Review Article



# Oral cancer anaesthesia emergencies

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**Abstract:** Oral cancer is the seventh most common cancer in the world today and trends show an increasing incidence. Patients with this disease present, electively or in an expedited manner, for surgical intervention as treatment or as part of a multi-modal oncological approach. Patients can also present in emergency situations with complications related to their malignancy or its treatment; which in the main relate to bleeding, obstruction, reconstructive free-flap failure or post-operative tracheostomy problems; all of which can create challenges for the anaesthetic team. The purpose of this review is to present strategies that can be applied in these settings, where time critical and complex decision making is required. Significant airway bleeding impacts all aspects of airway management and can create challenges in carrying simple interventions such as effective pre-oxygenation or using more advanced techniques such as awake intubation or videolaryngoscopy. There can be failure in standard approaches and so a more pragmatic approach can be required in crisis situations. Novel techniques have their place but not all anaesthetists will have the skills or experience to execute these. Preparedness for surgical front of neck access is therefore required. Peri-operative obstruction, tracheostomy complications and free flap reconstruction salvage all present their own challenges and anaesthetists need an array of techniques within their armoury, combined with excellent non-technical skills, to address an array of pathologies in time pressured situations.

**Keywords:** Airway; bleeding; obstruction; oral cancer

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## Introduction

### *Background*

Oral cancer refers to cancer of the tongue, lip, buccal mucosa, floor of mouth, and oropharynx; base of tongue, soft palate and tonsils. It is the seventh most common cancer in the world with over 700,000 new cases per annum (1). Incidence is increasing, with the disease affecting males at a rate almost twice that of females. It is are associated with tobacco, alcohol and Epstein-Barr virus and human papilloma virus (HPV), specifically HPV-16. Although there are many oncologic treatments, surgery is often required, either in isolation or as part of a multi-modal approach including adjuvant radiotherapy, chemotherapy or immunotherapy.

Evidence from 4$^{th}$ National Audit Project demonstrated disproportionate representation of head and neck malignancy patients in its reported cases; with 40% cases coming from this group (2). Upper airway cancer can cause anatomical distortion, reduced and painful mouth opening, increased tissue friability, increased risk of iatrogenic trauma, airflow limitation and increased airway difficulty; for example, with disease extension into the tongue base limiting tongue protrusion, prior radiotherapy causing a less compliant airway or symptoms of collateral tissue invasion, such as trismus. More generally, these patients have associated cardiorespiratory co-morbidities and/or poor nutritional status resulting in increased perioperative risk, even in elective settings.

Emergency anaesthetic involvement in this group relate, in the main, to obstruction, bleeding, free flap failure and tracheostomy problems; all increasing risk with the impact of hypovolaemia, hypotension and hypoxia on the comorbid organ systems.

### *Rationale and knowledge gap*

Complications relating to bleeding and airway obstruction can present significant anaesthetic challenges. Although haemorrhage control and resuscitation have widely accepted treatment approaches, there is no defined approach or guideline for managing airway bleeding or obstruction due to the large variance in presentation, disease location and severity of symptoms. By focusing solely on oral and oropharyngeal disease, we can to provide readership with general decision making strategies for this subgroup of patients with airway disease.

### *Objective*

The objective of this review is to provide the journal readership with an appreciation of the challenges in managing emergencies in patients with oral cancer and provide a template for decision making in generating their airway strategy.

This review will focus on the most significant and common emergency situations that the anaesthetist may be presented with in managing patients with oral malignancy. These are namely; obstruction, bleeding, free-flap failure and post-operative tracheostomy problems. The strength of this review is that it offers simple decision making suggestions that anaesthetists can utilise when formulating their airway strategy. These are realistic solutions to anaesthetic challenges, that recognise that practicioners and institutions have different skill sets and equipment at their disposal. The limitations mainly lie in the level of evidence that supports these solutions. These are not based on high levels of evidence such as randomized trials but are gathered from expert opinion, consensus and case reports.

### *The obstructed airway & oral cancer*

Although laryngeal and tracheal malignancies are more common causes of airflow limitation, obstruction in the larger volume oral cavity or oropharynx is more likely a marker of advanced disease or a complication of surgical treatment. Lip, tongue, hard palate or floor of mouth cancer are unlikely to cause respiratory distress by themselves though the complication of an expanding mucosal, tongue or floor of mouth haematoma will cause significant oral obstruction and challenging intubation conditions. Likewise prolonged tongue retraction related swelling from Transoral Robotic Surgery (TORS) can create an oral access challenge should re-intubation be required post-operatively. Tonsillar and tongue base malignancy tend to invade inwards rather than becoming significantly exophytic but a tendency to obstruct, even in lesser disease, will be influenced by any concurrent conditions such as male pattern obesity or obstructive sleep apnoea.

