Burns and tracheo-oesophageal-cutaneous fistula

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We report an unusual case of electric burns suffered by a 15-yr-old boy. The patient’s neck had come in contact with a high voltage broken electric wire and by reflex he had pulled it away with his right hand. He presented with a tracheo-cutaneous fistula with a right-sided pneumothorax. Emergency airway management included insertion of a tracheostomy tube through the traumatic opening in the neck and insertion of an intercostal tube drain. When the diagnostic endoscopy revealed an externally communicating tracheo-oesophageal fistula, protecting the lower airways from gastrointestinal contamination became a priority. The patient was anaesthetized through the traumatic tracheostomy and a formal low tracheostomy was done below the level of the fistula. The patient then underwent oesophageal reconstruction with a stomach free flap. Tracheo-oesophageal-cutaneous fistula is a rare presentation of electric burns. The anaesthetic management of the emergency difficult airway in any penetrating neck injury can be extremely difficult requiring a carefully planned multi-disciplinary approach.

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Accidental electrical injury may cause serious burns to any part of the body. In the head and neck region, regardless of the percentage of burns, it may cause severe airway compromise. Tracheal injuries with associated tracheo-oesophageal-cutaneous fistulas are difficult to manage because of potential airway complications.

Case report

A 15-yr-old male was referred from a peripheral secondary level hospital for the management of electric burns to the neck. He had suffered accidental electrocution while working in the fields 4 h before admission. He was complaining of a difficulty in breathing, speaking, and had facial puffiness. The father had witnessed the electrocution and according to him, the patient’s neck had come in contact with a broken high-voltage electric wire and by reflex he had pulled it away with his right hand. On examination, he was conscious and breathing spontaneously but laboriously through an opening in the anterior neck below the cricoid (Fig. 1). He was haemodynamically stable, his heart rate was 134/min, his arterial pressure was 140/80 mm Hg, and his ventilatory frequency was 26/min with an oxygen saturation of 95% while breathing room air. He had evidence of increasing s.c. emphysema, extending from the chest to both the upper limbs and face.

Examination of the respiratory system revealed absent breath sounds on the right side. On the palmar aspect of the right thumb and index fingers there was evidence of third degree burns. The total area of burns was less than 1%. Abdominal examination revealed no significant findings. Central nervous system examination was normal. There was no evidence of cervical spine or any other bony injuries. Urgent radiographs of the neck (Fig. 2) and chest were performed.

A diagnosis of traumatic tracheal injury secondary to electric burns with right-sided open pneumothorax was made. I.V. access was obtained and lactated Ringer’s solution was given at 100 ml h−1 and continued for 24 h.

He remained stable and the continuous ECG was normal. The airway was a priority and tracheostomy and chest tube insertion was planned in the Intensive Care Unit (ICU). The airway was secured awake and with the patient breathing spontaneously, using a 6.5-mm Portex cuffed tracheostomy tube (Portex Ltd, Hythe, CT21 6JL Kent, UK), inserted into the traumatic tracheal opening. When connected to a Bain’s circuit, the patient breathed comfortably through this tracheostomy, with improved air entry.
over the right lung and decreasing s.c. emphysema. An intercostal drainage tube was inserted under local anaesthesia and the pneumothorax connected to an underwater seal. He was moved to the operating theatre where flexible fibre-optic bronchoscopy and oesophagoscopy was performed under local anaesthesia and sedation (midazolam 2 mg i.v.). This revealed a subglottic tracheo-oesophageal-cutaneous fistula. Examination of the laryngeal inlet was difficult because of the oedema of the glottis and no vocal cord movement could be ascertained. An elective low tracheostomy was planned, in view of the extensive tracheo-oesophageal burn, the need to protect the lower airways and for reconstructive surgery.

Assisted ventilation was possible using the traumatic tracheostomy, without evidence of gastric distension. Anaesthesia was induced with ketamine 75 mg i.v. and maintained with a mixture of oxygen–nitrous oxide and halothane. A formal low tracheostomy was then carried out with a Portex cuffed tracheostomy tube 6.5 mm ID (Portex Ltd) and the traumatic tracheostomy tube was removed after satisfactory ventilation was established. A feeding jejunostomy was performed and the patient was returned to ICU. Elective tracheo-oesophageal separation and free flap reconstruction was planned.

After fasting overnight and no pre-medication, the patient was taken to the operating theatre and monitoring instituted. The tracheostomy was connected to the breathing circuit and anaesthesia was induced with the patient breathing a mixture of oxygen and nitrous oxide (1:1) with increasing concentrations of halothane (0.5–1.5%), followed by pancuronium bromide 4 mg i.v. to facilitate mechanical ventilation.

