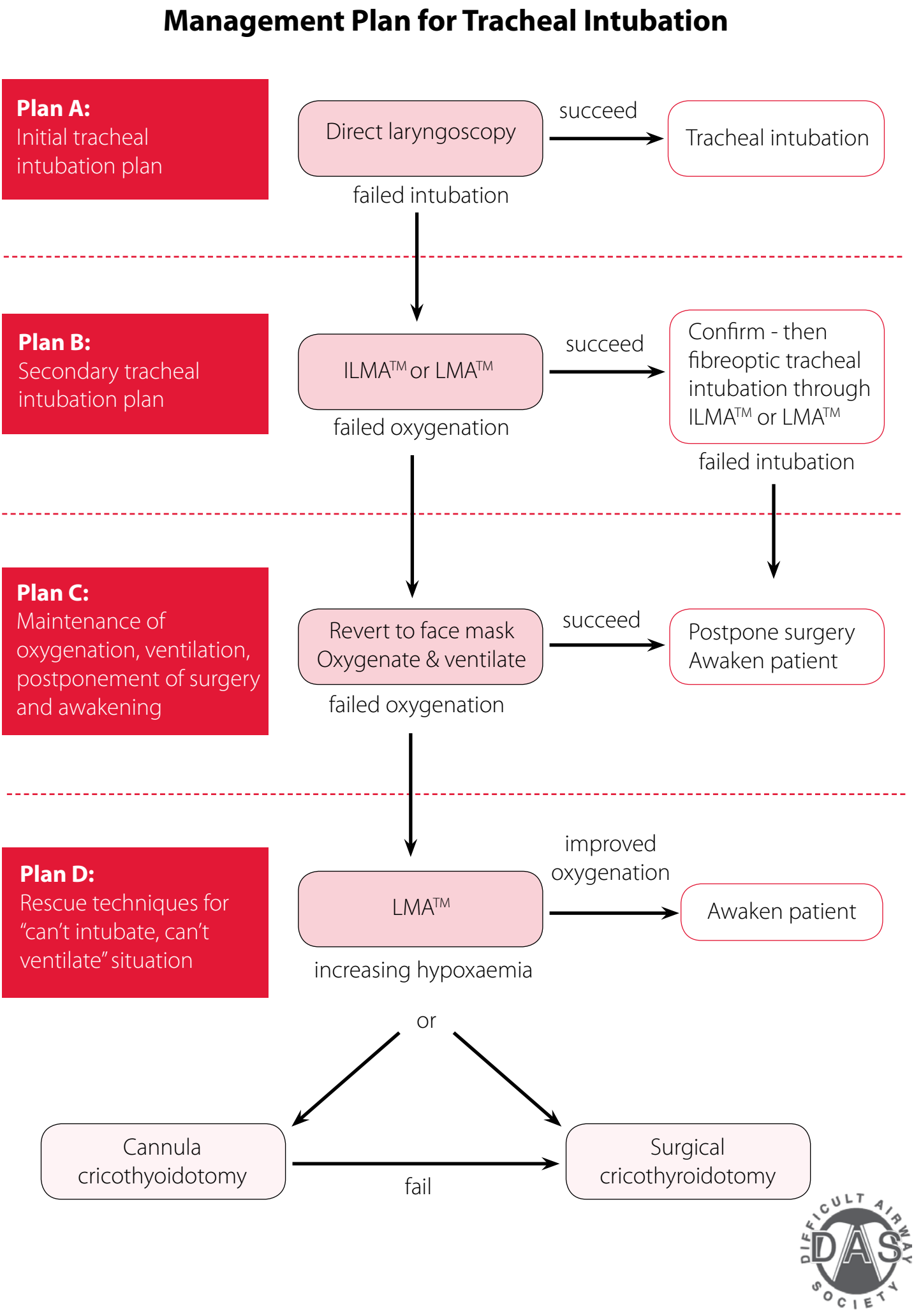

Figure 1. *Reproduced by kind permission of the Difficult Airway Society (UK) and available for download at*: www.das.uk.com/files/simple-Jul04-A4.pdf

Management plan for tracheal intubation

Leonard Pott* and Arne Budde
*Correspondence Email: lpott@hmc.psu.edu

Summary

Oxygenation takes priority over everything else.

Avoid trauma by minimizing attempts.

Call for help early.

Plan carefully, for every case.

INTRODUCTION

Tracheal intubation is not the main objective of airway management – maintenance of adequate oxygenation is paramount and this can usually be achieved without intubation. The second objective of airway management is to achieve adequate ventilation, i.e. adequate oxygenation plus adequate CO_2 removal. The third objective is to secure the airway from aspiration.