Any surgery or anaesthetic intervention to the airway risks compromise at extubation or subsequent post-operative deterioration. Airway surgery presents a risk of extubation failure and patients should be assessed to determine appropriateness for extubation, deferred extubation or tracheostomy. Duration of surgery and the nature of direct surgical trauma are significant risk factors and should be considered in addition to any pre-operative airway difficulty including patient factors such as obesity, obstructive sleep apnoea and reintubation difficultly, in determining the safest approach. Where reintubation is likely to be very difficult or if there is concern over efficacy of oxygen delivery, a deferred/delayed extubation following a period in ICU or tracheostomy should be actively considered. Intra-operatively, teams should aim to avoid any unnecessarily prolonged use of surgical access devices such as Boyle-Davis mouth gags, tongue retractors or surgical suspension. Risk of post-operative airway deterioration can be minimised by the use of peri-operative steroid to reduce odeama, head-up nursing and avoidance of excess fluid administration. In high risk patients, administration of high flow nasal oxygen (HFNO) is warranted post-operatively. These patients should have extended stays in the post-anaesthetic care unit or be nursed in areas with closer observation and monitoring capabilities such as a High Dependency Unit, if possible. Staff should observe for signs such as increased work of breathing, swallowing difficulty, changes to pattern of breathing or agitation. This is in addition to changes in routinely monitored physiological parameters as part of Early Warning Scores, as well as capnography via adapted facemask or nasal prongs. Stridor and desaturation are late signs. Prompt senior clinical review should occur if any concern exists amongst any team member.

### *Management of airway obstruction*

Anaesthetists around the world benefit from guidance

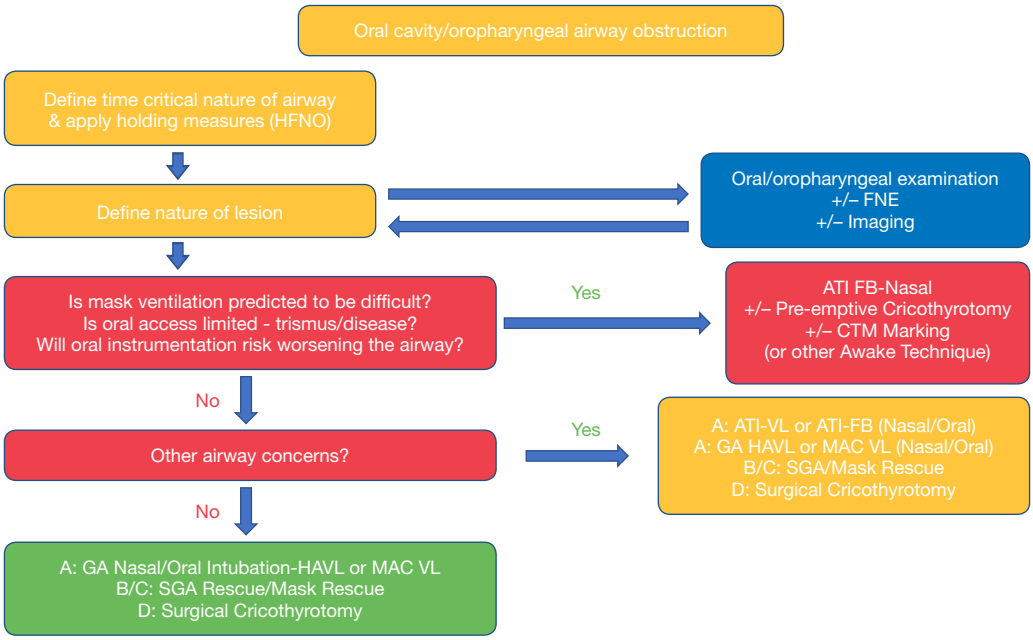


**Figure 1** Mental model approach to oral cavity/oropharyngeal airway obstruction. HFNO, high flow nasal oxygen; HAVL, hyperangulated videolaryngoscopy; MAC VL, MacIntosh Videolaryngoscopy; SGA, supraglottic airway; ATI-FB, awake tracheal intubation with flexible bronchoscope; FNE, flexible nasendoscopy; CTM, cricothyroid membrane.

on airway management from groups such as the Difficult Airway Society (DAS) (3). However, as yet, there remains no algorithm for the management of airway obstruction due to the variation in pathology and presentation. There is general consensus around key treatment principles and ethos in decision making that can be applied to these situations (4). Application of holding measures, such as HFNO or raumatiz adrenaline have been common practice for many years and can allow teams involved more time to assess, plan and execute considered airway strategies.