The surgeons explored the neck and found a defect in the posterior wall of the trachea extending inferiorly approximately 5 cm. The injury appeared to extend posteriorly through the oesophagus to the prevertebral fascia. The oesophageal burn was extensive and required reconstruction with a stomach free flap, taken from the greater curvature based on the right gastro epiploic artery and vein and anastomosed to the facial artery and superior thyroid vein. Omentum was used to interpose the new oesophagus and trachea. The patient had an uneventful postoperative period. The chest tube was removed on the fifth day after a chest radiograph showed full expansion. He was discharged with the tracheostomy tube and is planned for a tracheal reconstruction at a later date.

Discussion

The patient presented with a traumatic tracheo-oesophageal-cutaneous fistula after accidental electrical burn injury to the neck. The entry point was very unusual and resulted in electric burns to his neck and hand. His emergency management goals included securing the airway and identifying and treating associated life-threatening injuries (pneumothorax). We secured the airway through the traumatic tracheostoma. When the diagnostic endoscopy revealed externally communicating tracheal and oesophageal injuries, protecting the lower airways from gastrointestinal contamination became a priority. Therefore, a formal low tracheostomy under general anaesthesia was planned. An inhalation anaesthetic

Fig 1 Preoperative photograph showing electric burn of the neck and a tracheo-cutaneous fistula. (Figure reproduced with the patient’s permission.)

Fig 2 Preoperative plain radiograph of the neck lateral view showing discontinuity of tracheal gas shadow and s.c. emphysema.
using halothane in an oxygen–nitrous oxide mixture, with a spontaneously breathing patient, was chosen whereby the patency of the airway would control the depth of anaesthesia. Although nitrous oxide should be avoided in a patient with a pneumothorax, we felt that this was justified in our patient who had a ‘dangerously difficult airway’. Halothane, if used in oxygen 100%, would have required high concentrations, which could have resulted in dysrhythmias and haemodynamic instability. The patient was stabilized before major elective reconstruction in a staged manner.

Electric burns to the neck resulting in an tracheo-oesophageal-cutaneous fistula and its anaesthetic management to our knowledge has not been reported previously. Electrical injuries currently remain a worldwide problem. Accidental electrical injury is more common in children, particularly males (11–18 yr). Electrical burns differ from thermal and chemical burns in that they tend to have deeper surface penetration resulting in extensive tissue damage. Voltage, point of entry, pathway of current, associated multiple trauma or flame burns, and surgical treatment seem to be the main factors influencing the lesion and the morbidity. Sequelae include limb fractures and amputations, renal failure, cardiac arrhythmias, cataracts, and neurological complications. Entry points are most commonly in the hand. This patient was haemodynamically stable and the continuous ECG monitoring did not reveal any conduction abnormality; hence a formal 12-lead ECG was not done. This is indicated in all patients with electric burns and especially those with injury as a result of electric current pathways that cross the chest.

Penetrating injuries to the neck may result in major vessel injury and laryngotracheal injury, with or without oesophageal injury. Oesophageal injury is infrequent but may go unnoticed and present later. Therefore, a high index of suspicion of oesophageal injury is required in these patients.

Tracheo-oesophageal-cutaneous fistulas are uncommon. In a series of seven patients with complete laryngotracheal disruption all but one had intact cutaneous tissue of the neck. The presenting symptoms of traumatic TOF are dysphonia, cough, noisy breathing stridor, and dysphagia. Diagnostic evaluation in a series of 32 patients described by Grewal and co-workers included: laryngoscopy/tracheoscopy (17), oesophagoscope (12), contrast oesophagography (9), angiography (8), and bronchoscopy (3). Emergency airway management in this series included: tracheostomy (15), endotracheal intubation (14), and cricothyroidotomy (3). Fitzhugh and Powell recommended tracheostomy as the method of choice to establish an airway in the acutely injured patient with neck trauma, as attempts at tracheal intubation may result in the creation of a false passage, compromising the airway. A tracheostomy below the level of the injury is the preferable option. When the diagnosis of TOF has been made, the immediate goal should be to minimize tracheobronchial soilage by placing the cuff of a tracheostomy tube distal to the fistula so as to effect adequate ventilation.

Tracheo-oesophageal-cutaneous fistulas may be managed with the ‘logical’ technique as described in 1969 by Geffin and co-workers that consisted of tracheal intubation above or sometimes through the lesion to facilitate lung ventilation. After exploration or resection the surgeon inserts a new sterile tracheal tube or tracheostomy tube into the distal trachea so that ventilation can be resumed. Cardiopulmonary bypass is an alternative and usually reserved for low lesions that prevent adequate access and ventilation.

Anaesthetists treating tracheal injuries should be prepared to manage the resulting difficult airway. The management is centred on securing the airway preferably awake with the patient breathing spontaneously. Early surgery is required to prevent long-term morbidity. The management of the emergency difficult airway in any penetrating neck injury can be extremely difficult and requires a planned multidisciplinary approach in which anaesthetists should assume a leading role.

References