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Rare and fatal complications of tonsillectomy: sudden pneumothorax and extensive subcutaneous emphysema

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Abstract

Tonsillectomy is a common, minimally invasive, and relatively safe surgical operation. Although the surgical technology for such minor operations is mature and widely available in most countries worldwide, postoperative adverse complications occur and may be hazardous and fatal. Our article presents the details of a 4-year-old boy who suddenly developed pneumothorax and systemic extensive subcutaneous emphysema after tonsillectomy. He received professional treatment from a multi-disciplinary team (MDT) and timely rescue in our hospital; however, he died tragically. To this end, there is an urgent need to raise clinicians' awareness of the potentially fatal and rare complications that can occur after tonsillectomy.

Keywords

Tonsillectomy, pneumothorax, subcutaneous emphysema, complication, prognosis, multidisciplinary team, fatality

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Introduction

Tonsillectomy is a common and mature surgical procedure in otolaryngology; however, any operation has certain risks of adverse events and postoperative complications.[1] Some common complications of tonsillectomy are postoperative infection, bleeding, edema of the tongue, glossopharyngeal nerve injury, and carotid artery injury.[2] Conversely, the rare complications

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of tonsillectomy have been neglected by most clinicians. Rare occurrences of subcutaneous emphysema or pneumothorax after tonsillectomy may spontaneously resolve silently. On the contrary, sudden pneumothorax and subcutaneous emphysema are dangerous and fatal complications that seriously damage the body's respiratory and circulatory functions.[3] We describe a rare case of a 4-year-old child from the First Affiliated Hospital of Gannan Medical University who developed sudden-onset pneumothorax and generalized subcutaneous emphysema after tonsillectomy. This paper is expected to raise awareness and clinical alert regarding the rare complications of tonsillectomy.

Case report

A 4-year-old male patient with a complaint of nocturnal snoring with mouth breathing during sleep of more than 6 months' duration presented to the Department of Otolaryngology of the First Affiliated Hospital of Gannan Medical University. The child's family told the otolaryngologist that the boy had been snoring and breathing through his mouth for no apparent reason for 6 months, with signs of sleep apnea. Additionally, the child had a history of repeat episodes of tonsillitis and pharyngitis (at least eight times a year), without dizziness, headache, nausea, vomiting, or other symptoms. The child's family stated that he carried the thalassemia gene (specific mutations unknown), and that he had allergies to shrimp and dust mites. Moreover, his medical history, personal history, and family history were unremarkable, and he was admitted to the hospital for "chronic tonsillitis".

Routine physical examination of the child after admission revealed the following: body temperature: 36.6°C, pulse rate: 93 beats/min, respiratory rate: 21 breaths/min, and blood pressure: 95/55 mmHg. Physical examination findings for the heart, lungs, abdomen, and limbs were normal. The specialized otorhinolaryngology examination showed bilateral inferior turbinate hypertrophy, viscous nasal mucus on both sides of the middle nasal passages, swelling of the mucosa of the throat wall, proliferation of lymphoid follicles at the base of the tongue, and bilaterally swollen tonsils (grade III). The remainder of the otorhinolaryngology examination showed no obvious abnormalities. Additionally, the otolaryngologists attempted to perform nasopharyngoscopy and laryngoscopy, but the child could not cooperate. Relevant examinations were completed after admission and the findings comprised the following: blood routine examination: white blood cell count (WBC): 13.18×10^9/L, hemoglobin (Hb): 117 g/L, platelet count (Plt): 493×10^9/L, eosinophil count: 2.23×10^9/L, and mean corpuscular volume (MCV): 58.8 fL. Other laboratory blood test results were within their respective normal ranges. An otolaryngologist performed electronic laryngoscopy on 9 August 2021, and the results showed adenoid and tonsillar hypertrophy. Additionally, chest radiographs were obtained (Figure 1) on 10 August 2021, which showed no abnormalities.