Within all strategies, oxygenation is the priority; before and during any efforts to secure a definitive airway. Within the context of an oral malignancy, this is no different and options still include awake insertion of an endotracheal tube orally or nasally using a flexible endoscope, direct laryngoscopy, videolaryngoscopy (VL) or by a front of neck airway (FONA); surgical cricothyrotomy or tracheostomy. Standard rescue techniques involving supraglottic airways (SGA) have an important role although may be impacted by trismus or significant oral obstruction. Primary approaches and rescue techniques will have context specific advantages and limitations. The job of the anaesthetist is to decide on the strategy that addresses urgency, patient state and compliance, pathology, concurrent airway difficulties, equipment available and their skill in using it. A general outline to major decision-making questions is shown in *Figure 1* although it must be understood this may not address every clinical connotation.

First one must define the clinical urgency based on presence of distress and predicted course of deterioration. Applying holding measures such as HFNO is beneficial is almost all obstructive settings and may allow time to assemble further team members and equipment. In the context of obstruction in the oral cavity or oropharynx, the provision of HFNO is unlikely to cause harm. Its advantages are well known; it is well tolerated, provides excellent oxygenation provided there is a degree of airway patency, and has work of breathing and positive airway pressure benefits which may improve the degree of obstruction (5). The administration of raumatiz adrenaline may allow some symptoms relief, as would intravenous steroid if an oedematous element was involved although specific evidence for both therapies is lacking despite widespread use in airway obstruction.

One must make effort to define the obstructive lesion to aid decision making on best strategy. Emergency cases may not allow time for investigation to define the obstructive lesion. A CT scan may be warranted in more distal

obstruction, if it can be performed safely and time allows. Direct light assisted oral cavity and pharyngeal examination is likely possible and may provide sufficient information in this setting for airway management decisions. Rapid access to a flexible nasendoscope (FNE) will provide information on any pharyngeal or tongue base disease that cannot be visualised transorally. Surgical presence at time of FNE is useful. Identifying the obstructing lesion allows one to judge best airway management considering the impact on manual ventilation, instrumentation, the ability to bypass a lesion and preservation of a sagittal visual plane to the glottis, directly or indirectly. FNE also has a role in assessment of postoperative anterior neck haematoma, following any associated neck dissection. Any neck haematoma causing airway compromise should be addressed before airway management with clot evacuation in the same manner suggested after other anterior neck surgeries (6). The 2021 joint DAS/ENT-UK/BAETS consensus guideline on haematoma after thyroid surgery has utility beyond its initial scope and this must be recognised. The core messages around awareness, close observation, recognition of signs of evolving obstruction (DESATS), initial actions and escalation to senior colleagues is paramount in all cases of airway surgery.

Anaesthetists must then determine if a technique under general anaesthesia (GA) is safe or if an awake approach should be implemented. They must ask themselves if mask ventilation is likely to be difficult, with specific focus on limitations to oral access from trismus or disease. A reduction in space within the oral cavity limits the ability to perform basic airway management or utilise oral adjunct use if mask ventilation is suboptimal. Likewise, achieving indirect or direct glottic views through laryngoscopy is significantly impaired by oral access and instrumentation angles may prove this to be impossible. As such, one should be directed to an awake flexible endoscopic technique or a video assisted flexible intubation (VAFI) approach to address the limitations presented. VAFI requires two operators and combines the manoeuvrability of an endoscope with the creation of space and wide angled supraglottic view provided by VL use to offer the user maximal airway visualization and optimal conditions for intubation.

Finally, before embarking on airway management, another specific factor to consider is potential for additional trauma with airway instrumentation and worsening the situation. There should be no blind techniques in modern airway management, especially in this group. Oral airway insertion and laryngoscopy can raumatizi oral or oropharyngeal tissues so insertion of any airway device should be done with respect to the tissues. This is of particular importance in base of tongue disease where the risk of bleeding is high. Right sided oral and oropharyngeal disease is also more prone to laryngoscopy related trauma. If the risk of worsening the airway is high, again, the use of an awake endoscopic nasal intubation is warranted. One can give consideration to accessing the contralateral nostril, in raumatizin oropharyngeal disease both to minimise tube related trauma and improve surgical access.

