Annals of the Royal College of Surgeons of England (1983) *vol.* 65

ASPECTS OF OTOLARYNGOLOGY*

Epiglottopexy: a new surgical technique to prevent intractable aspiration

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Key words: NEUROLOGICAL DYSPHAGIA; LARYNGEAL INCOMPETENCE; EPIGLOTTOPEXY; LARYNGEAL SURGERY; SURGICAL TECHNIQUES

Summary

Severe derangement of the protective function of the larynx results in intractable aspiration with secondary life-threatening pneumonia. The new surgical technique of epiglottopexy is described, which in addition to achieving protection of the laryngeal inlet, allows preservation of speech and in certain cases an adequate laryngeal airway. The advantages over current alternative treatment methods is discussed, and the results of five cases of gross laryngeal incompetence managed by epiglottopexy are presented.

Introduction

The larynx has three main functions—maintenance of the airway, phonation and protection of the tracheo-bronchial tree. Laryngologists have always been primarily concerned with airway adequacy and secondarily with speech disorders. The vital protective role of the larynx has, until recently, been largely neglected, mainly because gross functional abnormalities are uncommon, and because current therapeutic alternatives are unsatisfactory. Derangement of the normal protective function of the larynx is termed laryngeal incompetence. Severe laryngeal incompetence results in intractable aspiration, which may lead to secondary pneumonitis and life-threatening pneumonia with abscess formation *(1–4)*. Hippocrates is credited with the first clinical description of this condition, and the first scientific investigation is ascribed to John Hunter in 1871 *(1)*.

Several definitive surgical techniques have been devised for the treatment of the grossly incompetent larynx *(5–11)*, and total laryngectomy is still recommended *(12)*. The limitations of these various surgical options prompted a reappraisal of the management of our patients with this disorder, and led to the development of the epiglottopexy operation. This new technique to prevent intractable aspiration was first suggested by McKelvie *(13)*. In addition to achieving protection of the laryngeal inlet, speech is preserved, and it may also allow an adequate laryngeal airway. Six cases of severe laryngeal incompetence have recently been assessed, and five have undergone epiglottopexy surgery. The surgical technique is described, and its advantages over current alternative methods of management discussed.

Applied physiology of deglutition

Swallowing is a highly complex motor activity which is completed as an orderly sequence of reflexes, co-ordinated mainly by the deglutition centre in the medulla. Reflex activity is elicited following stimulation of the mechano-receptors of the pharyngeal wall, and the afferent impulses are relayed via neural fibres of the glossopharyngeal, pharyngeal and internal laryngeal branches of the vagus nerve, and the trigeminal nerve to the brain-stem. The swallowing impulses pass bilaterally to the deglutition centre, and also more widely to other parts of the brain-stem and cerebellum.

The motor neurones involved in the efferent limb of the reflex are situated in the motor nerve nuclei of the trigeminal, glossopharyngeal, vagus and hypoglossal cranial nerves, and in the nucleus ambiguus. The nucleus ambiguus is particularly important because it provides the main motor innervation for both the upper gastro-intestinal tract muscles and the laryngeal muscles. Apart from elevation of the larynx and pharynx and closure of the laryngeal inlet and nasopharynx by muscle contractions, the efferent impulses induce a co-ordinated peristaltic wave of contraction of the pharyngo-oesophageal musculature, and inhibition of the cricopharyngeal sphincter. Extensive proprioceptive innervation provides feedback information which is important in the precise control of this complex motor reflex activity. There is bilateral higher cortical representation, and partial decussation of the pyramidal tract fibres before reaching the nucleus ambiguus. This cross over pattern means that only bilateral cortical lesions can cause upper motor neurone laryngopharyngeal dysfunction, a rare phenomenon.

In the normal subject closure of the laryngeal inlet occurs automatically during swallowing to prevent foreign material or saliva from entering the trachea. The sphincter mechanisms of the larynx behave functionally as a three tier system. Following contraction of these sphincters, retroversion of the epiglottis occurs covering the laryngeal opening. Elevation of the larynx under the shelter of the tongue base by contraction of the pharyngeal muscles also contributes to laryngeal protection.

