COMPLICATIONS IN PRESERVING THE AIRWAY IN INTENSIVE CARE UNIT PATIENTS

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SUMMARY – Maintaining the airway in patients in intensive care unit (ICU) is often a vitally important issue for successful treatment of patients. The aim of the study was to identify the complications as the most common causes of difficult ventilation in ICU patients. This retrospective study included 12 patients with difficult pulmonary ventilation, aged 12-70 years, 8 male and 4 female. All patients were intubated for a period of 7-14 days on mechanical ventilation. Due to the need of prolonged mechanical ventilation, the patients underwent surgical tracheotomy and tracheal cannula was placed in five patients. Patients with unilateral atelectasis of the lung underwent bronchoscopy and airway lavage. All patients underwent regular intensive clinical observation and diagnosis, x-ray, CT and MRI. They all were administered antibiotic therapy as well as symptomatic and supportive therapy. Five patients underwent tracheotomy. In one patient with Down syndrome, tracheal rupture occurred two hours after general anesthesia. He developed massive pleural, mediastinal and subcutaneous emphysema. Seven patients with unilateral atelectasis of the lung underwent bronchoscopy and airway lavage. In two patients, therapeutic bronchoscopy with lavage was repeated twice, and in one patient bronchoscopy was repeated 4 times over a 6-month period. Eight patients died and four patients survived. Of the patients with polytrauma, two were in vigil coma, one survived for 6 months, while the other died from respiratory failure. In conclusion, it is important to promptly recognize and appropriately treat complications while maintaining airway in ICU patients, especially those with multiple trauma or conditions after extensive surgery. Preventing hypoxemia as a result of hypoxia has a far-reaching significance for the clinical course and success of patient treatment.

Key words: *Trachea; Difficult ventilation, complications; Intensive care; Mechanical ventilation*

Introduction

Difficult ventilation may be caused by various mechanisms such as injury, inflammation, allergies, acute or chronic pulmonary disease, and inadequate artificial procedures in maintaining the airway. It can result in the emergence of a high risk to the patient's hemodynamic and respiratory functions, with unfavorable influence on the outcome of treatment[1]. Patients in intensive care unit (ICU) with severe pulmonary ventilation problems often come from the operating room or other locations such as the Emergency Medical Center. They are usually intubated with or without pleural drainage[2]. However, rapid and abbreviated history and inadequately assessed physical examination along with inappropriate intervention may be the cause of poor health status of the patient. In addition to injuries caused by blunt mechanical force (traffic accidents), injuries often result in rupture of the trachea, bronchus and lung parenchyma contusion, with all the consequences that result in hypoxemia, induced pneumothorax, hemothorax, respiratory distress, atelectasis, and other disorders[3]. Complications

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in maintaining respiratory tract are often related to massive secretion, hemorrhage, edema or spasm of the vocal cords, trachea and bronchi, often caused by repeated artificial manipulation[4]. Despite a large number of studies that discuss airway management, it is difficult to determine the exact incidence of complications (laryngospasm, bronchospasm, bleeding, tissue trauma, aspiration, inadequate ventilation, difficult intubation, extubation problems) due to insufficient information and the small number of samples in the studies[5]. The present study was undertaken to point to the clinical significance and analysis of complications in airway maintaining.

Material and Methods

This retrospective study was conducted at University Department of Anesthesiology and Resuscitation, Sarajevo University Hospital Center, where complications in maintaining airway were monitored in 12 patients during a 6-month period 2011-2012. The study included patients with severe ventilation problems. Study patients were aged 12-70 years; there were eight male and four female patients. During their hospital stay, 11 of 12 study patients underwent one or more operations performed by maxillofacial, abdominal, thoracic, and orthopedic surgeons. Ablation for breast cancer in one patient was performed at University Hospital in Ljubljana, Slovenia. During hospitalization, all patients underwent endotracheal intubation with mechanical ventilation support. Evita 4 (Dräger, Germany) fans were used. In 5 patients, standard tracheotomy was performed for a period of 7-14 days; it was done by an otolaryngologist or maxillofacial surgeon under general anesthesia. A plastic cannula (Portex) of appropriate size was placed. In patients with unilateral atelectasis of the lung, bronchoscopy and airway lavage by fiberoptic bronchoscope was performed. All patients were under regular intensive clinical observation and diagnostic work-up with x-ray, computed tomography (CT) and magnetic resonance imaging (MRI). All patients were administered antibiotic therapy according to the antibiotic sensitivity report for bacteria isolated in swab tube or cannula, as well as symptomatic and supportive therapy. Airway aspiration was performed with outdoor classical sterile technique in all patients with recurrent aspiration catheter through the vacuum.