In obstructed cases, awake techniques are often preferred but these additionally require a compliant patient who will tolerate the intervention, although these patients are likely to be less distressed than those with glottic obstruction due to the nature of disease presentation. HFNO may improve compliance by addressing any concurrent respiratory distress, hypoxia and any work of breathing compromise (7). Careful sedation may be required to achieve a more compliant patient. A pre-emptive needle cricothyrotomy or cricothyroid membrane marking may be considered when there is significant oral cavity obstruction as oral rescue strategies, if the airway is lost during interventions, are unlikely to succeed. All awake techniques are feasible in this setting and the DAS guideline for awake tracheal intubation is an excellent resource (8). Awake intubation should be performed with the patient in the sitting position but patients may adapt their own position to one that allows them to breathe easier. This should be allowed in order to preserve patient compliance. The technique should combine HFNO, minimal sedation and effective airway topicalization to optimise success. A flexible endoscope passed nasally will best facilitate intubation, bypassing any oral cancer related disease, if the nasal passage can be successfully navigated. Although there is growing trend in awake VL as a technique, one can see the limitations here within a group of patients with trismus and intraoral pathology. Cases resulting from obstruction by an expanding floor of mouth or tongue haematoma can make VL insertion impossible and so the technique becomes obsolete. When the clinical situation indicates, VL use can displace tissue in the oral cavity, create space in the pharynx and present a more familiar wide aspect and orientated view of the airway (9). Use of a hyper-angulated device, with its camera aligned along the pharyngeal wall facilitates passage of the nasally passed tube, addressing the sometimes "tricky" skill of passing a heavily styletted oral tube "around the corner".

An uncompliant patient, intolerant of an awake approach

**Pre-operative causes**
Abnormal vasculature secondary to malignancy
Systemic disease (Haemophilia, platelet disorder)
Drug induced coagulopathies
Prior chemoradiotherapy

**Intraoperative causes**
Airway instrumentation
Vascular tissue damage
Abnormal/tortuous vasculature
Accidental vessel damage
Highly invasive procedure
Difficult surgical access

**Post operative causes**
Wound dehiscence
Infection
Coagulopathy
Failure of vessel ligatures

**Figure 2** Risk factors for bleeding in oral malignancies.

may require riskier levels of sedation or GA to gain control. Administration of sedation to achieve control for airway management describes a Delayed Sequence Induction (DSI), whereby sedation to given to allow pre-oxygenation or other peri-intubation procedures such a positioning to occur (10). This is a useful approach in emergency airway management for patients with altered mental status. A DSI separates hypnotic and muscle relaxant administration to a greater degree than a Rapid Sequence Induction, to allow more effective preoxygenation. A slow bolus of a dissociative dose of ketamine (1 mg/kg with additional aliquots of 0.5 mg/kg titrated) is administered so that pre-oxygenation can be achieved. Neuromuscular blocking drugs are administered once intubating conditions are optimised. Another approach is that of undertaking a high-risk induction of general anaesthesia. This should be performed as a "double set-up" technique with equal preparedness for intubation and eFONA in relation to role allocation, equipment readiness and personnel in the room (11). The cricothyroid membrane (CTM) should be marked with the neck in extension. An ultrasound probe can be used to locate this or to at least locate the midline if there is difficulty with CTM identification. Once the "double set-up" is ready, induction of anaesthesia is followed by optimal videolaryngoscopy with a low-profile blade, coupled with preparedness for optimal supraglottic rescue, mask ventilation and FONA rescue. Optimal attempts at each aspect of airway management should include all efforts to optimise success such as external laryngeal manipulations, adjunct use, secretion management and impact of muscle relaxation. Induction in this setting should be prompt and by the intravenous route to separate anaesthesia delivery and airway management. Inhalational induction is not advised due to significant limitations; such as worsening obstruction with ongoing negative pressure inspiratory effort and prolonged duration of induction.

Of course, rescue with a SGA may be less reliable due to the impact of the obstructing lesion, concurrent trismus or previous radiotherapy. Second generation SGAs are preferred in airway rescue to their higher oropharyngeal seal pressure and gastric drainage facility. However, as choice of device may be dictated by mouth opening, first generation devices can still have some role in situations whereby a second generation cannot be passed due to their slight increased profile. Failure to achieve an airway here should prompt transition to an alternative technique. If insertion is successful, anaesthetists will find themselves within the "Stop and Think" stage of the DAS failed intubation guidelines (3). Communication between anaesthetist, surgeon and operating room staff is key at this stage. Continuing a case with an SGA still in situ will impede surgical access and may be discounted from options to proceed with. A secondary intubation plan involving an Aintree Intubation CatheterTM (AIC), airway exchange technique, or tracheostomy are therefore likely to be required.

