ANAESTHETIC MANAGEMENT OF ACUTE LARYNGEAL TRAUMA

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SUMMARY
Three patients suffering acute laryngeal trauma illustrate problems of missed diagnosis and airway management confronting anaesthetists. A 55-year-old man suffered multiple injuries, including a supraglottic laryngeal fracture which was not diagnosed during administration of a subsequent general anaesthetic. The diagnostic delay compromised any reconstructive surgery. Two 26-year-old males suffered laryngeal fractures, but tracheal intubation for reconstruction and tracheostomy was successful. Guidelines for management are suggested.

Acute laryngeal trauma and the consequent difficulty in maintaining an adequate airway demand of the anaesthetist skills in both diagnosis and subsequent management. When associated with major head, neck and maxillofacial trauma, the closed laryngeal injury may pass unnoticed on initial assessment in the casualty department, only to be recognized by the anaesthetist during tracheal intubation or even in the recovery period. Early treatment to protect the airway and avoid residual impairment of laryngeal function is vital and it is therefore imperative to seek and exclude such injuries during laryngoscopy at intubation and to be aware of the immediate problems in management of the airway which may occur.

CASE REPORTS
Patient 1
A 55-year-old male suffered fractures of his mandible and left wrist following head-on collision with a lorry. In a local hospital, both fractures were reduced with internal fixation under general anaesthesia. There was no apparent difficulty with tracheal intubation and no laryngeal injury was noted.

Five days after operation the patient was fevered, complained of dysphagia, haemoptysis and stridor on lying supine, although his voice was normal. On his transfer to this hospital computerized tomograms and x-rays revealed a supraglottic laryngeal fracture and a longitudinal tear of the posterior pharyngeal wall (figs 1, 2). Laryngoscopy and elective tracheotomy were performed under general anaesthesia induced with thiopentone 350 mg, in

FIG 1. Xerogram of lateral neck, supine, showing fracture of the hyoid, with a deep tear through the vallecula and consequent posterior displacement of the epiglottis.

FIG 2. C.T. scan of neck showing displacement of epiglottis, restricted airway and widening of the vallecular sulcus.

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semi-erect position, after 5 min of preoxygenation, and maintained with halothane in a mixture of nitrous oxide in oxygen. The patient breathed spontaneously via a Magill system. As the vocal cords were easily visible on lifting the epiglottis, suxamethonium 100 mg was given i.v. and the trachea was intubated (8-mm cuffed oral endotracheal tube).

Laryngoscopy revealed deep tears through the vallecular sulcus and posterior pharyngeal wall. Because of delay in presentation and consequent sepsis the injuries were managed conservatively and surgery was limited to fashioning of a tracheostomy. A McMichael fine-bore naso-gastric tube was passed and antibiotic therapy commenced.

The tracheostomy was retained to allow access to the airway for general anaesthesia as further operations were necessary to reduce the mandible and wrist. The patient was now comfortable and serial x-rays showed progressive restoration of the airway. At 6 weeks the tracheostomy was corked and withdrawn at 10 weeks. There was no residual damage to airway or voice.

**Patient 2**

A 26-year-old male was admitted following a road traffic accident. Preliminary examination revealed scalp injuries and superficial injuries of the neck. Over the next 7 h there developed gross surgical emphysema of the neck, stridor when supine, and pain and tenderness over the larynx.

The patient underwent laryngoscopy, exploration of the neck, and tracheotomy. Anaesthesia was induced with halothane in nitrous oxide in oxygen. However, the patient became excited with increasing stridor, and thiopentone 200 mg allowed successful ventilation of the lungs via a mask. Suxamethonium 100 mg was given and a 6-mm nasal cuffed endotracheal tube was inserted.

Direct laryngoscopy and exploration of the neck revealed a vertical midline fracture separating the thyroid alae, with a horizontal tear of the laryngeal mucosa along the right false cord, exposing the arytenoid cartilage. The mucosal tear was sutured and the thyroid cartilage fracture reduced and fixed with steel wire sutures. A tracheostomy was fashioned and McMichael naso-gastric tube passed.

Six days after operation the patient commenced oral feeding. At 20 days direct laryngoscopy showed the right arytenoid to have satisfactory mucosal cover. At 24 days the tracheostomy tube was withdrawn and at 3 months a final endoscopy showed fully mobile cords with no stenosis, while the voice and airway were normal.

**Patient 3**

A 26-year-old male was punched on the throat. On admission to hospital he complained of hoarseness, dysphagia and haemoptysis. There was no stridor. Surgical emphysema of the neck produced loss of the normal laryngeal prominence. Mirror examination revealed some posterior displacement of the epiglottis.

