Airway Management in Facial Trauma Patients

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Abstract

Airway management in craniofacial trauma patients is a challenge for an anesthetist. Treating these patients requires a close interdisciplinary communication and cooperation. Maintaining the airway and oxygenation of the patient is the initial challenge in craniofacial trauma patients. The management of the difficult airway is facilitated and patient’s safety improved by following one of several published difficult airway algorithms. We describe the St. Gallen difficult airway algorithm for the management of difficult airway in general and the airway in facial trauma patients in particular. Whenever possible, the airway should be secured in a conscious and spontaneously breathing patient. It is important to be familiar with different techniques and to change the approach after two unsuccessful attempts with one technique. Once the airway is established, all available preventive measures should be used to avoid losing the airway. A tracheotomy has its place in a significant number of patients in whom an immediate postoperative or a delayed extubation appears unfeasible.

Keywords
► airway management
► facial trauma
► algorithm
► difficult airway

In facial trauma patients, the anesthetist primarily intends to maintain the airway open. The complexity of the trauma with involvement of the upper airway, often accompanied by concomitant brain and spine injuries, frequently makes this a most challenging task.1

Maintenance of an airway may be challenging due to blood collections directly caused by the trauma,2 impaired mouth opening, or the immobilization of the cervical spine. These factors may impede mask ventilation and endotracheal intubation. In addition, trauma patients must be expected to have a full stomach by definition.

The concomitant cerebral and soft tissue trauma may cause an unpredictable and often highly dynamic obstruction of the airway. Therefore, the anesthetist is under pressure to secure the airway before the patient suffers dyspnea heralding imminent airway obstruction.2

Difficult Airway Algorithm

The difficult ventilation or intubation situation in elective or emergency cases is a well-known problem for each anesthe-
tist. Its management remains a challenge. Because of the high vital impact for the patient, many societies3–12 have published guidelines or recommendations to manage these difficult airway situations. These guidelines have proved to be very helpful in the management of the difficult airway as they allow anticipating the next step in the difficult airway management for all staff members. Therefore, in current anesthesia, these difficult airway algorithms are indispensable.11,13 Facial trauma patients have a difficult airway by definition, and it is obvious that airway management algorithms should be used in these patients.

The St. Gallen Difficult Airway Algorithm

At the Division of Anaesthesiology, Intensive Care, Rescue and Pain Medicine, Kantonsspital St. Gallen, in St. Gallen Switzerland, a simple algorithm has been introduced in the early 1990s and subsequently has been validated by Heidegger et al.14 The base of the St. Gallen algorithm is the American Society of Anesthesiologists difficult airway algorithm.11,15–17 It has been adapted to our situation and our
resources. Since the introduction and validation of the algorithm, the process has not been changed substantially, but the laryngeal mask has been added and the feasibility of mask ventilation is no longer checked before neuromuscular blockade (Fig. 1).\textsuperscript{18}

The algorithm is based on three fundamental principles:

1. The difficult airway should be secured in the spontaneously breathing patient.
2. The anesthetist should only use techniques he/she masters.
3. The approach must be changed no later than after the unsuccessful second attempt.

It appears not to be important which technique is applied to secure the airway in conscious patients. The anesthetist must be well trained in the use of different techniques and use them often.\textsuperscript{19}

A bronchoscopy-guided intubation is the preferred method for handling the anticipated difficult airway.\textsuperscript{14,20–23} The transnasal route is chosen, because patients better tolerate the transnasal passage of the tube after decongestion and topical anesthesia of the nasal mucosa (we use 0.5 mL of a 10% cocaine hydrochloride solution) compared with the transoral route.\textsuperscript{24} Epistaxis and fractures of the skull base need not to be contraindications;\textsuperscript{25,26} as long as the endoscope and the tube are inserted and advanced under visual control and not in a blind way.