## Oral cancer—the bleeding airway

Bleeding is a common issue in patients with malignancy, with events ranging from minor oozing to profuse haemorrhage with catastrophic consequences. Risk factors for bleeding associated with oral malignancies are shown in *Figure 2*.

Spontaneous tumour bleeds can occur; most are minor and will have little bearing on anaesthetic management. Iatrogenic bleeding from airway instrumentation against friable disease is an issue and can be minimised with meticulous and considered approach. Advanced oral or oropharyngeal disease can invade adjacent structures and can reach vessels near the skull base. Recurrent disease, especially in irradiated tissues carry higher bleeding risk which is likely to be more significant (12,13).

The presence of blood in the airway impacts all aspects airway management through impairment of visualisation, risk of airway contamination and obstruction. Profuse oral bleeding with clot formation within the distal airway can result in complete airway obstruction. Of course, not all oral bleeding will be visualised. Increasing tongue swelling or

tongue displacement against the hard palate from haematoma is unlikely to cause haemodynamic instability but can create significant challenges in airway access as outlined above.

Management of bleeding can be grossly subdivided into three main areas: resuscitative management of haemorrhage; airway management; surgical control of bleeding. Aspects relating to surgical management are beyond the scope of this article but may include pre-emptive transcervical ligation of external carotid artery branches prior to TORS procedures given that the incidence of post-operative haemorrhage can be as high as 9.8% (14-16). Active bleeding control measures include direct pressure on the lesion if accessible; vessel embolisation or revision surgery for haemostasis (17). The anaesthetic approach is dictated by the severity of active bleeding, which in turns determines the time critical nature of haemorrhage control and airway management decisions. These situations are tasks for two anaesthetists; one to manage bleeding and resuscitation and one to focus on the airway. Sharing the work will reduce mental burden.

Measures should be taken to prevent or minimize severity of bleeding. The use of Tranexamic Acid in elective or scheduled surgery is increasing beyond its original indication in trauma and emergencies patients. Coagulation can be optimised by good peri-operative temperature control. Coagulation can be checked intra-operatively if the patient is bleeding more than normal and tests such a thromboelastography can be used to better target deficiencies affecting clot formation, platelet function and fibrinolysis.

## Management of haemorrhage

Oral bleeding can be significant, and patients may present with airway compromise as well as physiological derangement secondary to major haemorrhage. If time permits, it is preferable to initiate fluid resuscitation before securing the airway, as onset of anaesthesia may further exacerbate physiological instability. In reality, if blood loss has been severe enough to cause compromise or is ongoing, airway control will be equally time critical and so will happen alongside resuscitation. Whilst detailed stepwise approach to the management of a major haemorrhage can be found elsewhere, key aspects would include providing care in an upright position, if blood pressure allows, to aid with clearing the airway of blood, simple compression to the bleeding point if it is identifiable and accessible, careful fluid resuscitation via robust IV access, tranexamic acid administration, red cell support through transfusion and reversal of coagulopathy. Patient reassurance is crucial as this is a very distressing and frightening experience.

### *Management of the bleeding airway*

This is a challenging scenario and one with high risks of failure as these scenarios can have an anatomical, pathological, physiological and a situationally difficult airway; all at the same time. This topic is addressed in depth by Kristensen (18) in an excellent review of airway management in upper airway bleeds.

There is no algorithm for the approach to the bleeding airway as variation in underlying pathology, activeness and quantity of bleeding, and underlying airway issues means no one approach will fit all scenarios. As with any airway emergency, basic principles and approaches can be applied but senior surgical and anaesthetic input, team discussion and preparedness for FONA are key components of success. A gross structure is outlined in *Figure 3*, however unique situational combinations may generate a need for a more nuanced approach or less raumatiz techniques requiring operator skill that some may not have.

Adequate oxygenation throughout is essential but application may be difficult due to patient distress and need for repeated suctioning. This may be achieved with standard binasal cannula or face mask as tolerated. Cautious sedation may be required to allow more effective administration of oxygen throughout management in the distressed patient. Ketamine's sedative effect combined with preservation of respiratory drive may be useful option. HFNO is relatively contraindicated, as it may force blood distally into the bronchial tree. It is though, an excellent therapy in difficult airway management and is often well tolerated in the agitated patient, more so than a tight-fitting facemask. Administration of moderate flows (<20 L/min) may provide a more balanced risk profile by providing sufficient oxygenation whilst still allowing oral access for suctioning and patient expectoration of blood. Humidification of gas is likely to mean a higher flow rate is tolerated compared to standard cold dry gas when passed nasally so some benefit is still likely to be achieved even at much lower flows (<10 L/min).