Normal sensation, proprioception and co-ordinated reflex motor activity from an anatomically intact tongue base, pharynx, supraglottic larynx and hypopharynx are all important for laryngeal competence. Disturbance of one of these functions may lead to incompetence, but usually of a mild form. Severe intractable aspiration is invariably associated with combined motor and sensory deficits affecting the neural pathways involved in deglutition. Various traumatic, infective, vascular or neoplastic lesions may involve the lower cranial nerves and are summarized in the Table. These may occur at the skull base, high in the neck, or in the medulla. There may be additional brain-stem or cerebellar dysfunction in this this latter group, which results in a more severe functional disturbance.

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TABLE *Main causes of gross laryngeal incompetence*

1. Lesions within the medulla:
   Tumours, Infarction, Syringobulbia, Motor neurone disease, Bulbar poliomyelitis.
2. Lesions at the skull base:
   Posterior fossa tumours, Basal meningitis, Fractures or tumours involving the jugular foramen.
3. High neck lesions:
   Tumours, Trauma.

Clinical features

The symptoms of laryngeal incompetence may vary from minimal occasional aspiration of saliva causing an irritating cough, to marked tracheal overspill. Excessive coughing after drinking fluid is almost always the presenting symptom. On occasions there is associated dysphagia due to failure of relaxation of the cricopharyngeal sphincter. Chronic aspiration is not only unpleasant, but as indicated before, often leads to secondary pneumonitis and pneumonia with a significant mortality.

The aetiology is often apparent from the history. Signs of lower cranial nerve paralyses may be found on examination, and excessive pooling of saliva due to cricopharyngeal dysfunction is frequently seen on indirect laryngoscopy. The important clinical test is to observe the patient swallowing a mouthful of water. When gross laryngeal incompetence is present there is immediate explosive coughing, which continues sometimes for up to a minute.

A barium swallow X-ray examination is essential, because the main differential diagnosis is a tracheo-oesophageal fistula, which may be impossible to define endoscopically. It is important to warn the radiologist of the likelihood of overspill, so that the minimum amount of contrast medium is given.

The epiglottopexy operation

The epiglottopexy operation protects the laryngeal inlet by permanently fixing the epiglottis to the aryepiglottic folds of the supraglottic larynx. The principle of the technique is shown in Figs. 1 and 2. The broken line along the posterolateral margin of the epiglottis and superior aspect of the aryepiglottic fold delineates the area of mucosa which is excised prior to fixation of the epiglottis in a retroverted position. A small opening is left in the posterior laryngeal inlet (Fig. 2) to preserve phonation, and which may also be an adequate airway.

OPERATIVE TECHNIQUE

General anaesthesia is established using a cuffed endotracheal tube. A preliminary tracheostomy is performed, and the anaesthetic continued by this route, allowing the oral tube to be discarded. A standard lateral pharyngotomy approach is used through an oblique skin incision (Fig. 3a), retracting the sternomastoid muscle, and dissecting medial to the carotid vessels. The lateral pharyngeal wall should be clearly exposed from the cricoid cartilage below to the hyoid

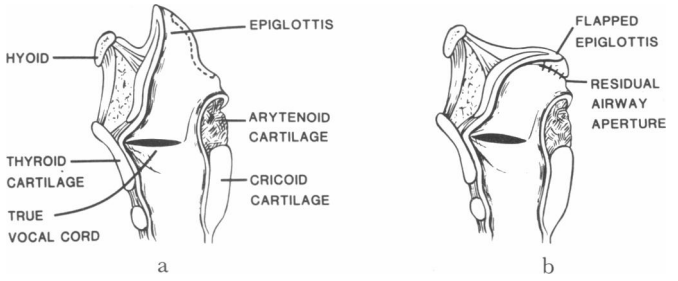


FIG. 1 (a) Sagittal section of a normal larynx. Broken line indicates the medial edge of laryngeal mucosa which is excised. (b) Similar view showing the position of the epiglottis following surgery.

