Management of the airway in intensive care

Miles Beeny

Abstract

Airway management in the intensive care unit (ICU) is largely uneventful; there is a higher incidence of airway difficulties, however, than those encountered in the operating suite. Management of the airway in the ICU presents challenges unique to this environment that must be coped with by a multidisciplinary team that may be less experienced in airway management than clinicians in the operating theatre. The risks associated with this situation, I believe, may be ameliorated by planning and forethought. This article outlines some of the specific difficulties faced by clinicians in ICU and attempts to provide some guidance as to how these may be overcome, or at least abated. Drug choices are discussed, as are equipment choices. A suggestion for a difficult airway algorithm for use in the ICU is put forward. The timing of tracheostomy is discussed. Finally, the importance of the team and the human factors that are at play are touched upon.

Keywords Endotracheal tube; extubation; intubation; oxygenation; tracheostomy

Royal College of Anaesthetists CPD Matrix: 1C01, 1C02, 2A01, 2C02, 2C05, 3C00

Learning objectives

After reading this article you should:

- recognize the challenges airway management in the intensive care unit (ICU) presents to the clinician
- be aware of the equipment that may be on an ICU difficult intubation trolley
- be familiar with a suggested difficult airway algorithm for the ICU
- understand that human factors are a major contributor to success or failure in airway management in the ICU (as elsewhere) and that communication and practice may improve performance of the team

Case history

A morbidly obese 67-year-old woman presents to the emergency department at approximately 1500 hours with abdominal pain. She is diagnosed with acute pancreatitis. She is hypotensive and requires vasopressors to maintain a mean arterial pressure of greater than 65 mmHg. Her heart rate is 110 beats per minute. Her oxygen saturations are 94% while receiving 10 litres/minute of O_2 via a Hudson mask and her respiratory rate is 27 breaths per minute. She is transferred to the intensive care unit (ICU) for ongoing management.

Despite initially appearing to be stable on a low dose of norepinephrine, in the hours following her admission to the ICU she deteriorates and by 0200 her breathing has become increasingly laboured, her respiratory rate rises to 38 and her saturations have fallen to 84% despite optimal management. It is decided to intubate her trachea to allow invasive ventilation. The medical staff in this ICU overnight consists of an internal medicine trainee with 1 year of full-time intensive care training to date and a junior resident. The on-call intensivist resides 20 minutes away. A call to the anaesthetic department reveals that the covering anaesthetist is currently busy in the operating theatre and unable to attend for some time. The patient is unable to comply with non-invasive ventilation and is becoming increasingly agitated and hypoxic.

As the case below illustrates, airway management in intensive care unit (ICU) patients has a number of challenges that differ from management in other settings. These issues can be divided into the following categories: patient related; environment related; and staff related. Box 1 summarizes some of these difficulties.

Patient factors

Patients in intensive care are subject to many factors that make managing their airways prone to problems. They often require exogenous support of various organ functions. The lack of cardiovascular reserve requires extreme care on the part of the intensivist in terms of their choice of airway management techniques, especially regarding induction agents with their attendant possibility of cardiovascular collapse. The indications for intubation in ICU often relate to failure of the respiratory system, meaning that the period of time before dangerously low oxygen saturation levels are reached after sedation is commenced is likely to be very limited. As well as limited cardiopulmonary reserve, critically ill patients may have impaired renal, hepatic and/or neurological function, adding other dimensions of complexity. The need to intubate a patient for ventilation in the ICU is rarely predictable, thus making a potentially full stomach (which may be exacerbated by gastroparesis in this patient group) and the attendant risk of aspiration a significant issue. In addition, the indications for intubation in critically ill patients are usually time critical, thus removing the option of delaying until other staff are present or of allowing the patient to recover from the effects of the induction agent and attempting intubation at another time. Finally, ICU patients are more likely to have a poorer Cormick and Lehane grade view at laryngoscopy than other patients (that is, more difficult to visualize vocal cords on direct/conventional laryngoscopy).

Environmental factors

The environment at the bedside in intensive care can be very crowded. Potentially, a patient's room may contain multiple

Miles Beeny *MBBS FRACP FCICM FANZCA is a Consultant Anaesthetist at The Peter MacCallum Cancer Centre, Melbourne and Cabrini Hospital, Melbourne and an Intensivist at Knox Hospital, Melbourne, in Victoria, Australia. He is an adjunct lecturer at Monash University, Melbourne. Conflicts of interest: none.*

Please cite this article in press as: Beeny M, Management of the airway in intensive care, Anaesthesia and intensive care medicine (2016), http://dx.doi.org/10.1016/j.mpaic.2016.09.001

Complicating factors in intensive care unit (ICU) airway management

- Bag mask ventilation is impaired by: upper airway oedema; increased incidence of obesity; and increased age
- Laryngoscopy may be impaired by: limited preoxygenation; higher incidence of anatomical abnormality; and neck immobility (e.g. in C-spine injury)
- Cricothyroidotomy may be more difficult due to the width of the bed and positioning of the patient
- Extraglottic devices may be more challenging to use, due to increased airway resistance and decreased pulmonary compliance of ICU patients