To ensure a smooth sliding of the tube over the bronchoscope, we use only spiral reinforced tubes with an inner diameter of 6.0 mm (RüschFlex armored tracheal tube, cuffled, Willy Rüschi GmbH, Kernen, Germany). This size is sufficient for adequate ventilation, while the difference in diameter of the bronchoscope and the tube is small enough to pass the nasal cavity without clinical relevant injury to the nasal mucosa, the septum, or the turbinates. A bronchoscope with an outer diameter of 5.0 mm is preferred to an outer diameter of 4.0 mm to minimize the diameter difference. In addition, the image quality, the maneuverability, and the rigidity of the 5.0-mm bronchoscope are superior.

Failure to manage the airway by bronchoscopic intubation calls for a different approach. Securing the airway in spontaneously breathing patients with extraglottic devices (laryngeal mask, laryngeal tube etc.) or through direct or indirect laryngoscopy is considered difficult. Alternatively to bronchoscopic intubation, we prefer a needle laryngoscopy,\textsuperscript{27,28} after injection of local anesthesia of the prelaryngeal skin and the tracheal wall, a Ravussin cannula (13G Jet Ventilation Catheter acc. to Ravussin, VBM, Sulz, Germany) is passed into the tracheal lumen. The correct placement is checked by aspiration of air and/or sidestream capnography. This transtracheal 13G cannula permits sufficient ventilation using a transtracheal jet ventilation device.\textsuperscript{28,31,32} After ensuring oxygenation of the patient, the airway can be definitively secured without time pressure. Both jet ventilation\textsuperscript{28,33} and Ventrain,\textsuperscript{24,35} are good options for mechanical ventilation. Jet ventilation is a well-established technique for ventilating through small-caliber cannulas and is considered to be safe.\textsuperscript{28,33} Of note, safety of the method depends on clinical expertise.\textsuperscript{19,33} The most important advantage of the Ventrain system is the active expiration, permitting transtracheal ventilation in completely obstructed airways. While the Ventrain system is the method of choice in total or near-total airway obstruction, the jet ventilation is preferred in patients without airway obstruction.

Our experience shows that jet ventilation significantly facilitates establishing a definitive airway: The continuous positive airway pressure opens the airway, and the well-audible sound of ventilation gas outflow is altered after correct placement of the tracheal tube. Depending on the situation and the trauma pattern, the choice of subsequent airway management, such as conventional laryngoscopic, video laryngoscopic or bronchoscopic intubation, or tracheotomy, may be performed without time pressure.

At the author’s institution, the technique of transtracheal jet ventilation has also been introduced into the clinical routine for elective procedures,\textsuperscript{27} such as endolaryngeal surgery. The anesthesiology staff members are trained to perform the transtracheal punctuation and to use jet ventilation technique under optimal conditions. In addition, the ENT (ear–nose–throat) surgeon benefits from a perfect view to the larynx and trachea. Experience has shown the technique to be reliable and safe.\textsuperscript{27}

If both bronchoscopic guided transnasal intubation and transcutaneous transtracheal cannula placement fail, a surgical approach to the airway is mandatory. This may include a tracheotomy or a tracheotomy of the awake patient under local anesthesia. In our hospital, this exceedingly rare constellation is managed in cooperation between the most experienced anesthetist available and an ENT-head and neck surgeon.

**Intubation of the Patient with Facial Trauma**

Patients with maxillofacial trauma cannot be considered elective and may require intubation in two situations: first, when breathing spontaneously; second, when unable to sustain sufficient ventilation.

In patients with facial trauma the difficult airway must be expected, and one of the accepted management algorithms for the difficult airway should be followed. We proceed as described earlier following our difficult airway algorithm.

**The Sufficiently Breathing Patient**

As long as the patient manages to oxygenate autonomously without undue strain, measures for airway maintenance may be strategically planned and executed. If difficulties in airway maintenance are to be anticipated, a general consensus is to secure the airway in the spontaneously and autonomously breathing patient. This approach becomes more imperative the more indicators hint at an impending difficult airway.