For many years direct laryngoscopy and tracheal intubation has been the mainstay of airway management. While it is true that an endotracheal tube will achieve all three objectives, other techniques such as the various supra-glottic devices (Table 1) or a cricothyroid puncture can at least provide for adequate oxygenation and maybe more, and should therefore be important components of the airway management algorithm. Recently a number of different airway management techniques have been introduced. The use of fiberoptic bronchoscopy has become widespread and supra-glottic devices and video-laryngoscopy have resulted in very significant changes to clinical practice (Figure 2).

Various societies and national organizations have produced guidelines on the management of the difficult airway and intubation. One of the first, and probably the best known, is the American Society of Anesthesiologists (ASA) algorithm which was published in 1993 and revised in 2003.[1] The Canadian, Italian and French anesthesiology societies, amongst others, have also introduced algorithms. In 2004 the Difficult Airway Society (DAS) published their guidelines,[2] which are the subject of this overview and will be analysed in subsequent articles in this issue of *Update in Anaesthesia*.

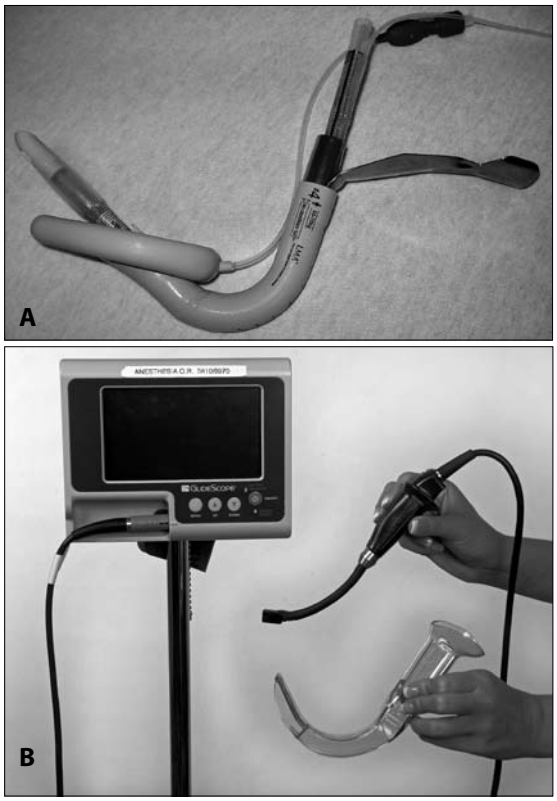

Figure 2. *Examples of airway devices – (A) the intubating laryngeal mask airway (ILMA) and (B) the GlideScope*

TYPES OF ALGORITHMS

An algorithm takes the clinician through a series of decisions and actions from a start point to a final

Table 1. *Airway devices*

Supraglottic airway devices	
	Laryngeal mask airway, ProSeal, Supreme, Air-Q, Slipa, Cobra, I-Gel, Intubating Laryngeal Mask Airway, CombiTube, EZ Tube
Indirect visual laryngoscopy	
Rigid:	GlideScope, McGrath, Pentax AWS, Storz, Bullard, Wu, C-Trach
Stylet:	Shikani, Levitan, Bonfils

Arne O Budde
Assistant Professor of Anesthesiology
Associate Residency Program Director

Leonard M Pott
Associate Professor of Anesthesiology and Emergency Medicine
Director of Advanced Airway Management
Penn State College of Medicine
Milton S Hershey Medical Center
Hershey PA
USA

outcome. Anyone designing an algorithm must first decide what the start point should be, and what will constitute an acceptable end state. In the case of the DAS algorithm the start point is when an attempt is made to intubate a patient who is not expected to have a difficult intubation. The construction of the ideal algorithm is difficult because some of the characteristics of the ideal algorithm are contradictory (see Table 2)

Table 2: *Characteristics of the ideal algorithm*

1. Feasible
2. Short (not too much detail)
3. Simple to memorize
4. Covers all possibilities
5. Effective
6. Provides choice
7. Specific (limited or no choice at each point)
8. Deals with anticipated and unanticipated difficult intubations.
9. Evidenced-based

The ASA algorithm is very thorough and offers many choices to the clinician, but this means that it is also complex which limits its clinical usefulness.[1] Studies have shown that many anesthesiologists do not, and perhaps cannot, memorize the algorithm. The DAS algorithm on the other hand offers a binary outcome at each point with no, or very limited choice, with the intention that the definitive and simple flow-charts will be easier to use.