With bleeding above the glottis, only a cuffed endotracheal tube, passed orally, nasally or via front of neck airway (FONA), will guarantee ventilation; prevent further contamination and provide surgical access to achieve haemostatic control. Options for securing the

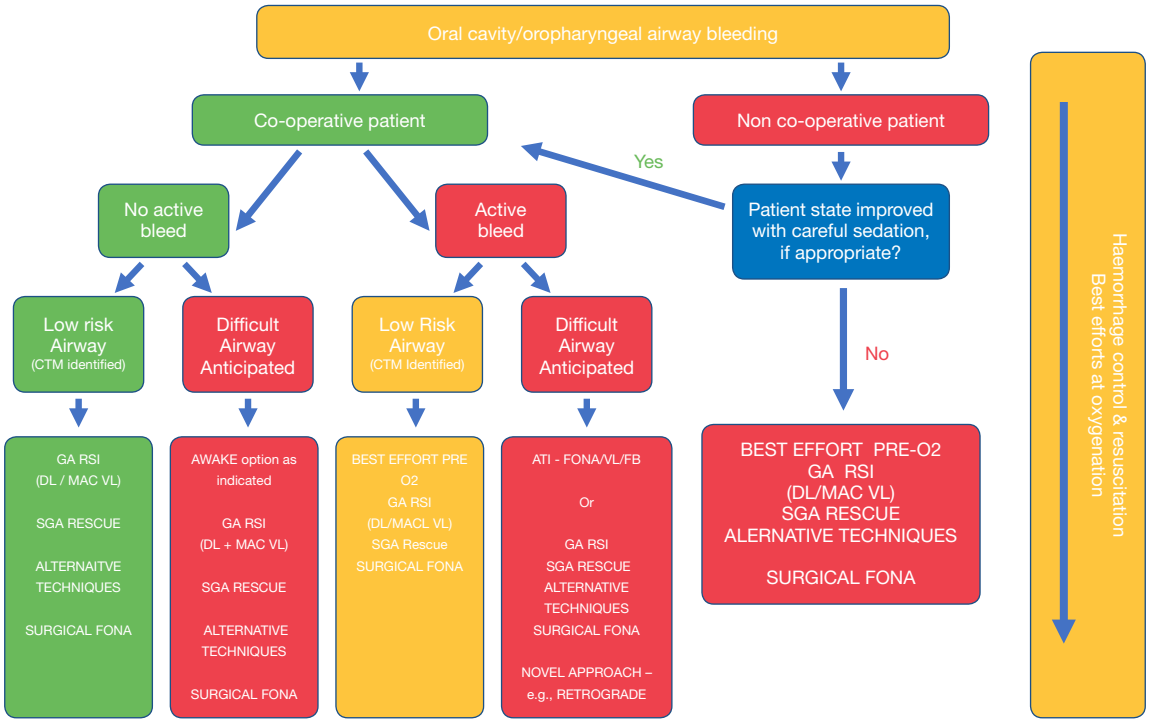


**Figure 3** Mental model for approach to oral cavity/oropharyngeal airway bleeding. DL, direct laryngoscopy. MAC VL, MacIntosh Videolaryngoscopy; GA, general anaesthesia; RSI, rapid sequence induction; SGA, supraglottic airway; FONA, front of neck access.

airway include rapid sequence induction (RSI) of general anaesthesia (GA) with a double set-up technique (11), awake oral/nasal intubation or awake surgical cricothyroidotomy or tracheostomy. Decisions on strategy will factor in patient compliance, briskness of bleeding, the time critical nature of the situation, anticipated difficulties in airway management, available equipment and operator skill using such equipment. Concurrent obstruction will add further considerations to be factored. SGAs do not provide definitive lower airway protection but successful placement does provide a position of relative safety and airway control, allowing time to prepare a secondary intubation technique. Awake tracheostomy may be feasible if time allows and the patient can tolerate a more supine position. Rescue FONA with scalpel cricothyroidotomy is the end point of all emergent strategies.

### *General anaesthesia for airway management in the bleeding airway*

Induction of anaesthesia is warranted when assessment does not suggest difficulty in direct laryngoscopy and the cricothyroid membrane is palpable or identifiable by other means such as ultrasound. Unanticipated difficultly must still be planned for. If a general anaesthetic technique is decided upon then a Rapid Sequence Induction (RSI) is suggested with best effort pre-oxygenation, accepting the need for essential suctioning, with two available suction units. Any cricoid pressure, if used, should be removed at first sign of difficulty in any aspect of airway management. RSI may also be indicated in situations of significant non-compliance to allow an awake technique in a time critical situation. A DSI approach may have application if meaningful pre-oxygenation cannot be achieved. GA in the uncompliant bleeding airway is a very high risk undertaking but a crisis situation may still warrant it when other 'preferred' awake options may just not be feasible. Surgical presence and equal preparedness for eFONA is essential.

