison.

DISCUSSION

In comparing the normal infantile with the adult larynx Wilson (1955) describes four important differences between them:

(1) Size: the infantile larynx is smaller both actually and relatively. Tucker (1932) states that a subglottic diameter of 6 mm is normal at 2½ months while 4 mm indicates a definite stenosis. Engel (1947) gives the sagittal and coronal diameters of the trachea in the newborn as 5.7 mm and 6.0 mm respectively. On the other hand Negus (1949) gives the length of the vocal folds at 3 days as only 3 mm.

(2) The consistency of all its tissues is softer (an important cause of stridor).

(3) Position: in the infant the larynx is placed high. Eckenhoff (1951) states that at birth the glottis is at the level of the lower border of the third cervical vertebra. As a result of this the line of entry of the air current is straighter than in the adult.

(4) Shape: the upper end of the larynx and trachea is funnel shaped in the infant, the cricoid plate being tilted backwards and the tracheal lumen becomes smaller as it descends.

In both patients the stenosis was caused by the enlarged cricoid cartilage which obstructed the lumen of the larynx just below the vocal cords. From his wide experience of paediatric anaesthesia, Rees (1958) reports only two cases of subglottic stenosis. Glaser, Landau and Heatley (1935) describe one case of subglottic laryngeal stenosis in infancy but this was due to redundancy of the normal laryngeal mucous membrane. Schwalbe (1912) referred to a similar case originally reported by Gigli (1902). Schwalbe suggested that such an error of development may have been due to an inflammatory process during foetal life or to an inequality in the rate of growth between epithelial and mesenchymatous tissue.

In one of the three malformations reported by Potter (1952) the larynx was completely occluded by a solid mass of cricoid cartilage. This case was a stillborn iniencephalic foetus with cystic disease of all lobes of both lungs and complete tracheal atresia. In the other two instances there was a fine aperture about 1 mm in diameter through the posterior part of the cartilage in the midline.

Jackson (1915) described one case of laryngeal stenosis in the newborn in which, at postmortem examination, the cricoid and arytenoid cartilages were much thickened and firmer than normal. The glottis, in contrast to the two cases described here was very small, the vocal cords being shorter, thicker and firmer than normal.

Differential diagnosis.

Obstruction at the level of the vocal cords, such as might occur with laryngeal web, is excluded by inspection and passing of an endotracheal tube through the cords. Obstruction
immediately beyond the vocal cords suggested cricoid narrowing. Anderson (1959) points out that the narrowest point of the infant larynx is often at the cricoid ring. Tracheal obstruction, either extrinsic or intrinsic, might also be present. Stewart and Pinkerton (1955) reported an unusual case of tracheal stenosis in an adult which was thought to be of congenital origin. If there is doubt as to the level of the obstruction, radiographic examination may show constriction of the trachea. More than one film should be taken to exclude temporary tracheal obstruction. Straight antero-posterior or lateral views of the neck do not show the narrowing of the cricoid aperture (Rawson, 1960).

**Management.**

The above evidence shows that cricoid stenosis may be severe and even extend to complete atresia. The diameter of the passage should be ascertained accurately. Laryngoscopy and the gentle passage of catheters of various sizes are recommended. The decision can then be taken whether or not a tracheotomy is to be performed. A tracheotomy in a newborn infant carries a serious risk and involves prolonged and skilled post-operative management. Therefore cricoid stenosis should not be diagnosed lightly.

In small infants there are other causes of difficulty in intubation such as micrognathia and glossoptosis (Pierre-Robin syndrome) or sclerema (“cold injury”) where the thickened woody epiglottis and arytenoid folds make the laryngeal aperture too small and rigid. Trainees in this hospital are taught the importance of inspecting the larynx (with or without light general anaesthesia) before administering a muscle relaxant.

**SUMMARY**

The occurrence of congenital stenosis of the cricoid cartilage in two newborn infants is reported. In both cases oesophageal atresia and tracheo-oesophageal fistula were present. A review of the literature shows that this is a rare condition particularly when associated with oesophageal atresia.

The differential diagnosis is discussed and management suggested.

The possible occurrence of cricoid stenosis draws attention to the risks associated with intubation of the newborn.

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**REFERENCES**