The initial diagnoses after admission were as follows: 1. chronic tonsillitis and 2. tonsillar hypertrophy with adenoid hypertrophy. The otolaryngologists evaluated the child's preoperative physical fitness and risk assessment, with the family's informed consent. The child was treated with low-temperature plasma bilateral tonsillectomy and nasal endoscopy-assisted adenoid ablation under general anesthesia at 9:00 am on 11 August 2021. The procedure went smoothly, and he was safely transferred to the anesthesia and resuscitation room for observation postoperatively. Unfortunately, he suddenly had no spontaneous breathing, and cardiac arrest and

cyanosis ensued at 9:50 am, after which, he rapidly developed subcutaneous emphysema of the face, neck, and chest (Figure 2). The doctors in the anesthesia and resuscitation room immediately performed a series of rescue treatments, such as continuous cardiopulmonary resuscitation, cardiac electric defibrillation, closed thoracic drainage, and intermittent intravenous injections of epinephrine, with a bedside X-ray examination (Figure 3). The radiographs showed subcutaneous emphysema in the bilateral maxillofacial region, neck, scapular area, and bilateral chest and abdominal walls.

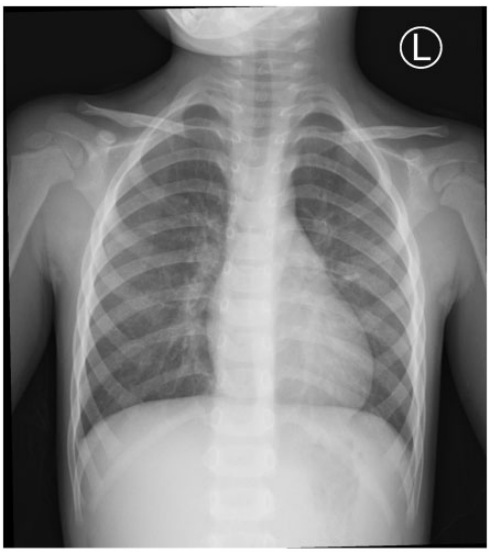

Figure 1. Anteroposterior chest X-ray of the child before the operation showing no abnormalities.

At 11:23 am, despite the rescue measures, the child still had no spontaneous heart rate, his pupils were dilated and fixed, and his blood pressure and blood oxygen saturation could not be measured. Therefore, he was immediately transferred to the intensive care unit (ICU) for further rescue at 11:26 am. After entering the ICU, we could not auscultate heart sounds, blood oxygen level and blood pressure were undetectable, and his pupils remained dilated and fixed. It is worth noting that from the anesthesia recovery room to the ICU, the child received continuous cardiopulmonary resuscitation, cardiac electric defibrillation, closed thoracic drainage, ventilator-assisted ventilation, and intermittent intravenous epinephrine, which were continued to 12:40 pm. At this point, the child's heart beat had not recovered, his pupils were

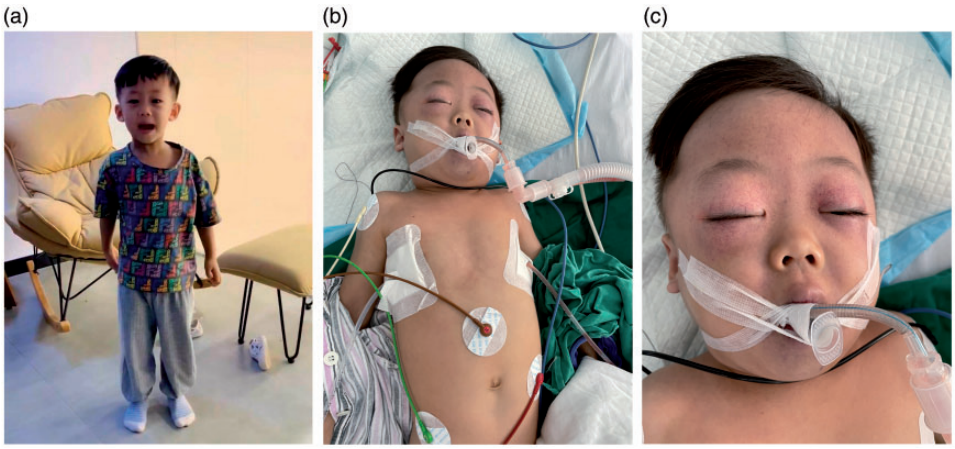

Figure 2. Changes in the child's appearance before and after complications (a) preoperative photograph of the child; (b) sudden subcutaneous emphysema of the entire body during the rescue attempt and (c) subcutaneous emphysema is most obvious on the face and in the scapular area.

