Anesthetic Complication during Maxillofacial Trauma Surgery: A Case Report of Intraoperative Tension Pneumothorax

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Abstract

Keywords

- tension pneumothorax
- anesthesia complications
- facial trauma

Tension pneumothorax is a life-threatening emergency that requires a high index of suspicion and immediate intervention to prevent circulatory collapse and death. Only five cases of pneumothorax were described in the Oral and Maxillofacial Surgery literature. All cases were postoperative complications associated with orthognathic surgery. We report a case of intraoperative tension pneumothorax during a routine facial trauma surgery requiring emergency chest decompression. The possible causes, classification, and reported cases will be presented.

Pneumothorax is defined as the presence of air within the pleural space.¹ Its occurrence is due to one of the following: (1) communication between alveolar spaces and pleura, (2) direct or indirect communication between the atmosphere and the pleural space, or (3) the presence of gas-producing organisms within the pleural space proper.²

Pneumothoraces are classified depending upon their underlying etiology (► **Table 1**).^{2–4}

Spontaneous

Spontaneous pneumothoraces occur without any preceding trauma or obvious precipitating causes. If the patients have no underlying pulmonary disease, it is termed primary spontaneous pneumothorax. Typically, this is due to a malformation called blebs, bulla, or cyst. The exact cause of these malformations is unknown, although they are more common in the general population in tall, skinny men.

If there is an underlying pulmonary disease or pathology and a rupture of the lung viscera occurs, it is termed a secondary spontaneous pneumothorax. Typical diseases associated with secondary pneumothoraces are chronic obstructive pulmonary diseases, cystic fibrosis, and *Pneumocystis carinii* pneumonia.⁴

Nonspontaneous

Nonspontaneous pneumothoraces, also known as traumatic pneumothoraces, are classified as traumatic and are subdivided into noniatrogenic and iatrogenic. Noniatrogenic pneumothoraces can develop following direct or indirect trauma, often to the chest, unrelated to any medical procedure. Iatrogenic pneumothoraces result from medical interventions/complications.⁴

Case Report

A 36-year-old man, smoker, American Society of Anesthesiologists (ASA) physical status class II with a body mass index of 22 kg/m², was brought to the emergency department by an ambulance after being assaulted while intoxicated with alcohol. Computed tomography (CT) of the head, face/neck, chest, and abdomen was performed, which revealed a left mandibular parasymphysis and a right condylar head fracture. No other abnormal findings were found on physical exam or imaging.

On hospital day 2, the patient was taken to the operating room for mandibular fracture repair under general anesthesia. Nasotracheal intubation was planned to allow for

Table 1 Clinical classification of pneumothorax

Spontaneous	
Primary	No apparent underlying lung disease
Secondary	Clinically apparent underlying disease (e.g., chronic obstructive pulmonary diseases, cystic fibrosis)
Nonspontaneous	
Iatrogenic	Secondary to medical interventions (e.g., transthoracic and transbronchial biopsy, central venous catheterization)
Noniatrogenic	Due to blunt or penetrating chest injury

maxillomandibular fixation (MMF). The nasal mucosa was pretreated with oxymetazoline. Following preoxygenation, anesthesia was induced with propofol. Immediately after induction of anesthesia, rocuronium bromide was administered. A lubricated size 7 nasopharyngeal airway was placed easily for mechanical dilation. The patient was easily mask ventilated with oxygen and sevoflurane. On the initial intubation attempt, a size 7.5 Ring-Adair-Elwyn (RAE) tube was unable to negotiate the nasal passages bilaterally.

Further dilation of the nasal passages was performed using a size 8 nasopharyngeal airway. Intubation was attempted again utilizing a smaller RAE tube, size 6.5, which was also unsuccessful to bypass the nasal obstruction. During this time, the patient was still easily mask ventilated and maintained a saturation of 100%. The patient, however, had nasal bleeding which required intermittent suctioning. A decision was made to change the route of intubation to an oral one and 7.5 endotracheal tube (ETT) was placed under direct laryngoscopy and was confirmed with positive end tidal carbon dioxide.