The option of ventilating with a facial mask is difficult to predict and could be too uncertain in emergency situations. Data on difficult mask ventilation\textsuperscript{19,38} have been published for elective procedures, and the conclusions cannot be extrapolated to the facial trauma patient.
Even if facial mask ventilation is possible in facial trauma patients, a fracture of the skull base can lead to a tension pneumocephalus worsening the neurologic status.

The combination of a facial trauma with the risk of emesis or regurgitation due to a full stomach may also keep the anesthetist from attempting mask ventilation before hypoxia becomes manifest.

Even in elective situations we prefer to secure the airway in patients with maxillofacial trauma while they are awake; the main reasons are the unpredictability of mask ventilation, the
potential complication of a pneumocephalus, and the expected difficult intubation.

The Insufficiently Breathing Patient
The situation changes dramatically, if a respiratory incompetence manifests in a hypoxic patient, making immediate oxygenation the first priority.

As long as the patient is conscious, the management described earlier may be adequate under supportive mask ventilation, if feasible.

If the patient is unconscious, we recommend initiating mask ventilation, followed by one attempt at conventional laryngoscopic intubation. If this attempt fails, an alternative method is chosen immediately. The alternative choice will be based on best availability. Options are a laryngeal mask, video laryngoscopy, or bronchoscopy. If one of these secondary techniques fails, another will be tried. If the airway is still not established, an infraglottic access to the airway, be it a puncture coniotomy, a classic coniotomy, or a tracheotomy, must be executed without delay. In this situation the key to success is an interdisciplinary cooperation between anesthesiologist, ENT-surgeon, and neurosurgeon. Involving these disciplines early will improve patient safety.

Intraoperative Airway Management
Indications
Once initial airway management has secured oxygenation, it may become necessary to change to a different ventilation mode for surgical procedures pre- or intraoperatively. Changing from a nasal to an oral tube or vice versa is equally feasible. The authors strongly advise proceeding under visual control and protrusion of instruments and endotracheal tubes. The unpredictable and frequently impressive dynamic swelling of the airway should not be underestimated. Otherwise, a rapid worsening of the respiratory situation caused by edema, hematoma, intraluminal collection of secretions, and blood clots, or simple repositioning of the patient can blind-side the treating physicians. Therefore, any tube changing should be preceded by a careful endoscopic reevaluation of the airway, either by bronchoscopy or by direct or indirect laryngoscopy.

In cases that will most likely require a postoperative tracheostomy, an initial (preoperative), tracheotomy should be considered because it facilitates ventilation throughout the surgical procedure.

Techniques
Access to the airway may be secured with an airway exchanger. The device is inserted into the established airway. The intubation through an alternative route is then performed with the airway exchanger in place, acting as a guide to the airway in case the attempt at intubation is unsuccessful. There are many different methods to visualize the glottis for this maneuver. We prefer to use the bronchoscope, which permits following the airway exchanger under vision and intubating the trachea next to the airway exchanger. Alternatively, the bronchoscope may be inserted parallel to an endotracheal tube that has been left in place and removed over an airway exchanger catheter with the bronchoscope in place. In this way the patient can be ventilated for the time of airway changing maneuver. In all cases the airway exchanger should be withdrawn only after verification of the correct positioning by capnography.

Postoperative Period
The postoperative period requires a new assessment of the airway and respiratory situation. Preoperative airway compromise may have been corrected, may persist unchanged, or may have aggravated by the surgical intervention. Repositioning fractures, evacuation of hematoma, secretions, and blood clots may have reestablished a stable and patent airway. On the other hand, growing edema, iatrogenic hematoma, or obstruction of the airway, such as intermaxillary fixation, may turn the airway into a difficult airway. If so, accidental extubation would put the patient at greater risk.

Posttraumatic neurologic impairment may be a relevant aggravating factor. A reduced vigilance and plegia of cranial nerves may impair the patient’s ability to keep the airway patent. This may necessitate supporting the airway with a mechanical stent, such as a ventilation tube, an oropharyngeal, or nasopharyngeal tube. This is an important aspect in patients with craniofacial trauma in whom respiratory compromise due to concomitant facial and central nervous trauma must be anticipated.