dilated, blood pressure and blood oxygen were undetectable, and electrocardiographic (ECG) monitoring indicated that the ECG activity was a straight line. Sadly, we announced the clinical death of the child. The diagnoses were as follows: 1. obstructive shock; 2. respiratory and cardiac arrest; 3. bilateral tension pneumothorax; 4. pneumomediastinum; 5. subcutaneous emphysema; 6. chronic tonsillitis; and 7. tonsillar hypertrophy with bilateral adenoid hypertrophy. On 13 August 2021, the Department of Pathology in our hospital reported the results of the pathological examination of the excised tonsils (Figure 4) as "chronic tonsillitis".

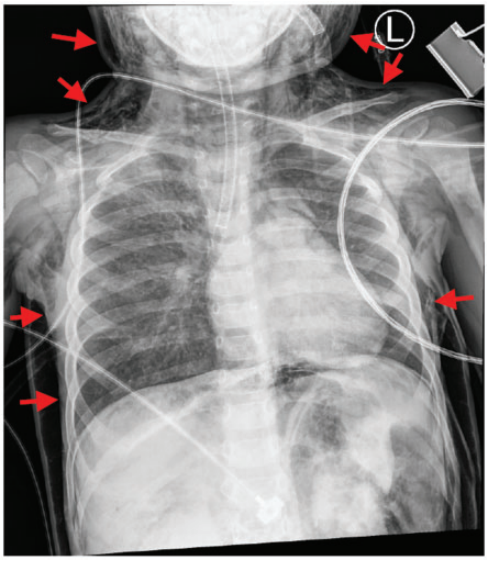

Figure 3. Bedside X-ray examination of the child after the onset of the operative complications. "→" indicates the subcutaneous emphysema in the bilateral maxillofacial region, neck, scapular area, and bilateral chest and abdominal walls.

Discussion

Patients treated with tonsillectomy usually suffer from frequent episodes of tonsillitis or refractory chronic peritonsillar abscesses.[4] As mentioned, tonsillectomy may be accompanied by complications; while, subcutaneous emphysema and pneumothorax are extremely rare. Such rare complications usually resolve spontaneously. However, it is possible that the gas accumulation in subcutaneous emphysema may cause upper respiratory tract obstruction and spread to the thoracic cavity, leading to pneumothorax or mediastinal emphysema, which in turn induces obstructive shock.[5,6] Nevertheless, the mechanism of pneumothorax and subcutaneous emphysema after tonsillectomy is unclear.

The causes of subcutaneous emphysema comprise traumatic, iatrogenic, and spontaneous mechanisms, and subcutaneous emphysema of the head and neck is usually

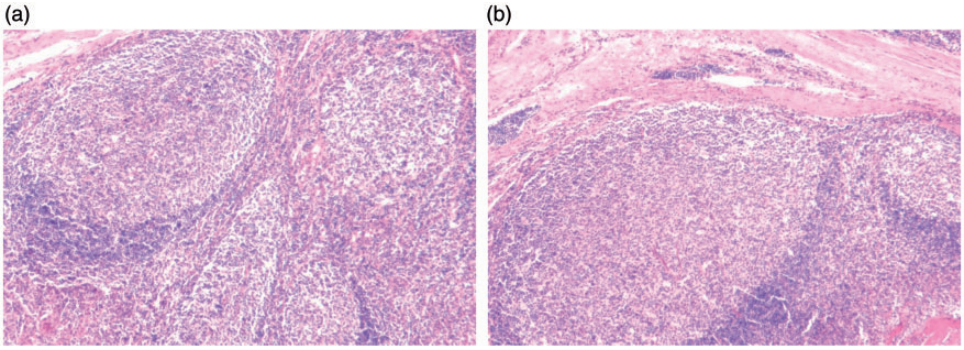

Figure 4. Pathological biopsy report of the analysis of the tissues removed during tonsillectomy showing chronic tonsillitis (a) and (b); hematoxylin and eosin (HE) staining ×10.