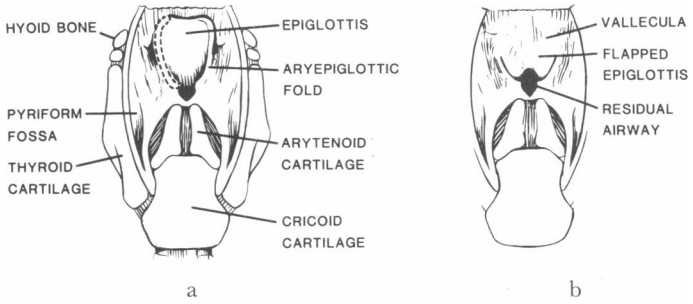


FIG. 2 (a) Posterior view of normal larynx. Broken line delineates area of laryngeal mucosa removed on one side. (b) Posterior view following epiglottopexy surgery showing the approximate relative size of the residual airway aperture.

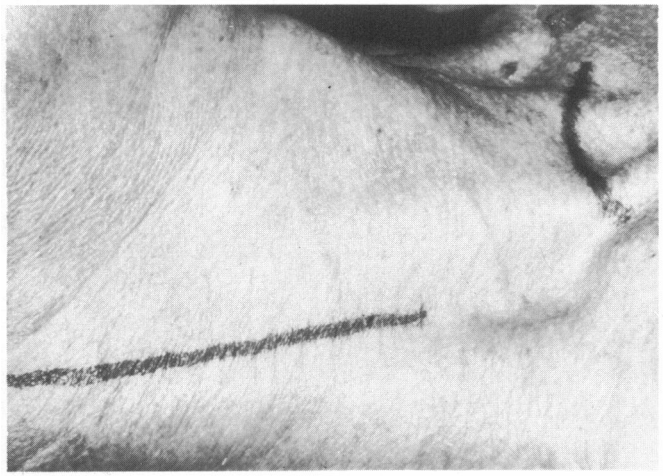
bone above (Fig. 3b). The pharynx is opened just behind the posterior aspect of the thyroid cartilage, revealing the laryngeal inlet from its posterolateral aspect (Fig. 3c). In Fig. 3d a metal probe is holding the epiglottis in the desired final position. Dissection of the mucosa from the aryepiglottic fold is readily accomplished with scissors. It is quite firmly attached to the posterior epiglottis and must be freed using a blunt dissector. Interrupted silk sutures are then inserted into the distal half of the larynx, through the aryepiglottic fold and lateral epiglottis. These sutures are left long on artery forceps until all have been placed, and then tied starting at the angle between the epiglottic base and mucosal fold. Sutures are placed in a similar manner into the proximal supraglottis, until the residual opening is approximately 6 mm (Figure 3e). With a finger passed down into the upper oesophagus a cricopharyngeal myotomy is performed. Finally a fine-bore nasogastric feeding tube is inserted. This is preferred to a standard Ryle's tube, which may cause pressure necrosis of the repositioned epiglottis tip. The pharyngeal wall is closed with an inverting continuous chromic catgut suture, and the wound in layers with suction drainage.

Nasogastric feeding can usually be commenced on the day following surgery, and oral fluids on the 10th postoperative day. Regular chest physiotherapy is important in view of the high incidence of concurrent pulmonary infection. Broad spectrum antibiotics are not prescribed prophylactically, but may be required for established sepsis. Progressive occlusion of the tracheostomy tube is begun around the 10th postoperative day with a view to removal if the airway is adequate.

Figure 4 compares the pre and postoperative barium swallow examinations in one of the cases. There is marked contrast aspiration into the trachea before surgery; the post-epiglottopexy examination (Fig. 4b) shows the curled epiglottis protecting the laryngeal inlet and the absence of tracheal aspiration. Voice quality following this procedure is usually strong but slightly muffled. Some reduction of exercise tolerance is likely, but it should be appreciated that the majority of these patients have long since passed their peak of physical activity. In cases with insufficient pulmonary function, or those where a tight epiglottic flap was necessary to prevent aspiration, a long-term tracheostomy will need to be maintained.