Laryngoscopy, open exploration of the larynx and tracheotomy, under general anaesthesia, followed. After preoxygenation the patient received an inhalation induction with oxygen, nitrous oxide and halothane. When the patient was sufficiently anaesthetized to allow manual ventilation of the lungs with bag and mask, suxamethonium 100 mg i.v. produced relaxation and a 9-mm red rubber Magill cuffed oral tube was introduced to the trachea.

Laryngoscopy showed swelling of the left arytenoid, but intact vocal cords. Exploration of the neck revealed a vertical midline crack down the laryngeal prominence, without damage to the underlying anterior commissure and this fracture was splinted with steel wire. A horizontal tear through the cricotracheal membrane had produced partial laryngo-tracheal separation but was closed satisfactorily in layers. A naso-gastric tube was inserted.

After 9 days the tracheostomy tube was corked and on the 12th day, withdrawn. Direct laryngoscopy at 4 months showed no abnormality and the voice was normal.

**DISCUSSION**

In major trauma, laryngeal injury may pass unnoticed in initial assessment. As illustrated in patient 1, at the time of intubation the anaesthetist has the opportunity to visualize the laryngeal lumen and prevent missed diagnosis. In this patient the more obvious major injuries, facial trauma and blood in the airway proved a distraction. In the second patient, the superficial neck injuries were noted, but the diagnosis was not made for some hours.

The possibility of laryngeal injury should be suspected in all victims of major trauma, especially in road traffic accidents, assault or sporting injury. Symptoms include local pain and dysphagia, hoarseness or haemoptysis. Examination may reveal superficial injuries to the neck and stridor. Increased
inspiratory effort, as shown by tracheal tug and suprasternal and intercostal recession, will worsen surgical emphysema. Cyanosis alone is an unreliable index of oxygenation, but hypercarbia produces restlessness and irritability.

Where time allows assessment is aided by mirror examination (indirect laryngoscopy) to assess cord mobility and integrity of the laryngeal lumen. A lateral soft tissue x-ray of the neck and cervical spine may reveal bony or cartilaginous injury. Xeroradiography proved especially useful in patient 1, demonstrating soft tissue injuries. CAT scanning can reliably diagnose fractures of the thyroid cartilage or cricoid ring and assess airway patency (Mancuso and Hanafee, 1979).

Four varieties of laryngeal injury are encountered (Bryce, 1978). In supraglottic laryngeal fracture, as in patient 1, the epiglottis and laryngeal inlet is displaced posteriorly and the vocal cords may be spared. In cricotracheal separation the larynx and trachea are distracted and possibly subluxated, as illustrated in patient 3. Complete separation is usually immediately fatal (Le Jeune, 1978). Commonly a vertical midline fracture will damage the anterior commissure and separate the thyroid alae as in patients 2 and 3. A comminuted fracture, or shattering of the laryngeal skeleton, is found in the older, calcified and rigid larynx.

With the diagnosis established on initial assessment, or at tracheal intubation, the priority is maintenance of the airway. Conservative treatment is hazardous as laryngeal edema may rapidly progress, although humidified oxygen, steroids and antibiotic prophylaxis may help.

In the cases presented general anaesthesia was required to evaluate the injuries by endoscopy, explore the neck and repair mucosal and cartilaginous injuries and fashion a temporary tracheostomy. Intubation was successfully performed on the unconscious patient in each case.

Hazards which may be encountered on intubation include:

(a) Associated maxillofacial injuries and displacement of teeth, bone or blood into the upper airway, as in patient 1.
(b) Injury to the cervical spine, at risk on neck extension during intubation.
(c) Complete cricotracheal separation. Symptoms may initially be mild because of the splinting action of the strap muscles. However, paralysis may cause distraction and subluxation of the larynx and trachea, making intubation impossible. In retrospect, use of suxamethonium in patient 3 carried some risk.
(d) Supraglottic laryngeal fracture, producing detachment and posterior displacement of the epiglottis, when the patient is supine. As in patient 1, the Mackintosh laryngoscope blade inserted into the vallecula can elevate the tongue but not the detached supraglottis. Only on elevating the epiglottis was the laryngeal lumen revealed.
(e) Surgical emphysema was not marked, except in patient 3, but may make neck extension difficult and proceed to mediastinal emphysema. None of the patients had penetrating injuries, which can produce air embolism into the great veins of the neck (Vaughan, 1971). A tension pneumothorax is especially dangerous where IPPV is in use.

Alternatives to tracheal intubation on the unconscious patient include tracheotomy or per nasal intubation under local anaesthesia.