fatal.[7] When a large amount of air accumulates between the fascial surface of the connective tissue, the typical characteristics are those seen in our case. The air can spread to the posterior pharynx, mediastinum, pleura, and retroperitoneal space.[8] Relevant studies have shown that maxillofacial surgery can cause subcutaneous emphysema, but the probability of this event is extremely low.[9] If a patient suddenly develops this rare complication, a timely and effective differential diagnosis should be made to avoid misdiagnosis and adverse consequences. This is because the emergency presentation with subcutaneous emphysema is similar to the clinical manifestations of postoperative hematoma, acute allergic reaction, angioedema, infection, and necrotizing fasciitis.[10]

Very few scholars have reported cases of subcutaneous emphysema after tonsillectomy.[11,12] A small number of scholars believe that tonsillar tissue laceration may occur during tonsillectomy, or owing to postoperative dry cough, vomiting, coughing, and other predisposing factors. These conditions permit air to enter the superior pharyngeal constrictor muscle fibers through the mucosal tear. The air can then pass through the fascial plane to the parapharyngeal area and neck,[13,14] and then to the cheeks, eyes, mandible, and supraclavicular and temporal areas.[15,16] The possible anatomical mechanism underlying the spread of subcutaneous emphysema is that the deep part of the suprapharyngeal contractile muscles can shift to form a path through the neck to the parapharyngeal, postpharyngeal, and prevertebral spaces. Free air can also descend through the deep interstitial space of the neck tissues to enter the mediastinum and cause pneumomediastinum. It is worth noting that pneumomediastinum can compress the heart, affect the returned blood volume, reduce cardiac output, cause venous congestion, seriously affect circulatory function, and then cause acute respiratory distress and low blood oxygen saturation.

In a very small number of cases, air in the mediastinum progresses through the diaphragm and descends into the abdominal cavity.[17,18] From a diagnostic perspective, the presence of air outside the lungs can be clearly distinguished by X-rays and other imaging methods. Additionally, if the patient suffers dyspnea, cyanosis, dysphagia, chest and back pain, and shows Hamman's sign during recovery from anesthesia after tonsillectomy, this rare complication of pneumothorax and subcutaneous emphysema should be considered. In pediatric patients, it is more likely that severe subcutaneous emphysema of the neck causes the tracheal rings to collapse, which compresses the trachea, leading to respiratory and circulatory disorders. Alternatively, the results of some clinical studies showed that some patients suffer laryngotracheal mucosal damage owing to tracheal intubation, excessive positive pressure ventilation, or excessive artificial ventilation. These factors are classified as iatrogenic injuries that also lead to the occurrence of the rare complications of pneumothorax and subcutaneous emphysema.[19,20]

We believe that the procedural details before and during tonsillectomy in this rare clinical case are critical to disclose. We reviewed the clinical medical record data of this case in the hospital's electronic medical record system. The preoperative specialist examination showed that bilateral inferior turbinates were slightly hypertrophic, the bilateral middle meatus was filled with sticky mucus, and there was no local skin swelling or tenderness in the sinuses. The mucosa of the posterior pharyngeal wall was slightly red, the lymphoid follicles of the posterior pharyngeal wall and the lymphoid follicles at the base of the tongue were hyperplastic, bilateral tonsils were hypertrophic (grade III), and the tonsillar surfaces were rough. Additionally, the

child was uncooperative during indirect nasopharyngoscopy and laryngoscopy. It is also important to note that electronic laryngoscopy showed adenoid and tonsillar hypertrophy.