Immediately afterwards, the saturation dropped. On auscultation, the right chest breath sounds were absent. The patient also had decreased right chest rise on ventilation. No subcutaneous emphysema was observed. With signs of loss of breath sounds, decreased chest rise, and rapidly dropping oxygen saturation level, a clinical diagnosis of tension pneumothorax was made. A stat general surgery consult was called. The anesthesiologist continued manual ventilation in an attempt to improve the saturation. The patient's saturation, however, continued to drop with more obvious flattening of the right chest wall and marked supraclavicular depression.

At this critical juncture, a right thoracostomy was performed by the maxillofacial team. A 2-cm incision was made at the level of the nipple along the anterior axillary line. The pleural space was entered using a Kelly clamp. Upon entering the pleural space, an immediate gush of air came out and the saturation increased to the high 80s. The chest tube was inserted and attached to a drainage device. A chest X-ray was done which showed decreased pneumothorax, widening of the mediastinum, and hazy opacity of the right upper lobe (→ Fig. 1). The general surgeon arrived and recommended a bronchoscopy. A bronchoscopy was done which showed a bloody mucus plug in the right upper lobe bronchus which was evacuated. No disruption or laceration of the tracheobronchial tree was detected. A repeat chest X-ray showed improved upper lobe aeration. The saturation improved to 100%. The surgical procedure was aborted. The patient remained intubated and was transferred

to the surgical intensive care unit. A subsequent chest X-ray showed clear lungs with no pneumothorax. The patient was extubated uneventfully on postoperative day 2 and the chest tube was removed on postoperative day 3 (→ Fig. 2).

Discussion

Tension pneumothorax is a life-threatening emergency with a high mortality rate if not recognized and treated promptly.⁵ Making the diagnosis in a rapidly deteriorating patient is more challenging than the actual intervention. In tension pneumothorax, a flap valve effect may develop that allows air to enter the pleural cavity during inspiration but does not permit it to escape during expiration.⁶ This can cause a progressive increase in intrathoracic pressure caused by entrapment of air between the pleura and chest wall. This causes a decrease in pulmonary expansion and venous return to the right side of the heart.

Another technique for emergent chest decompression is needle thoracostomy, particularly if a thoracostomy set is not immediately available. In this procedure, a large caliber needle is inserted in the second intercostal space in the midclavicular line of the affected hemithorax, as recommended by the Advanced Trauma Life Support guidelines.⁷ This maneuver converts a tension pneumothorax into a simple one and allows controlled placement of a chest tube (→ Fig. 3).⁷

Fig. 1 Portable chest X-ray immediately after intercostal tube drainage shows resolution of right-sided pneumothorax and atelectasis and hazy opacification of the right upper lobe.

Fig. 2 Portable chest X-ray on postoperative day 3 shows clear lungs.

Fig. 3 Tension pneumothorax management. (a) Needle thoracostomy in the second intercostal space at the midclavicular line. (b) Tube thoracostomy in the fifth intercostal space at the anterior axillary line.

Nasotracheal intubation is commonly used in patients undergoing maxillofacial surgery as it has a distinct advantage of providing good accessibility to the oral cavity. Complications occur more frequently with nasotracheal than with the orotracheal route.⁸ Epistaxis, sinusitis, bacteremia, turbinate avulsion, and retropharyngeal dissection are reported.^{8–16} These complications commonly arise from the blind passage of tube in the nasal cavity. Epistaxis is the

most common reported complication with an incidence of 17 to 66%.^{11–13} Damage to Kiesselbach plexus in Little area in the anterior part of the nasal septum is usually the cause of the bleeding.¹⁷ Local application of vasoconstrictive drugs, softening of the tube, and use of a nasopharyngeal airway as a pathfinder can reduce the incidence of this problem.⁸

Pneumothorax is a rare complication in oral and maxillofacial operations. Only five cases of pneumomediastinum and pneumothorax were reported in the literature.^{18–21} All cases were postoperative complications associated with orthognathic surgery. There are two mechanisms for the introduction of air into the pleural or mediastinal compartments in oral and maxillofacial operations. The first is by an increase in intra-alveolar pressure with a subsequent rupture of a perivascular bleb followed by the extravasation of air through the interstitial space into the pleural and mediastinal spaces; the second is by the traumatic disruption of the chest wall or cervical fascia leading to air dissecting down the fascial planes of the neck.²¹