Table 1. Causes of difficult ventilation in ICU patients that posed problems during treatment

Cause of difficult ventilation	Number of patients
Fractures of facial bones (mandible, LeFort)	3
Pneumothorax	3
Hemothorax	2
Fractures of the bones of the thorax (clavicle, ribs, sternum)	5
Contusion of lungs	5
Metastasis of brain	1

Results

The average age of the study patients was 43 years; the youngest patient was aged 12 and the oldest 70 years. Duration of hospitalization of our patients was 10 to 180 days, mean 44.3 days. Five of 12 injured patients had sustained traffic accidents with polytrauma and lung contusion, fractures of the bones of the thorax (the ribs, sternum, clavicle), mid-facial massive trauma with fractures (the mandible, maxilla, nasal and zygomatic bones) and fractures of extremities (Table 1). All patients had one or more surgical procedures. Five patients underwent abdominal surgical interventions as the leading pathological condition. A female

Table 2. Frequency of complications as the possible reasons of difficult ventilation in ICU patients that posed problems during treatment

Complication	Number of patients
Respiratory infection	12
Bronchial hypersecretion	11
Rupture of trachea	1
Bronchospasm	9
Bronchopneumonia	5
Atelectasis	7
Edema of airway mucosa	9
Malposition of tube and cannula	5
Acute respiratory distress syndrome	2
Liquidothorax	9
Bronchotracheal hemorrhage	3

patient was operated in Ljubljana for breast cancer. She was hospitalized for 20 days after surgery because of the problem with lung ventilation and presence of distant metastases in the brain with consequent compression of respiratory center. Five patients underwent tracheotomy performed by otolaryngologist or maxillofacial surgeon. One patient, a child with Down syndrome, had rupture of the trachea two hours after general anesthesia with orotracheal intubation, after surgical correction of the teeth. Massive pleural mediastinal and subcutaneous emphysema developed in the neck, chest and head. Right sided thoracotomy, suture of the trachea and bilateral pleural drainage were performed in this child. Bronchoscopy and bronchoalveolar lavage with fiberoptic bronchoscope was done in seven patients with unilateral atelectasis of one part of the lungs. Therapeutic bronchoscopy with lavage was repeated twice in two patients, and in one patient bronchoscopy was repeated 4 times during a 6-month period (Table 2). Eight patients died due to severe general condition and respiratory failure, and four patients survived. Among patients with polytrauma, two patients were in the state of vigil coma; one of them survived for 6 months, while the other patient died from respiratory failure. All patients had tube or cannula swab samples positive for nosocomial microorganisms, but bronchopneumonia closely related to mechanical ventilation developed in five patients. *Acinetobacter* species were the predominant bacteria isolated from positive swab samples.

Discussion

In our study, we demonstrated that airway control in ICU patients is often accompanied with many complications, timely resolution of which yields better chances of survival. The causes of difficult ventilation may often be associated with comorbidity, which then threatens the patient's life and increases mortality.

Twelve patients included in our study represented the most complicated cases encountered in ICU. Despite modern diagnostic and therapeutic options, the 66.6% mortality recorded in our study shows that airway management is of vital importance in clinical practice. Common to all of our patients was hypoxemia, but each of these patients had a clinical course that should be most clearly presented as separate case reports.

Besides hypoxemia as a consequence, common symptoms in most of our patients were hypersalivation with mucosal edema, bronchospasm, atelectasis, and liquidothorax.

Other studies report similar results considering various causes and complications of the airway due to multiple trauma or operative trauma. In one study, only complications during the first month after surgery were analyzed in 1425 patients that underwent 1451 surgeries in total (i.e. 192 malignant, 247 hyperthyroidism, 98 reoperations, 13% total thyroidectomy and 14.8% lobectomy). Complications occurred in 14.3% of patients. The most common complication was recurrent laryngeal nerve lesion, which occurred in 9.3% of patients, while the most common cause of death was a problem with breathing and airway obstruction[6].

The study by Đanić *et al.* shows that laryngotracheal stenosis, although not often clinically severe, is very important because it is a serious illness for the patients and a diagnostic and therapeutic challenge for doctors. Trauma caused stenosis in 9 patients. There were three stenoses as a consequence of endotrauma (intubation) and four stenoses as a consequence of penetrating injury to the larynx[7].

In one patient. we had occasionally transitory tracheal stenosis (up to 0.5 cm), 2 cm above the bifurcation, which we handled with bronchoscopy and intense pressure ventilation. After these interventions, the patient could breathe sufficiently for the next ten days. We think that the cause of the above mentioned stenosis was accumulation of granulation at the wall of the trachea, as the result of tracheal mucosal lesions after frequent aspiration of tracheal contents and infection. Generally, the problem of ventilation may be caused by allergic reactions to insect bites, food allergies or the application of various drugs such as angiotensin-converting enzyme. It is the leading cause of angioedema caused by drugs, with an incidence of 0.2%. Angioedema is not of immune nature, but occurs in predisposed individuals as the result of accumulation of vasoactive mediators, whose degradation is blocked[8].

