Airway Update

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Traditional ideas regarding the "difficult airway" are being challenged. This may be just as well since we are not very good at predicting it. What does "difficult mask ventilation" mean when shaving a beard makes it easy, or when insertion of a supraglottic airway can be performed awake or as a rescue technique? What does "difficult intubation" mean when an awkward Gd 3 direct view with a Macintosh blade becomes a Gd 1 VL view with a McGrath? What does "failed intubation" mean when a routine fibreoptic intubation is performed instead of an impossible laryngoscopy?

The development and refinement of new and existing airway equipment is influencing ideas about assessment, planning, performance, and documentation of airway management. The over-arching importance of oxygenation from induction to recovery is being re-emphasized as the glue that holds the multiple facets of airway management together.

Evolution of Equipment

The profound impact of the original LMA has been extended by 2nd generation supra-glottic airways. Starting with hands-free convenience for the anaesthetist, the indications for use now include rescuing of difficult airway situations, minimizing airway stimulation and protecting the airway from ENT bleeding. The second generation SGA's have extended the applications by providing access to the stomach and achieving a higher seal pressure, in particular making positive pressure ventilation safer and more effective. The proseal LMA has been particularly useful in adults and children but there is a development race to perfect the supraglottic triumvirate of high seal pressure, gastric access and conduit for intubation. The AirQ provides a good airway and conduit for intubation but gastric access is prototypical. The Auragain is a good device with effective gastric access. Intubation with normal sized tubes is readily achievable over a bronchoscope. The current version is slightly stiff at the tip which may make insertion difficult.

Video-laryngoscopes (VLs) with traditional or highly angulated blades are challenging the supremacy of direct laryngoscopy (DL) in routine practice. The longevity of nuanced DL is perhaps threatened by the simplicity and ease of VL. It is said that VLs can make difficult DL easy and easy DL difficult. With markedly angulated blades, difficulty visualising the glottis is replaced by difficulty locating the tip of the endotracheal tube, requiring specialised stylets. Airway bleeding or soiling can render VL techniques useless where DL techniques are invaluable.

The flexible bronchoscope remains the gold standard for management of most supraglottic airway challenges. Failure to use the technique when indicated was highlighted in NAP4. Barriers to appropriate use have perhaps increased due to the popularity of VL and attendant risk of inadequate training and exposure to bronchoscopic techniques. Barriers to using video-bronchoscopes have been reduced with the advent of the single use a-Scope from Ambu, the latest iteration of which is excellent for routine use. The unit cost of disposable bronchoscopes is similar to the processing and repair costs for re-usable scopes in our department.

The emergence of electronic record keeping in systems such as Safer Sleep make it possible to create comprehensive user friendly templates to record the detail of airway management, and could tie in with national databases and alert networks for complex patient airways.

Evolution of Drugs

Sugammadex allows exquisite control of the neuromuscular junction that has been blocked by rocuronium. Post-apnoea oxygenation is maintained longer with non-depolarising rocuronium than with depolarising succinylcholine and reversal with 16mg/kg sugammadex is faster than spontaneous offset with succinylcholine. This presumes that an adequate quantity of sugammadex is immediately

available, preferably in 5ml (100mg/ml) ampoules. The combination of rocuronium and sugammadex is attractive for higher risk rapid sequence intubations but is tempered by issues related to cost (sugammadex), allergy (rocuronium) and the impact of other induction drugs on the return of spontaneous ventilation.

Emphasis, Assessment and Strategy

Maintenance of oxygenation is assuming its rightful position as the over-arching concept driving airway management decisions from induction to recovery. NAP4 has had considerable influence with renewed emphasis on assessment and planning, front of neck access (CICO) and extubation issues. Airway algorithms have evolved from complex top-down decision and equipment flowcharts (ASA) to more simplified strategic plans (DAS) with the latest DAS iteration due out this year. The "Vortex" model is a useful visual concept that combines key airway decisions with dynamic oxygenation.

Placing oxygenation at the forefront of assessment and planning, helps shift emphasis toward patient-centric rather than tool-orientated airway management. Airway assessment then includes not only the key techniques (mask ventilation, supraglottic airway placement, laryngoscopy, front of neck access) but also systemic patient factors that influence the speed and consequences of hypoxemia and other complications. These include pre-oxygenation, apnoeic oxygenation, haemodynamic compromise (e.g ICU patient), ventilation-perfusion inequality (e.g obesity) and aspiration. A common thread in induction-related airway crises is running out of time due to failure of oxygenation. Benumof's desaturation curves may not apply in the critically ill or the inadequately pre-oxygenated patient with shunt. Desaturation to 85% may be as short as 23 seconds in critically ill patients compared to 8-9 minutes in healthy adults.