COMMENTARY ON ALGORITHM

The DAS algorithm specifically deals with the ***unanticipated*** difficult tracheal intubation, and consists of a series of plans - Plan A, Plan B, Plan C and Plan D. The structure of the basic algorithm is shown in Figure 1. The basic algorithm is modified depending on the clinical scenario, either routine induction or rapid sequence induction (with an increased risk of aspiration).

The DAS algorithm has been deliberately designed to provide limited choices at each decision point, in order to make it more memorable and easier to follow under stressful circumstances. The DAS algorithm assumes that optimal attempts have been made at direct laryngoscopy including patient positioning, the use of external laryngeal manipulation, an appropriate choice of tube and the use of a gum elastic bougie (Eschmann tracheal tube introducer).

Plan A

Plan A of the DAS algorithm emphasizes that it is necessary to "limit the number and duration of attempts at laryngoscopy in order to prevent trauma and development of a 'can't ventilate, can't intubate' situation." It is difficult to justify use of the same direct laryngoscope more than twice and the maximum number of laryngoscope insertions should be limited to four. However, tracheal intubation may be successful when it is performed by a more experienced anesthetists and one such additional attempt is worthwhile.

Plan B

Plan B requires a change to an alternative technique - there is no point in continually attempting the same technique and expecting a different outcome! The DAS algorithm specifically recommends the use of a Laryngeal Mask Airway (LMA) or Intubating LMA. This recommendation may be changed depending on the specific local conditions. Other supra-glottic devices are acceptable, as would other intubating techniques such as video-laryngoscopy, with the proviso that adequate expertise and equipment are available.

Plan C

Plan C emphasizes the importance of allowing the patient to wake and postponing surgery. This may not always be possible, but it is definitely the safest course of action. When the patient is awake and able to maintain and protect their own airway, then further management can be planned. At this stage the patient is known to have an anticipated difficult airway, which is briefly discussed below.

Plan D

Plan D describes the management of the 'cannot ventilate, cannot intubate' situation. This is a life-threatening situation which is rare, but must be dealt with immediately, and is discussed in more detail in a subsequent article.

Limitations of the DAS algorithm

The DAS algorithm does not cover the anticipated difficult airway, nor does it address prior recognition of a challenging airway. The algorithm also does not deal with the obstetric patient or the paediatric patient.

Anticipating the difficult airway

It is very difficult to predict all difficult intubations. Some clinical situations, such as severe facial trauma and large intra-oral tumors, may be clear-cut, but identification of more borderline cases is a challenge. Tests such as the Mallampati classification, the thyromental distance, the mandibular protrusion and many others have been proposed but none can accurately predict difficult laryngoscopy. Even combinations of these tests cannot provide high levels of sensitivity (predicting cases that will be difficult) or specificity (predicting cases that are not difficult).[3] Part of the problem is that the tests only examine patient factors and do not account for the skill of the intubator. It is therefore appropriate to have a clear plan for the difficult intubation for every case undergoing anesthesia.

All patients must be examined prior to induction of anesthesia. The airway examination must consider the following questions:

Management of an anticipated difficult airway

If difficult intubation is anticipated, always consider whether the proposed surgery can be done under regional anesthesia. Regional techniques are advantageous because the patient can remain awake and can protect and maintain their own airway. However, even in cases when regional anesthesia will be used, a thorough airway examination and appropriate planning must still be done. Patients receiving local anesthesia may develop an anaphylactic reaction, may have a high neuraxial block, or may require conversion to a general anesthetic technique during the procedure. Regional techniques reduce, but do not eliminate, the risk of loss of airway control.

If the answer to Question 1 (Table 3 - will it be possible to bag mask ventilate (BMV) this patient?) is 'No', do not induce general anesthesia, and be cautious about administering sedation. If a regional

Table 3. *Preoperative airway assessment*

1. ***Will it be possible to bag-mask ventilate (BMV) this patient?***
   Indicators of difficulty include a beard, facial trauma, no teeth, history of snoring and sleep apnoea.
2. ***Will it be possible to insert a supra-glottic device?***
   Indicators of difficulty include a small mouth opening, large pharyngeal masses, grossly distorted anatomy.
3. ***Will it be possible to intubate?***
   Indicators of difficulty include small mouth opening, large tongue, severe bleeding, abnormal dentition, inability to move the mandible or neck, and abnormal findings using the various tests mentioned above.
4. ***Will it be possible to perform a cricothyroid puncture?***
   Indicators of difficulty include a very short neck, radiation fibrosis, severe obesity, and a large thyroid goitre.