Chebel et al described a 25-year-old female patient who required continuous positive airway pressure (CPAP) after orthognathic surgery for hypoxemia. The patient developed pneumomediastinum and pneumothorax. They attributed the rapid increase in pressure in the oral cavity caused by the CPAP forced air to migrate through the surgical incisions to the deep structures of the neck, which caused her massive subcutaneous emphysema with communication to the mediastinum and the pleural cavity leading to pneumomediastinum and pneumothorax.¹⁸

Goodson et al reported a case of tension pneumothorax requiring chest tube placement in an 18-year-old patient, three days after orthognathic surgery. The etiology was unclear. They suspected either an iatrogenic cause from mechanical ventilation or a rupture of a malformation.¹⁹

Kim et al described a 23-year-old man who developed pneumomediastinum and pneumothorax after orthognathic surgery postoperatively. The patient was extubated and in MMF. They attributed the findings to retention of secretion causing right middle and lower lobar bronchus obstruction and atelectasis. Also, excessive pressure in the right upper lobe despite normal respiratory tidal volume is believed to have triggered the right upper lobe parenchyma tearing and bronchus dissection, leading to pneumomediastinum and right pneumothorax.²⁰

Edwards et al described a case series of two patients who developed pneumomediastinum and right pneumothorax postoperatively after orthognathic surgery. In their first patient, introduction of mediastinal and pleural air was probably secondary to increased intra-alveolar pressure from mucous plugs plus vigorous ventilation with an Ambu-bag. In the second patient, the etiology was less clear. Both patients were managed conservatively with complete resolution.²¹

Interestingly, the incidence of pneumomediastinum is more common in oral and maxillofacial surgery than pneumothorax. Most reported cases are sequelae of air dissecting down the fascial planes of the neck to the mediastinum.²² Reported cases were during orthognathic surgery, facial trauma surgery, temporomandibular joint surgery, dentoalveolar surgery, and

endodontic therapy.^{22–29} The management of pneumomediastinum remains largely symptom based, with careful monitoring to avoid complications of progressive pneumomediastinum.

In our patient, the preoperative chest X-ray and chest CT did not show lung contusions, blebs, emphysematous changes, ribs fractures, pneumomediastinum, or pneumothorax. Nor was there damage of the chest wall or cervical fascia. Therefore, his tension pneumothorax was not a result of a preexisting injury. Our patient had extensive nasal cavity manipulation causing nasal bleed for a prolonged period of time during attempts to pass the ETT beyond a nasal obstruction. The patient also had excessive positive pressure ventilation. On subsequent bronchoscopy, the patient was found to have an obstructing bloody mucus plug in the upper right lobe bronchus.

The clinical finding of decreased breath sounds on the right side, flat depressed right chest wall with supraclavicular depression, deterioration in saturation, tachycardia on positive pressure ventilation, and the immediate gush of air upon entering the pleural cavity resulting in an immediate rise in saturation from the 60s to the high 80s supported and confirmed our diagnosis of tension pneumothorax. The lack of any abnormal findings on preoperative chest CT (e.g., parenchymal contusions, blebs, emphysematous changes, or rib fractures) and the finding of a plug on bronchoscopy make us believe that the pneumothorax was probably due to a differential increase in alveolar pressure in the middle and lower lobes, leading to parenchymal tearing and tension pneumothorax. We believe the nasal bleed for a prolonged time with the infrequent suctioning led to upper lobe bronchus obstruction and atelectasis.

In our patient, we placed a chest tube instead of needle decompression due to the availability of the instruments at the time.

Conclusion

Nasotracheal intubation is frequently required for oral and maxillofacial surgeries. Careful and gentle manipulation of the nasal passages during nasotracheal intubation is essential to prevent epistaxis. Obstruction of the airway can occur from oropharyngeal mucus and blood. Although rare, this can lead to life-threatening tension pneumothorax. This case highlights the potential disastrous consequences that might have ensued without accurate clinical diagnosis and prompt intervention.

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