Results

Epiglottopexy surgery has been performed in 5 cases. Four patients had undergone neurosurgical treatment previously for extensive posterior fossa tumours. In three of these epiglottopexy was very successful. Tracheal aspiration was completely controlled, although two required long-term tracheostomies. The other patient was certainly symptomatically improved, but still had some residual tracheal overspill. Another patient sustained high vagal nerve and brain-stem damage following gunshot trauma, which also caused a high



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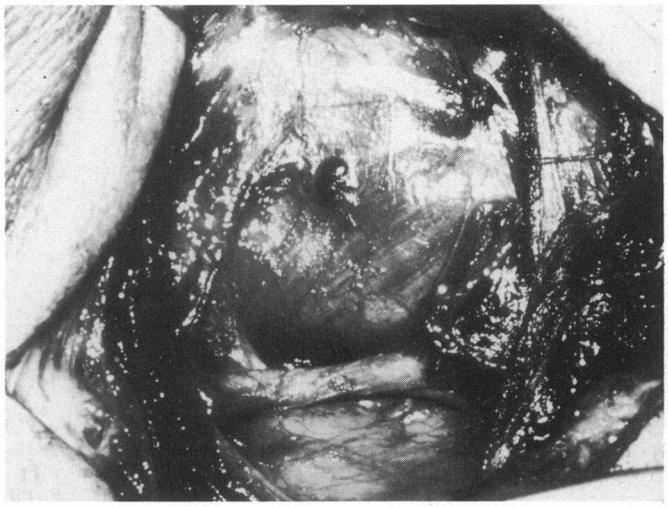

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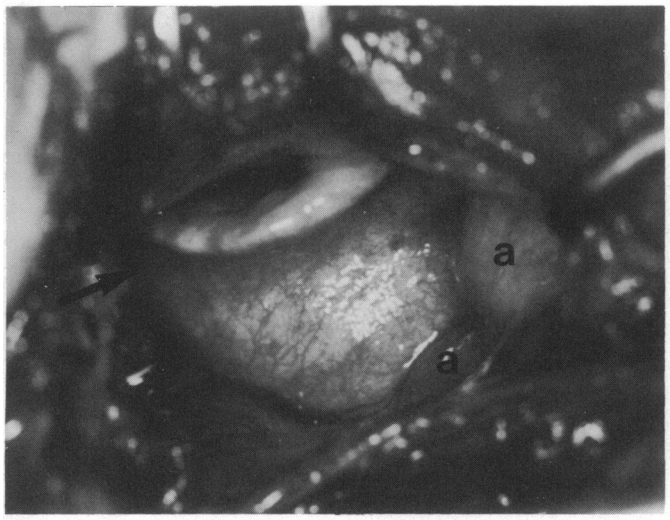

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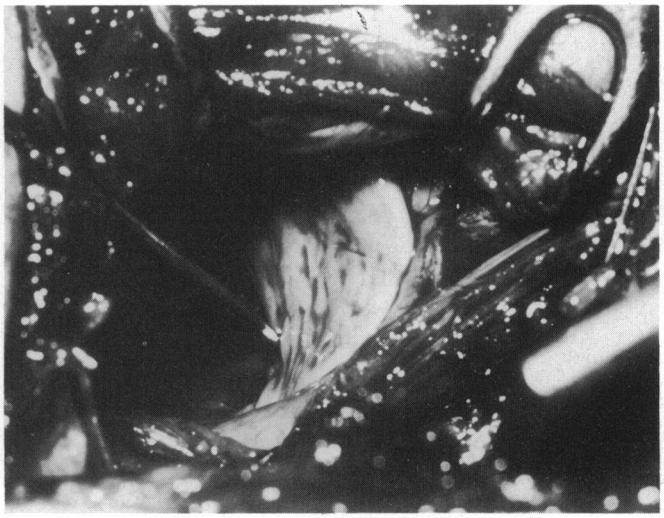