technique is not possible and the patient requires intubation, then consider awake fiberoptic intubation where the facilities are available. If you do not have the equipment or the necessary skill to perform an awake fiberoptic intubation, then other awake techniques can be done. For example, with adequate topical anesthesia an awake LMA or Intubating LMA can be inserted.[4]

If the answer to Question 1 is 'Yes', then general anesthesia can be induced, provided that adequate preparation has been made for the subsequent airway management. Especially important is to pre-oxygenate the patient thoroughly. A gas induction using halothane has been well-described. Gas induction using sevoflurane should only be performed by experienced anaesthetists since the rapid onset of anaesthesia and the limited metabolism of this agent may result in deep anaesthesia, apnoea and/or airway obstruction. It is far better to use an induction agent such as propofol or etomidate which is rapidly redistributed and allows the patient to wake up fast. Avoid the use of muscle relaxants until it can be shown that airway patency can be maintained after induction. If muscle relaxants are used, use suxamethonium (succinylcholine) in preference to long-acting neuromuscular blocking agents.

The contra-indications to the use of a supra-glottic device are still not clear. For example, in patients with GORD (gastro-oesophageal reflux disease) some people would use a supra-glottic device with a gastric reflux relief tube, such as the ProSeal LMA, while others would not. The same applies to the use of a supra-glottic device in the lateral and prone positions. In the absence of evidence, the choice depends on the operator's familiarity and level of comfort with the device.

A supra-glottic device can also be used as a conduit to place an endotracheal tube, as discussed in a subsequent article. Various other techniques exist which are beyond the scope of this article. For a detailed discussion of this topic, reference 3 is useful.[3]

Extubation algorithm

Any difficult intubation requires careful planning for the extubation. Recently various extubation algorithms have been suggested.[5] First the patient must meet the normal extubation criteria, such as demonstrating adequate tidal volumes and appropriate muscle strength. The cuff leak test (deflating the endotracheal tube cuff after suctioning the pharynx) checks that there is not excessive airway edema. As part of the extubation strategy following difficult intubation, most authors suggest the insertion of a tube exchanger (such as the Cook airway exchange catheter) through the endotracheal tube before the patient is extubated. The endotracheal tube is then removed, leaving the tube exchanger in place. Oxygen can be insufflated via the tube exchanger, and in case of respiratory decompensation a jet ventilator can be attached to the tube exchanger and used to oxygenate and ventilate the patient. Do not use a jet ventilator unless you have been specifically trained in its use. Jet ventilation can be associated with significant morbidity and even mortality. Re-intubation over a tube exchanger is associated with a high success rate, even in cases of a difficult initial intubation. It is recommended that an endotracheal tube one or two sizes smaller should be used. If the patient tolerates extubation well, then the tube exchanger can be removed. A further discussion of aspects of extubation is available in the previous edition of *Update in Anaesthesia*.[6]

CONCLUSION

All patients who have had a difficult intubation should receive a letter describing the difficulty with the airway, which techniques were used, and recommendations for future anesthesia. One copy should be placed in the patient's file, and the other copy given to the patient.

Airway emergencies can occur unexpectedly so familiarity with the management algorithms is essential. Appropriate training must be provided to everyone providing airway management, and the hospital management must ensure adequate functioning equipment.

REFERENCES

1. American Society of Anesthesiologists Task Force on Management of the Difficult Airway. Practice guidelines for management of the difficult airway. An updated report. *Anesthesiology* 2003; **95**: 1269-77.
2. Henderson JJ, Popat MT, Latto IP, Pearce AC. Difficult Airway Society guidelines for management of the unanticipated difficult intubation. *Anaesthesia* 2004; **59**: 675-94.
3. Drolet P. Management of the anticipated difficult airway – a systematic approach: Continued Professional Development. *Canadian Journal of Anesthesiology* 2009; **56**: 683-701.
4. Shung J, Avidan MS, Ing R, Klein DC, Pott L. Awake intubation of the difficult airway with the intubating laryngeal mask airway. *Anaesthesia* 1998; **53**: 645-9.
5. Murphy MF, Crosby ET. The Algorithms. In: Management of the difficult and failed airway. (ed) Hung O, Murphy MF 2008. McGraw Hill Medical, New York.
6. Jubb A, Ford P. Extubation after anaesthesia: a systematic review. *Update in Anaesthesia* 2009; **25**,**1**: 30-6.