Videolaryngoscopy (VL) in the actively bleeding airway has had its detractors with concerns over camera soiling and loss of view. Choosing a VL device that allows direct laryngoscopy is recommended; VL with mounted Macintosh type blade (Mac Blade), such as the McGrath™ Mac (Medtronic, Dublin Ireland), the Glidescope®

DirectView (Verathon, Bothwell, USA) or Storz C-MAC® (KarlStorz Endoscopy, Tuttlingen, Germany) still allow effective direct laryngoscopy if the camera becomes soiled. Hence assessment for DL capability, as above, is crucial. When not soiled, the Mac Blade VL device will still provide all the benefits of video-laryngoscopy, both technical and non-technical. The VieScope (Adroit Surgical, Oklahoma, USA) is an interesting line of sight rigid laryngoscope, with a bevelled blade comprising an enclosed circular tube. It has been studied in various scenarios (19) but not specifically in the bleeding airway. Its design, however, is one that should allow a protected line of sight glottic view from surrounding bleeding tissues.

If the glottis is visualised, unnecessary suctioning should not preclude intubation. If blood is hindering intubation, directed suctioning to allow visualisation should be applied. The suction catheter should be placed in the oropharynx and moved to the left side of the mouth, behind the inserted laryngoscope for ongoing decontamination as laryngoscopy and intubation is undertaken. Once the airway is secured, a suction catheter should be passed into the bronchial tree before starting ventilation to minimise distal contamination. Suction assisted laryngoscopy and airway decontamination (SALAD) has gained some popularity for massive airway contamination scenario (20,21). This technique combines both pre-emptive and continuous pharyngeal suctioning with ongoing airway management in an attempt to reduced aspiration and improve airway visualisation. Once a definitive airway is established and bleeding is controlled, one can consider formal therapeutic bronchial lavage if required.

SGAs can be useful as a channel for ventilation in situation where intubation has failed. Use of a device, designed to also facilitate intubation is ideal. Second generation SGAs will provide a better oropharyngeal seal and many now facilitate a conduit intubation. They will provide some airway protection, acting as an "umbrella" over the glottis from the proximal source of bleeding. A flexible endoscope to allow visualised direct railroading of an endotracheal tube or Aintree Intubation Catheter™ exchange can follow. If the endotracheal tube is passed directly over the endoscope through the SGA, the continuing presence of the rescue SGA will likely impact surgical access to control bleeding. In this situation an airway exchange catheter, or preferably an Aintree Intubation Catheter allowing visualized placement, will be required to enable safe SGA removal. These exchange techniques can be carried out once airway control and a period of stability has been achieved (22,23).

### *Awake techniques for airway management in the bleeding airway*

Awake technique may be indicated when there is predicted airway difficulty in primary or any likely rescue techniques. A relatively compliant patient increases the success of any awake option with the briskness or degree of bleeding in the oral cavity also having a major impact on camera-based techniques such as awake VL or flexible endoscopic intubation. Awake tracheal intubation may be orally, nasally or via pre-emptive FONA with cricothyroidotomy or tracheostomy.

If deemed the primary technique, awake intubation using the principles of DAS ATI guide should be applied with obvious caveats for the bleeding airway. Oxygenation is delivered by best tolerated means, whether by HFNO on lower flows, nasal prongs/sponge or facemask. Nasal local anaesthesia (LA) and vasoconstriction can be administered if a nasal airway is planned but further airway topicalization may be redundant in the presence of blood due to dilution effect and reduced mucosal contact. Any sedation administered must be well considered against need to maintain protective reflexes. Remifentanil, with its added benefit of reversibility, and dexmedetomidine have lower risks of over sedation than propofol but should still be used cautiously. Despite limitations in airway topicalization, the blood itself often acts as a lubricant and patients tolerate awake intubation quite well.

As stated, there is no algorithm for airway management in the bleeding airway due to the number of variables involved. Sometimes novel approaches may be required and many have been reported. Retrograde intubation uses a guidewire or epidural catheter, inserted via the identified cricothyroid membrane has been described at www.airwaymanagement.dk/retrograde (24). Light guided techniques, such as light wand intubations (25), or ultrasound guided techniques have also been described (26). These techniques however require previous familiarity with the equipment required, and may be limited by the need for a second operator or limited view due to the presence of blood. Rescue or pre-emptive cricothyroidotomy or tracheostomy may be required in the event of failed airway management or if the preoperative assessment displays likely airway difficulties. Post-operatively, the patient should be cared for in the most appropriate place for airway protection and physiological monitoring, often in a critical

 

care unit.