In their study including 104 patients intubated in the ICU or emergency center, Chan *et al.* report the following findings: difficult intubation in 9% of patients, 20% of patients with complications (such as

hypoxia, hypotension, esophageal intubation, cardiac arrest, or aspiration)[9].

Undoubtedly, in the management of difficult airway complications, experiential and intuitive timely detection of problems is of great importance in order to promptly find appropriate solution to the situation[10-13].

In our patients, tracheotomy was performed in the second week of hospital stay, although some injuries such as local injury to the larynx or brain injury required extended ventilation, so urgent tracheotomy could be done. Some authors recommend percutaneous tracheostomy, especially Ciaglia modified technique that is popular in Germany[14-20]. Regardless of the popularity of the technique of percutaneous tracheotomy in some countries over the past decade, there is no reliable evidence for the benefits of this technique over conventional surgical methods[21-23]. A special problem arises when replacing tracheal cannula in percutaneous tracheotomy, which is by many authors much more difficult to perform effectively in relation to standard tracheotomy[24-27].

In tumors of the pharynx and larynx, airway obstructions followed by hemorrhage and hypoxemia are frequent. However, both metastatic processes and primary brain tumors may also indirectly affect respiratory function and lead to hypoxia, as it occurred in our patient[28].

Relatively frequently detected atelectasis, of smaller or larger extent, causes hypoxemia, tachycardia, tachypnea, and may be solved by single or repeated therapeutic bronchoscopy, as we did several times in our patients, although in some patients with limited success because of the position of the focus of atelectasis[29].

Despite relatively many studies that discuss this problem in clinical practice, there are many drawbacks in those studies because they are very inconsistent, with a small number of patients and biased, which requires further research in order to achieve consensus on the timely and appropriate intervention to maintain an adequate airway.

Conclusion

It is important to promptly recognize and appropriately treat complications in maintaining airway in ICU patients, especially those with multiple trauma or conditions after extensive surgery. Preventing hypoxemia resulting from hypoxia has a far-reaching significance for the clinical course and success in treating patients.

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Sažetak

KOMPLIKACIJE U ODRŽAVANJU DIŠNOG PUTA U JEDINICI INTENZIVNOG LIJEČENJA

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Održavanje dišnog puta kod bolesnika u jedinici intenzivnog liječenja (JIL) je često vitalno važan problem u uspješnom liječenju bolesnika. U našem radu prikazuju se komplikacije kao najčešći uzroci otežane ventilacije bolesnika u JIL. U ovu retrospektivnu studija bilo je uključeno 12 bolesnika s otežanom plućnom ventilacijom, u dobi od 12-70 godina, 8 muškog i 4 ženskog spola. Svi bolesnici su bili intubirani kroz razdoblje od 7-14 dana, na mehaničkoj ventilaciji, zbog potrebe produžene ventilacije. Kod bolesnika s unilateralnom atelektazom dijela pluća provedena je bronhoskopija i lavaža dišnih putova. Kod svih bolesnika se redovno provodila intenzivna klinička opservacija i dijagnostika, RTG, CT, MRI. Svi bolesnici su bili pod antibiotskom zaštitom, uz ostalu simptomatsku i suportivnu terapiju. Kod 5 bolesnika učinjena je traheotomija. Jedan bolesnik s Downovim sindromom imao je rupturu traheje dva sata nakon opće anestezije. Razvio se masivni pleuralni, medijastinalni i potkožni emfizem. Kod 7 bolesnika s unilateralnom atelektazom dijela pluća rađena je bronhoskopija i lavaža dišnih puteva. Kod 2 bolesnika terapijska bronhoskopija s lavažom ponavljana je dva puta, dok se kod jednog bolesnika bronhoskopija ponavljala 4 puta u razdoblju od 6 mjeseci. Osam bolesnika je umrlo, dok su 4 bolesnika preživjela. Od bolesnika s politraumom dva su bila u stanju vigilne kome, jedan je preživio 6 mjeseci, dok je drugi umro zbog respiracijske insuficijencije. Zaključuje se kako je komplikacije u očuvanju dišnog puta kod bolesnika u JIL važno pravodobno prepoznati i primjereno liječiti, naročito kod bolesnika s politraumom ili stanjima nakon ekstenzivnih operacijskih zahvata. Spriječena hipoksemija kao posljedica hipoksije ima dalekosežan utjecaj na klinički tijek i uspjeh u liječenju bolesnika.

Ključne riječi: *Traheja; Otežana ventilacija, komplikacije; Intenzivno liječenje; Mehanička ventilacija*