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## Review

## Management of the airway in maxillofacial surgery: part 2

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## Abstract

Prediction of the difficulty of an airway is unreliable, and failure of one technique of management increases the likelihood of failure of subsequent interventions. Part 2 of this review describes strategies to avoid or mitigate the impact of failure, and the associated airway-related morbidity and mortality.

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*Keywords:* Airway management; intubation; laryngoscopy; risk factor

In part 1 we discussed our limited ability to predict if an airway will be difficult after induction of general anaesthesia. In real terms, a large Danish cohort study reported an overall incidence of difficult mask ventilation and difficult intubation at 0.66% and 1.86% respectively, with difficulty not anticipated in over 90% of cases.<sup>1</sup> Of note, 49.5% of the patients with difficult mask ventilation were also difficult to intubate (0.33% all cases), with intubation failing in 0.02% of patients. Failure to manage these patients appropriately can result in “can’t intubate, can’t ventilate”, which is reported to occur in 0.02% of general anaesthetics, with the need for an emergency surgical airway reported as 0.06/1000 general anaesthetics.<sup>2,3</sup> This review discusses planning for failure, the relevance of human factors, and the possible adverse consequences of management of the airway.

## Planning for failure

It is reasonable to agree how to deal with the airway before anaesthesia. An effective strategy comprises a series of

plans for oxygenation in the event of first line management being unsuccessful. In some high stakes cases, there may be only one plan. The plan should take into account the knowledge and expertise of the clinical staff, type and availability of equipment, and the impact of human factors and non-technical ability on performance. Optimum management relies on effective, collaborative communication between surgeon, anaesthetist, operating department practitioner, and theatre staff. The team leader should clarify the airway strategy during the theatre team briefing, with final confirmation of all elements made during the WHO (Surgical Safety Checklist) sign-in. Specifically, the competence of staff should be confirmed before airway-related tasks are allocated, with identification of likely problems, their solutions, and triggers to transfer from one plan to the next during management of the airway.<sup>4</sup>

*Avoidance and mitigation of failure*

*Positioning of the patient:* optimal positioning of the patient’s head and neck in the “sniffing” position (flexion of the sub-axial cervical spine with atlanto-occipital extension) improves ventilation by mask by increasing the pharyngeal space, and it maximises the chance of successful direct

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laryngoscopy.<sup>5–7</sup> In obese patients this is best achieved by placing them in a “ramped” position where the external auditory meatus and suprasternal notch are horizontally aligned.<sup>8–11</sup>

#### *Preoxygenation and peroxygenation*

Preoxygenation before induction of general anaesthesia prolongs the apnoea time before the onset of hypoxia, which provides more time for laryngoscopy, intubation,<sup>12,13</sup> and rescue of the airway. Adequate preoxygenation has been defined as an end-tidal (expired) oxygen concentration of 87–90%.<sup>13</sup> Preoxygenation is recommended for all patients.<sup>14</sup>

A recent addition to the anaesthetist’s armamentarium is “transnasal humidified rapid-insufflation ventilatory exchange” (THRIVE).<sup>15,16</sup> Its physiological basis is a ventilatory mass flow of oxygen (apnoeic oxygenation) into the alveoli secondary to a negative pressure gradient of up to 20 cm H<sub>2</sub>O, which is created by unequal alveolar absorption and excretion rates of oxygen and carbon dioxide, respectively. A prerequisite is that the patient’s airway must be maintained, otherwise a ventilatory mass flow cannot occur. Clinically, THRIVE has been used during airway management in anaesthetised, apnoeic patients with difficult airways, and this is termed “peroxygenation”.<sup>17</sup> In this context, THRIVE increases median (IQR) apnoeic times up to 14 (9–19) minutes, while maintaining arterial oxygen saturation  $\geq 90\%$ .<sup>18</sup> In terms of ventilation, end-tidal and arterial carbon dioxide increase by 0.12 kPa min<sup>-1</sup> and 0.24 kPa min<sup>-1</sup>, respectively.<sup>19</sup> The evidence supports the use of peroxygenation – that is, THRIVE – in all patients in whom it is anticipated that management of the airway will be difficult.<sup>17</sup>