The details of the surgical procedure are as follows: 1) The patient was placed in the supine position, the head was tilted back, and the endotracheal intubation was stable after general anesthesia, routine disinfection, and draping. 2) The procedure began with tonsillectomy on the left side, which involved placing a surgical mouth opener to open the child's mouth. The mucosa of the lingual and palatine arches and pharyngeal and palatal arches were incised along the edge of the tonsils with a low-temperature plasma knife. The upper poles of the tonsils were then separated and exposed and gradually excised and stripped to the lower poles until the tonsils were fully excised. Right tonsillectomy was performed in a similar manner. 3) Plastic catheters were inserted into both nasal cavities and retracted gently through the mouth. The soft palate was then elevated, and under direct vision using a 70° nasal endoscope, the adenoids were gradually ablated with a low-temperature plasma knife and then suctioned out. The surgeons checked carefully for residual adenoids and active bleeding, and the catheters and surgical mouth opener were withdrawn, completing the operation. 4) The anesthesia was stable during the operation; the bleeding volume was approximately 2 mL; the surrounding muscles, such as the superior pharyngeal constrictors, were not damaged during the operation; and the patient returned to the anesthesia recovery room safely. It is worth noting that the child's airway was observed by electronic bronchoscopy during the rescue process, and no phlegm or thrombus was found. Therefore, we were able to exclude a thrombus obstructing the airway and causing suffocation.

The serious and rare complications in this case did not involve simply self-limiting subcutaneous emphysema. We believe that fatal pneumothorax, respiratory distress, and cardiac arrest may occur in similar cases. As mentioned, this frustrating situation is a rare postoperative complication that affects oxygenation and then rapidly leads to circulatory failure after tonsillectomy. Furthermore, in this case, we identified tension pneumothorax and subsequent obstructive shock after tonsillectomy, rather than an anesthesia-related complication. Anesthesia-related complications often affect the circulation and can be improved with fluid replacement and vasoactive drugs. However, in our patient, irreversible respiratory and circulatory failure persisted despite mechanical ventilation; therefore, the presence of tension pneumothorax and obstructive shock after tonsillectomy are more reasonable explanations. Although this child suffered sudden subcutaneous emphysema, pneumothorax, cyanosis, and cardiac arrest during the postoperative awakening stage from anesthesia, we performed timely and professional hospital-wide MDT rescue. However, despite these efforts, the child's life could not be saved, indicating that these rare complications after tonsillectomy progress quickly and are fatal. Conservative treatment or conventional clinical rescue measures are difficult, and this issue requires the urgent attention of clinicians. Therefore, we recommend continuous and close monitoring of pediatric patients undergoing tonsillectomy from the perioperative period to 24 hours after surgery for timely and effective professional care and medical treatment.

Conclusion

It is sad and regrettable that the child in this clinical case died due to rare complications of tonsillectomy. Regarding the treatment of such rare complications, prevention is

essential because the complications are perilous, and the progress is extremely fast. Furthermore, it is indispensable to fully communicate with a patient's family, and humanistic care is particularly crucial to avoid unnecessary doctor-patient conflicts. For the patient in this case, timely tracheal intubation, assisted ventilation, closed chest drainage, and other methods appeared to have little effect on alleviating the degree of subcutaneous emphysema and the rescue treatment for tension pneumothorax. Perhaps, early tracheotomy or even thoracotomy may have been better treatment options. However, it is important to note that the use of non-invasive positive-pressure ventilation during tonsillectomy should be avoided as much as possible to maximize patient outcomes.[21]

Availability of data and material

All data generated in this study are included in the article.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

Ethics statement

The reporting of this study conforms to the CARE guidelines.[22] Detailed patient information has been de-identified. The study protocol was approved by the ethics review committee of the First Affiliated Hospital of Gannan Medical University (approval number: LLSC-20210809). We obtained parental consent for treatment. Written informed consent was obtained from the patient's family for the publication of this case report and the accompanying images.

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