d

e

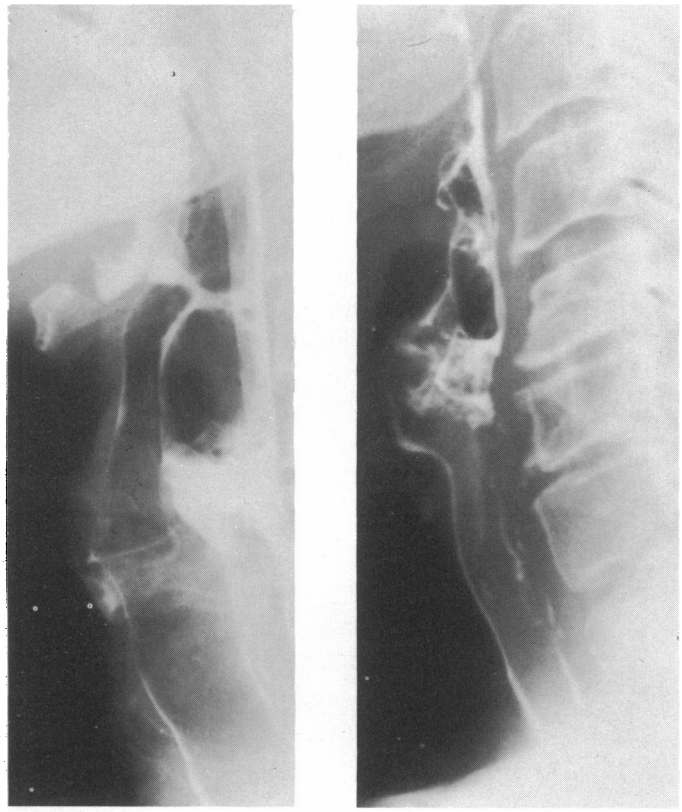
FIG. 3 (a) Tracheostomy and oblique right neck skin incisions. (b) Exposed larynx and lateral pharyngeal wall. Prominent superior thyroid artery and carotid sheath displayed more laterally. (c) Laryngeal inlet viewed from the postero-lateral aspect following lateral pharyngotomy. 'a'—marks the mucosa overlying the arytenoid cartilages; almost all of the posterior surface of the epiglottis is visible, and the black arrow points to its tip. (d) Epiglottis held flapped down over the laryngeal inlet by a metal probe to show the desired position. (e) Epiglottis sutured into a retroverted position. A large metal probe is inserted into the residual airway aperture.

intra-thoracic tracheo-oesophageal fistula. Epiglottopexy surgery successfully controlled his laryngeal incompetence, although the fistula subsequently reopened and a feeding gastrostomy and permanent tracheostomy were required for this reason. The remaining patient with progressive cerebellar and brain-stem degeneration following postoperative intracranial suppuration declined surgery.

Discussion

Severe laryngeal incompetence is uncommon. Ekberg and Nylander *(14)* recently studied 250 unselected dysphagic patients by cineradiography. They reported an incidence of tracheal aspiration of only 1.6%, and found that this was always associated with a functional anomaly of the epiglottis.

A cuffed tracheostomy tube provides only a temporary solution when the protective function of the larynx is significantly impaired. Injecting Teflon paste to add bulk to an inadequately compensated palsied vocal cord is rarely helpful *(13)*, but may certainly improve voice quality. Several definitive surgical techniques have been devised. In 1972, Habal and Murray *(5)* described the epiglottic flap operation, in which the laryngeal inlet is completely sealed off using the epiglottis held in place under mucosal flaps. The anterior approach through the vallecula endangers the superior laryngeal nerves, which could further impair laryngeal rehabilitation. Glottic closure by suturing the vocal cords together has been suggested as an alternative *(6, 10)*, as



a b

FIG. 4 (a) Lateral preoperative barium swallow X-ray examination showing marked tracheal aspiration of contrast medium. (b) Same examination post-surgery, showing the curled epiglottis protecting the laryngeal inlet and the complete absence of aspiration.

has division and diversion of the trachea *(7,8,11)*. The anterior approach used in all these surgical options does not allow a cricopharyngeal myotomy to be performed at the same time. This is an important consideration, for in most of our cases hypertonicity of the cricopharyngeus muscle has been present as a contributory factor. Total laryngectomy is still recommended in the management of this disorder *(12)*. These procedures all share the disadvantages of total sacrifice of phonation, and the absolute necessity for a long-term tracheostomy. The loss of voice represents a major additional problem, for many of these patients are already seriously handicapped by other features of a chronic neurological deficit. Speech preservation is one of the main advantages of the epiglottopexy operation, and is always attainable.

Neurological recovery is well recognized with these types of pathology *(15,16)*, often extending over one or two years *(8,9)*. In some cases functional improvement may occur due to normal compensatory mechanisms. The epiglottopexy operation does not cause increased damage to the glottis, and in such instances could easily be reversed. We conclude that epiglottopexy has an important place in the management of the incompetent larynx.

The authors acknowledge the assistance of Jo Abbott, medical artist at the London Hospital, in the preparation of Figs 1 and 2.

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