#### *Adequate neuromuscular blockade*

Neuromuscular blockade facilitates management of the airway by improving chest compliance and suppressing laryngeal reflexes, although there is concern that it may cause the airway to collapse. Recent data have shown that neuromuscular blockade with rocuronium, a rapid-onset muscle relaxant, improves mask ventilation, and that this benefit extends to patients who it has been predicted will be difficult to ventilate by mask.<sup>20,21</sup> With respect to laryngoscopy and intubation, the avoidance of muscle relaxants increases the chance of difficult tracheal intubation.<sup>22</sup> In a recent Cochrane review, the risk of difficult intubation was increased by the avoidance of muscle relaxants (RR 13.27, 95% CI 8.19 to 21.49).<sup>23</sup> When faced with difficulty it is important to ensure adequate muscle relaxation, particularly if one is faced with “can’t intubate, can’t ventilate”.<sup>17,24</sup>

#### *Choice of laryngoscope*

We discussed the advantages of videolaryngoscopy in part 1 of this review. Specifically, videolaryngoscopy is associated with a reduced incidence of failed intubation.<sup>25</sup> In the context of unanticipated difficult intubation, it is reasonable to change technique from direct to videolaryngoscopy, provided that the equipment and expertise is available.

In an ideal world, the airway strategy should be discussed for each patient. However, our experience is that these dis-

cussions are typically reserved for cases when difficulty is anticipated or known. In the event of unanticipated difficulty it is essential that all theatre team members are aware of what the priorities are with respect to that patient. To address this need, the United Kingdom Difficult Airway Society and the American Society of Anesthesiologists developed guidelines for unanticipated airway difficulty in adult, non-obstetric patients.<sup>24,26</sup> In this review we will concentrate on practice in the UK.

#### *Difficult Airway Society Guidelines for unanticipated difficult intubation<sup>24</sup>*

These guidelines set out a strategy to manage the unanticipated difficult airway, which can be viewed online.<sup>24</sup> It is recommended that all members of the theatre team are familiar with these guidelines so that everyone is “on the same page” when an unanticipated difficulty with an airway occurs.

The guidelines focus on maintenance of oxygenation as the priority, rather than intubation itself, with emphasis on limiting the number of interventions to minimise any associated morbidity. To avoid deterioration to a state where ventilation is impossible as a result of laryngoscopy-related airway trauma, the Difficult Airway Society recommends that attempts at laryngoscopy should be limited to three, with a fourth attempt reserved for more expert assistance should it arrive. A key consideration is to avoid the repeated use of a technique that has failed. In some instances, the patient may need to be woken up, and the operation re-scheduled.

Each step of the strategy concentrates on the essential skills and techniques that have the greatest chance of success when one is faced with a difficult airway. The final step assumes that it is neither possible to intubate the patient, nor to ventilate the lungs through a face mask or supraglottic airway (“can’t intubate, can’t ventilate”). At this stage, surgical cricothyroidotomy is recommended using the scalpel-bougie technique, which is thought to be the best way to achieve a surgical airway, although an emergency tracheostomy is an option provided that the expertise and equipment are immediately available to do it rapidly.<sup>27</sup> The scalpel-bougie technique for surgical cricothyroidotomy is described in the Difficult Airway Society guidelines, and was also described by Frerk et al.<sup>24</sup> We have found a tracheal hook useful to stabilise the cricoid cartilage while we insert the tracheal tube.

Despite guidelines, improved equipment, and the expertise to deliver it all, airway-related morbidity and mortality are still possible. The impact of human factors and non-technical skills on management of the airway cannot be ignored, particularly when the difficulty has not been anticipated.

#### **Human factors and non-technical skills in the management of the airway**

There is increasing recognition of the way in which human factors and non-technical skills adversely affect human per-

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