The three approaches include extubation, delayed extubation, or tracheotomy.

Extubation
The optimal timing for extubating the patient with a difficult airway continues to be a matter of debate, despite the fact that guidelines have been published. Two considerations must be taken into account: first, the neurologic status of the patient and its anticipated course; second, an evaluation of the airway by inspection and endoscopy. Patients with a low risk of neurologic defects, who do not require deep sedation for cerebral protection and who are capable of keeping the airway patent, can be extubated. The pattern of the facial trauma and the type and extension of the surgical procedure are important parameters.

A leak test is not routinely performed by the authors because it has been found to have an insufficient predictive value for airway patency after extubation. If the airway appears to be free of obstructions, the patient may be extubated without preventive measures. When in doubt, the anesthetist is well advised to place an airway exchanger before extubating. If reintubation is required, the airway exchanger may be used for a temporary oxygenation and an easier reintubation.

Delayed Extubation
If the airway is compromised by temporary obstructions, such as edema or hematoma, a delayed extubation may be
Beyond the realm of the anesthetist, a tracheotomy has patients may be facilitated and patient safety improved by patients to a high risk. Airway management in craniofacial patients requires a close communication and cooperation between anesthetist, ENT-head and neck surgeon, neurologist, neurosurgeon, ophthalmologist, maxillofacial surgeon, and intensivist. The initial challenge is maintaining the airway and oxygenation of the patient. Whenever possible, the airway should be secured in a conscious and spontaneously breathing patient. Subsequently, all available preventive measures should be undertaken to avoid losing the airway and exposing this specific group of patients to a high risk. Airway management in craniofacial patients may be facilitated and patient safety improved by adhering to the algorithm put forward in this article. Beyond the realm of the anesthetist, a tracheotomy has its place in a significant number of patients in whom an immediate postoperative or a delayed extubation appears not feasible.

**Tracheotomy for the Postoperative Period**

A tracheotomy should be considered in patients who require prolonged postoperative intubation, who are at increased risk of an inadvertent extubation, or in whom sedation is not indicated or is contraindicated. This constellation is frequently encountered in patients with severe craniofacial trauma. These patients may benefit from an early tracheotomy. Patients with a severe craniofacial trauma and head injury, requiring a deep analgesedation, need a prolonged intubation and may also benefit from an early tracheotomy. A tracheotomy is usually indicated in patients at high risk of an obstructed airway, if an early cessation of sedation, defined as an extubation planned within 72 hours after the trauma or the surgical intervention, is required. The choice of a conventional tracheotomy or an epithelialized tracheostomy will depend on the anticipated duration of assisted ventilation or upper airway obstruction. For short-term tracheotomy, a conventional tracheotomy has the advantage of being the simpler surgical procedure that will heal rapidly by secondary intention after decannulation. For a long-term or potentially permanent tracheotomy, an epithelialized tracheostomy is preferable, as adapting the cervical skin to the tracheal wall facilitates wound care and reduces the risk of losing the airway after unintended decannulation. At our institution, percutaneous dilatative tracheotomy is considered unsafe and therefore contraindicated in the treatment of patients with a difficult airway.

**Summary**

Airway management in craniofacial trauma patients continues to be a challenge for the anesthetist. Treating these patients requires a close communication and cooperation between anesthetist, ENT-head and neck surgeon, neurologist, neurosurgeon, ophthalmologist, maxillofacial surgeon, and intensivist. The initial challenge is maintaining the airway and oxygenation of the patient. Whenever possible, the airway should be secured in a conscious and spontaneously breathing patient. Subsequently, all available preventive measures should be undertaken to avoid losing the airway and exposing this specific group of patients to a high risk. Airway management in craniofacial patients may be facilitated and patient safety improved by adhering to the algorithm put forward in this article. Beyond the realm of the anesthetist, a tracheotomy has its place in a significant number of patients in whom an immediate postoperative or a delayed extubation appears not feasible.

**References**
