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Maintaining oxygenation with high-flow nasal cannula during emergent awake surgical tracheostomy

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Editor—Patients presenting with acute upper airway obstruction are at significant risk of morbidity and continue to be managed poorly.[1] Although several approaches can be taken, surgical tracheostomy placement under local anaesthesia is recommended because it ensures patients are kept awake, maintaining airway patency.[2] This poses several challenges for the anaesthetist, including limited access to the surgical field and risk of complete airway obstruction in a patient with potentially limited reserve.

We recently used a high-flow nasal cannula (HFNC) to maintain oxygenation in a 67-yr-old man who underwent emergent awake surgical tracheostomy for upper airway obstruction secondary to an infective acute leukaemic mass. The HFNC (OptiFlow System; Fisher & Paykel Healthcare Ltd, Panmure, Auckland, New Zealand) was placed before commencement, and oxygen flow rates were set at 50 litres min^{-1} through the Optiflow system. Moderate sedation was achieved with i.v. midazolam boluses (total of 3 mg) and remifentanil target-controlled infusion (2–6 ng ml^{-1}). The patient maintained spontaneous breathing, with a patent airway and oxygen saturations 98% or above throughout the procedure.

High-flow nasal cannulation is increasingly used in management of difficult airways,[3] but its use during placement of an emergent tracheostomy under local anaesthesia for acute upper airway obstruction has not been described. High-flow nasal cannulation is used successfully for preoxygenation, awake fibreoptic intubations,[3] acute hypoxic respiratory failure,[4] during bronchoscopy,[3] post-extubation,[5] and to avoid invasive ventilation in respiratory failure.[6] Its use allows delivery of oxygen at flow rates up to 70 litres min^{-1}, extending apnoeic time, facilitating carbon dioxide elimination, reducing the work of breathing, and providing PEEP.[7] This extension of apnoea time is useful where airway patency is at risk and time would be required for intervention.

Oxygenation via a face mask is intrinsically limited by the fixed fraction of oxygen being delivered. Non-rebreather masks at 15 l min^{-1} of oxygen flow generally yield fraction of inspired oxygen of 0.6–0.7, which can be increased with higher flow rates.[8] Non-invasive ventilation increases mean airway pressure and is an effective preoxygenation technique.[9] However, it can cause patient distress and is not without risks, including pneumonia, barotrauma, aspiration, and cardiovascular compromise.[10] The presence of absolute or relative contraindications (such as fixed obstruction of the upper airway) may limit its use,[10] and its application under a surgical drape during tracheostomy placement is less practical compared with other methods.

In instances of perilaryngeal obstruction, the other main approach to securing the airway involves inhalation induction of anaesthesia, with maintenance of spontaneous breathing, and attempting tracheal intubation with direct or videolaryngoscopy.[2 11] Patients presenting with severe stridor at rest are unlikely to tolerate a general anaesthetic, and awake tracheostomy is the safest option.[2 11] Patients with more chronic obstruction may tolerate an inhalation induction, but this can be associated with increased morbidity, namely risk of laryngospasm, coughing, breath-holding, and failed intubation.[1]

Awake fibreoptic intubation is considered by many anaesthetists as an optimal solution. However, this procedure is not devoid of risks, as it can result in bleeding, coughing, arrhythmias, increased patient distress, and deterioration of the clinical condition.[2] Rarely, other options can be considered, namely rigid bronchoscopy and femoral vessel cannulation for cardiopulmonary bypass.[2] Patients presenting with severe acute upper airway obstruction pose significant challenges to the anaesthetist. High-flow nasal cannulation appears to be a safe and effective means to ensure oxygenation during placement of a surgical tracheostomy under local anaesthesia, with added physiological benefits.

Declaration of interest

None declared.

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Raw EEG characteristics, bispectral index, and suppression ratio variations during generalized seizure in electroconvulsive therapy

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Editor—We wish to report our findings of an observational prospective study of raw EEG characteristics, bispectral index (BIS) and suppression ratio (SR) variations during a generalized tonic–clonic seizure induced by electroconvulsive therapy (ECT). After obtaining the approval of the Ethics Committee for biomedical research, 20 patients were included for a total of 39 sessions. The BIS sensor (BIS Quatro, Medtronic-minneapolis USA) was connected to the BIS-VISTA® (Medtronic-minneapolis USA) monitor (smoothing rate, 10 s). The BIS and SR values were retained for analysis if their corresponding signal quality index were ≥50 and EMG ≤50. To overcome electromagnetic interference, we excluded from analysis all BIS and SR values obtained from the end of the electrical impulse to 15 s later. Sedation was induced with a bolus of propofol [(median dose 0.86 (interquartile range 0.68–1) mg kg^{-1}] after 3 min of preoxygenation. Suxamethonium [median dose 1.1 (range 1–1.2) mg kg^{-1}] was injected 30 s after loss of the ciliary reflex. Electroconvulsive therapy began at least 30 s after the end of fasciculation and after the stabilization of BIS. The lungs were ventilated until ECT began, in order to avoid hypercapnia. Differences between BIS and SR values were analysed with the Friedman test, and when a significant difference was encountered the trend over time was analysed by a Mann–Kendall test. Statistical significance was assumed at $P<0.05$.

The pre-ictal EEG (Fig. 1) shows irregular oscillations of low amplitude (<25 μV). At the beginning of ECT, the electrical pulse is followed by an epileptic recruiting rhythm, as a pattern of low-voltage and high-frequency waves. The peri-ictal trace shows spikes, polyspikes, and spike-waves. The post-ictal EEG is characterized by electrical depression to a straight-line EEG. Pre-ictal BIS (obtained immediately before the electric shock) was defined as the reference value, and ΔBIS as the difference between a BIS value at a given time and the pre-ictal BIS. During the ictal phase, BIS values decreased over time (Friedman test, $P<0.0001$; Mann–Kendall test, $P=0.001$). Suppression ratio values did not vary over time during the ictal phase. During the post-ictal phase, BIS values decreased in the early period (Friedman test, $P<0.0001$; Mann–Kendall test, $P=0.001$), followed by a sustained increase. A concomitant frank increase in SR values was observed in the early period of the post-ictal phase (Friedman test, $P<0.0001$; Mann–Kendall test, $P=0.001$), followed by a sustained decrease.

The raw EEG of the BIS monitor allows diagnosis of spikes, spike-waves, and poly-spikes during a generalized tonic–clonic seizure. Immediately after the electrical shock, a recruiting rhythm appeared, followed by lower frequency and higher amplitude activity; both patterns are typical of generalized tonic–clonic