Running out of time may also reflect lack of comprehensive planning. There has been considerable emphasis on having a Plan B and C (DAS) but a comprehensive Plan A to prevent trouble happening might sometimes be lacking. Global assessment and planning should also include which rescue plans might be futile. (e.g inaccessible mouth or front of neck) A strategic framework that includes the finite possibilities for management of any patient's airway can be a useful tool for planning purposes and helps avoid the trap of blindly following an algorithm or of doing what normally works in normal patients.

This might include options for :

1. Consciousness: Awake (VL look, SGA, FOI, Tracheostomy, Extubation)
   Asleep; (Depth of anaesthesia, reversibility of relaxant)

2. Oxygenation: Spontaneous Breathing (Assisted, CPAP, Lung volume)
   Apnoeic (Pre-O2, Apneic -O2, CMV, Transtracheal)

3. Techniques: Positioning, Facemask/adjuncts, SGA, DL/VL/ETT, FOBI,
   Combinations of above.

Extubation / Emergence

There has been considerable emphasis on maintaining oxygenation before and after extubation since NAP4. The airway challenges facing the anaesthetist are often similar in magnitude to those at induction but made worse because:

1. It is more difficult to control emerging consciousness, reflex arcs, respiratory control and neuromuscular function, than it is to titrate sedation or render a patient unconscious and paralysed.

2. Airway management and respiratory function is influenced by surgery, analgesia, and the impact of residual anaesthesia and neuromuscular blockade.

3. Planning and preparation may be overlooked, complicating the response to a post-extubation crisis.

4. Control may have been delegated to PACU or ICU staff.

Basic clinical criteria for awake extubation include spontaneous ventilation, optimal lung volume, pre-oxygenation, airway toileting, demonstrated reversal of neuromuscular blockade, normo-thermia, haemodynamic stability, minimal volatile anaesthetic and a calm, comfortable, responsive patient.

The Cook Staged Extubation Kit includes a long soft wire and an airway exchange catheter both of which are surprisingly well tolerated by patients after extubation. It seems to be a sensible bridging technique between extubation and full patient autonomy when there is known airway difficulty, or when there is potential for difficulty to evolve because of oedema, infection etc. Hazards associated with the inappropriate use of long airway exchange catheters, particularly related to depth of insertion (direct trauma to the lung and barotrauma with high pressure oxygen) must be borne in mind.

Can't Intubate, Can't oxygenate

While the optimal techniques for front of neck access are being debated, the need for emergency oxygenation by this route in a CICO crisis is clearly established.

Needle cricothyrotomy

An attempt to locate a 14G cannula in the trachea is unlikely to cause direct harm, but it is essential to positively identify the tracheal lumen (free aspiration of air) and to quickly move on to a scalpel technique if identification is not or will not be possible e.g unclear anatomy or trauma/blood in airway.

The application of trans-tracheal oxygen from a high-pressure source can be either life-saving or life-threatening depending on the end-user. Clarity regarding safe techniques for emergency transtracheal oxygenation is developing rapidly. A single 1L breath of O2 in healthy post-apnoiec sheep with completely obstructed upper airways, can reinflate collapsed lungs and provide 5 minutes of normal oxygenation. The emphasis is rescue oxygenation followed by definitive management rather than normocarbia with its attendant risks of air trapping and barotrauma.

The Ventrain is a new device for transtracheal ventilation that can jet oxygen at high flows and low pressure as well as provide active expiration via a transtracheal catheter. It can achieve rescue oxygenation and normocarbia but the manual co-ordination required to use it safely may make it unsuitable for emergency use. The Rapid-O2 is a much simpler t-piece like device that works well for rescue oxygenation and provides palpable feedback to the user at higher airway pressures. Both these devices are flow controlled and when attached to a flowmeter open to 15L/min, will deliver 250ml O2 per second through a 14G cannula. The Manujet is pressure controlled. It is important to dial the pressure on the device back to 1bar and at this setting it will also deliver 250ml/sec O2 via a cannula but there is no pressure feedback. The manujet may be particularly useful if pressure needs to be titrated up to allow adequate forward flow of oxygen when the upper airway is relatively open.

CICO is fortunately a rare event but by definition it is highly stressful and there will be severe time pressure. An important human factor issue is the role of the arriving help and the asking of the key question that enables the emergency algorithm to unfold... "Is this a CICO?". We have attached CICO kits, (with cognitive aids based on the Heard algorithm techniques (needle cricothyrotomy, scalpel-bougie and scalpel-blunt dissection)) to our anaesthetic machines in all anaesthetising locations in Wellington Hospital. A rapid-O2 device is in each kit and the difficult airway cart also has a Ventrain (post-emergency sustained TTJV) and a Manujet (open airway). We are providing training that combines bench practice, simulation and wet labs (anaesthetised sheep) and at the time of writing approximately 30 senior staff have taken part.

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