Box 1

infusion pumps, a ventilator, a haemofilter, monitors, and even an extracorporeal membrane oxygenation (ECMO) circuit. Additionally, ICU beds are often designed with multiple aims in mind, in particular, facilitating transport of the patient with all the above paraphernalia, preventing pressure sores and facilitating nursing care. These design aims may sometimes conflict with the need for easy access to the airway (e.g. the presence of multiple poles at the head of the bed). Additionally, other equipment that may be *in situ*, such as air mattresses, orthopaedic frames and cervical collars, may hamper rapid access to the airway in an emergency.

Staff factors

Many intensivists are airway management experts in their own right; however, the various pathways to entry to intensive care training (internal medicine, anaesthesia, emergency medicine as well as direct entry, among others) result in varying skill levels and degrees of comfort with airway procedures. It would seem intuitive that increased airway skills ought to lead to better outcomes. Certainly, the presence of a senior clinician with airway skills supervising the procedure has been shown to improve success in emergency intubations.[1,2]

At present, ICUs have widely varying medical staffing models, with very different levels of expertise with airway management, even among staff at the same institution. Additionally, the skill level and experience of ICU nurses with assisting at intubation may be significantly less than that of anaesthetic nurses who routinely assist intubation in the operating suite.

Securing the airway

Pre-oxygenation is a highly desirable step in preparing a patient for intubation. The increased reserve may allow for significantly greater time before desaturation occurs. Unfortunately, lung disease and the ability of the patient to tolerate a facemask may decrease the efficacy of preoxygenation in the ICU setting. Note that sitting the patient at 25–30° of elevation may increase the efficacy of pre-oxygenation and may also enhance the view at laryngoscopy.[3]

Drugs

The most common induction method used to secure the airway in the ICU is a modified rapid sequence induction (RSI). The physiological considerations referred to above make the use of the predetermined, weight-based dosing of the standard RSI (based on the doses required for healthy, ambulant members of the population) unwise and even hazardous in ICU patients. The most commonly used drug for induction, propofol, causes direct depression of myocardial function and alters sympathetic output, leading to a fall in arterial tone. This combination of effects commonly results in significant hypotension.

Alternative agents, such as ketamine and etomidate, have been proposed as more suitable for the critically ill patient. Both these agents have disadvantages however – ketamine may increase myocardial oxygen demand and etomidate has the well-documented side effect of adrenal suppression. Given the lack of familiarity many practitioners have with these agents and the ubiquity of propofol, an alternative approach may be preferred. The use of a fast-acting opioid (such as alfentanil or fentanyl) in order to ablate the sympathetic response to laryngoscopy, together with the use of a much lower dose of propofol, is the author's standard technique. Alternatively, awake intubation using a fibreoptic bronchoscope and topicalization of the airway with local anaesthetic may result in a more cardiovascularly stable intubation, provided there is adequate time to prepare for this course and the airway is not soiled with blood or other material that may prevent adequate visualization with the bronchoscope.

Muscle relaxant is commonly given as part of the standard and modified RSI. In the recent past, the agent usually chosen was suxamethonium due to its rapid onset and offset. Intensive care patients have a higher than normal incidence of contraindications to suxamethonium – its use is to be avoided in patients with burns older than 24 hours, hyperkalaemia, neuromuscular disease, and prolonged immobility. Due to these downsides, rocuronium is increasingly becoming the preferred muscle relaxant for RSI. This agent has a fast onset but a prolonged action. This prolonged action may be curtailed, however, by use of the specific reversal agent sugammadex, and the reduction in cost of this agent over recent years has removed ost concerns related to the long duration of the paralysis induced by rocuronium.

As a general rule, the minimum amount of a drug required to optimize intubating conditions and provide patient comfort should be used. The best guide to this outcome is the judgement of an experienced clinician, allowing for the specific circumstances encountered, rather than dogmatic adherence to specific guidelines regarding dosage and drug choice.

Equipment

An 'airway trolley' should be maintained in all ICUs with standard airway management equipment arranged in a clear and easily navigable manner; ideally, this trolley would share a basic layout and contents with similar trolleys in the operating theatre suite and the emergency department at the same institution. This reduces the risk of error for rotating medical and nursing staff from these departments (common in many ICUs) as well as providing ICU staff performing airway management tasks outside the ICU with a higher degree of familiarity with the equipment they may encounter. One approach is to colour-code equipment draws according to an airway management flow chart, grouping items likely to be used together or for a particular situation in the same areas. A suggested list of contents is in Table 1.

Certain classes of item merit further discussion.

Please cite this article in press as: Beeny M, Management of the airway in intensive care, Anaesthesia and intensive care medicine (2016), http://dx.doi.org/10.1016/j.mpaic.2016.09.001