### *Oral cancer—flap failure*

Radical surgery for oral cancer followed by reconstruction of head and neck defects with microvascular free flaps is considered the gold standard of surgical management (27). Success rates are high; however, flap failures do occur in up to 6% of cases; with risk increased by patient co-morbidity, ischaemic time during harvest, need for intra-operative pedicle revision or suboptimal intra-operative or post-operative physiological control. Despite this, flap failure is often difficult or impossible to predict at initial surgery (28). Post-operative monitoring for signs of flap failure is a crucial part of care of this patient group. Early detection permits early salvage. Flap observation for color, swelling and capillary refill combined with doppler assessment of the vascular are commonly used.

A return to theatre for salvage presents a significant burden for the patients, both aesthetical and psychological, but also pose important challenges for the medical team (29).

### *Management of failed flap*

In the event of flap failure, revision surgery is normally undertaken to: try and re-establish flow and salvage the flap; remove the failed necrotic flap or perform a second flap reconstruction. Whilst the best option for flap management remains a surgical prerogative, anaesthetists will face significant challenges in the management of these patients. There will considerable non-technical stressors involved in the management of these patients, including surgical desire to intervene quickly to try and salvage the flap and patient anxiety. Although surgical intervention to rectify flap failures are time sensitive, most causes are generally not associated with an immediate threat to life thus allowing time for a considered approach.

Knowledge of the original airway management is useful and should be used in conjunction with knowledge of how the airway has changed, the nature of the airway at extubation and what impact this will have on subsequent success. Depending on the cause of flap failure, the anaesthetist may face bleeding or significant swelling. Those with a covering tracheostomy present less airway challenge provided this not the cause for their return to theatre. Patient that have not received a tracheostomy will present with a significantly distorted upper airway and should have had a reintubation plan handed over and documented for the night team to consider. Swelling may make mask seal and ventilation difficult and airway instrumentation more challenging. Suture lines will be fresh and more susceptible to traumatic damage during airway instrumentation.

Awake techniques remain the preferred option, as the use of a fibreoptic scope allows direct visualisation of the anatomy and correct identification of the glottis and distal airways. Secretions may be problematic and require targeted suctioning, orally and endoscopically. The nasal route will most likely be the preferred route to secure the airway. If oral access allows, a slim profile hyper-angulated VL blade can utilise less  raumatizing lifting forces and allow better visualised suctioning to facilitate awake nasal tube insertion. This, of course, can also be done asleep if safety of inducing anaesthesia allows. Nonetheless, it should be noted that most flaps have their vasculature anastomoses within the neck vessels. Therefore, surgical intraoral access may not be necessary and the oral route can be used in these cases. Pre-operative discussions with the surgical team will help airway decision making. Ultimately, securing the airway via the oral or nasal route may not be possible, or safe to achieve. In this case a planned front of neck airway may be necessary prior to flap salvage surgery.

### *Tracheostomy*

Historically, most head and neck cancer operations have been performed in conjunction with a tracheostomy. This surgical doctrine was a consequence of perceived benefit of a front of neck airway when bulky reconstructive flaps in the oral cavity might have predisposed patients to post-operative airway complications (30). Nonetheless, the evidence in favour of prophylactic tracheostomy is lacking and in view of their associated complications risks, scoring system have been designed to aid clinicians' decision making on which patient group would benefit from a tracheostomy at the time of initial surgery (31). Incidence of complications associated with tracheostomies are as high as 8% (32) and include obstruction, false passage creation and dislodgement. The importance of good tracheostomy care by well trained staff and the use of tracheostomy tubes with inner liners, facilitating rapid reversal of luminal obstruction, cannot be stressed enough. A structured approach is advocated in approaching the concerning tracheostomy and anaesthetists should be aware of how to manage these in accordance published guidance, including the use of bed-head safety signs and educational material available from institutions such as the National

Tracheostomy Safety Project (30). These issues are more thoroughly addressed within the Postoperative and Critical care reviews as part of this series.

## Conclusions

Anaesthetic emergencies in patients with oral or oropharyngeal malignancy can be challenging to address but it does not require complexity. Peri-operative teams can manage these scenarios well by utilising haemorrhage control, ranging from simple pressure to interventional radiological measures, implementing well considered decision making around airway strategy, delivering exemplary tracheostomy care and ensuring good communication with surgical and anaesthetic colleagues.

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