Preliminary tracheotomy under local anaesthesia is recommended where airway obstruction is severe, as shown by marked stridor at rest, and use of accessory muscles of respiration (Verrill, 1963). Preoxygenation with 80% helium and 20% oxygen (density one-third that of air) is helpful. Infiltration with lignocaine and adrenaline anaesthetizes the distribution of the superficial cervical plexus, but is used sparingly to avoid diffusion to the recurrent laryngeal nerves, consequent paralysis and further airway deterioration. Preliminary tracheotomy was avoided, however, as stridor was not severe in any case and the procedure on a restless, apprehensive patient with a compromised airway, hypoxia and distended neck veins, is more fraught than the elective procedure performed where endotracheal intubation has been possible.

Nasal intubation is possible under local anaesthesia using Moffat's solution 5 ml (1 ml of adrenaline 1 in 1000; 2 ml of 10% cocaine solution; 2 ml of bicarbonate solution) in the nose and, once the tube is in the nasopharynx, instilling lignocaine 4% to the lumen, anaesthetizing as the tube advances.

Intubation of the anaesthetized patient remains the ideal, however, and was successful in the patients presented. In each case the neck was, nonetheless, infiltrated with lignocaine and the surgeon gowned, lest an emergency tracheotomy be necessary during induction of anaesthesia. Transstracheal insufflation with an i.v. cannula as an emergency method of oxygenation may be performed. Suitable apparatus (Clarke and Cochrane,
be prepared for the problems with airway manage-
tion proved most successful. In patient 1, infection
certain the lungs could be inflated by manual venti-
lation and that intubation was possible (Atkinson,
1976).
A generally conservative approach to reconstruc-
tion proved most successful. In patient 1, infection
and necrosis as a result of the delay in diagnosis
prevented primary closure. Healing by secondary
intention was excellent. Surgical reconstruction
is generally required in penetrating injuries, less so in
the closed laryngeal trauma of traffic accidents, and
rarely in other blunt trauma (Maran et al., 1981).
Acute closed laryngeal injury is rarely reported
(Seed, 1971). Its recognition may be difficult in
the presence of major trauma, but a missed diagnosis
may produce an unexpected airway obstruction or
residual functional impairment such as dysphonia,
stenosis and spillover. It therefore behaves the
anaesthetist to suspect and exclude such injury and
be prepared for the problems with airway manage-
ment which may arise.

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CONDUITE A TENIR POUR L'ANESTHESIE
DES SUJETS PRESENTANT UN TRAUMATISME
LARYNGE AIGU

Trois patients souffrant de traumatisme aigu du larynx illustrent
les problemes de non-depistage et de controle des voies aeriennes
auxquels les anesthesistes se trouvent confrontes. Un homme de
55 ans a ete victime de traumatismes multiples, dont une fracture
laryngée supraglottique qui est passe inaperçue lors de l'ad-
ministration consequente d'une anesthesie generale. Le retard au
diagnostic a empache toute chirurgie reconstructrice. Deux homo-
nes jeunes de 26 ans ont ete victimes de fractures laryngees,
mais l'intubation trachéale pour plastie et trachéotomie a ete couron-
nee de succes. Nous suggérons quelques grandes lignes de traite-
ment.

DAS VORGEHEN DES ANÄSTHESISTEN BEIM
AKUTEN KEHLKOPFTRAUMA

ZUSAMMENFASSUNG
Drei Patienten, die ein akutes Kehlkopftrauma erlitten, machen
die Probleme anschaulich, die mit nicht erfolgter Diagnose und
fehlender Behandlung der Atemwege einhergehen. Ein 55-
jähriger Mann mit Polytrauma hatte auch eine Kehlkopfraktur,
die bei der später erfolgten Allgemeinnarkose nicht erkannt
wurde. Die Verzögerung der Diagnostik machte eine operative
Rekonstruktion unmöglich. Zwei 26-jährige Männer erlitten eine
Kehlkopfraktur, die endotracheale Intubation zur Rekonstru-
kion und Tracheotomie gelang jedoch. Es werden Richtlinien fürs
Vorgehen vorgeschlagen.
CONTROL ANESTÉTICO DE TRAUMAS LARINGEOS AGUDOS

SUMARIO
Se da una ilustración de los problemas de diagnósticos erróneos y control de las vías respiratorias a que se enfrentan los anestesistas con tres pacientes que padecían de traumas laringeos agudos. Un hombre de 55 años de edad sufrió lesiones múltiples, inclusive una fractura laringea supraglótica que no fue diagnosticada durante la administración de un anestésico general subsecuente. La demora en el diagnóstico comprometió toda cirugía de reconstrucción. Dos hombres de 26 años de edad sufrieron fracturas laringeas, pero la intubación de reconstrucción y la traqueotomía tuvieron éxito. Se sugieren pautas de control.