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КЛИНИЧЕСКИЙ СЛУЧАЙ УСПЕШНОГО ЛЕЧЕНИЯ ПОЛНОГО ОТРЫВА ТРАХЕИ ОТ ГОРТАНИ

© А.В. Михеев, С.Н. Трушин

ФГБОУ ВО Рязанский государственный медицинский университет
им. акад. И.П. Павлова Минздрава России, Рязань, Россия

Трахеобронхиальные повреждения как следствие тупой травмы грудной клетки встречаются редко. Тупая травма шейного отдела трахеи ещё более редкая патология, представляющая серьезную диагностическую проблему для клинициста. Летальность при травме гортани и трахеи составляет 40-80%. Шейная часть трахеи является уязвимой несмотря на то, что прикрыта мышцами шеи, позвоночником, ключицами и нижней челюстью. При колото-резаных ранениях повреждение шейного отдела трахеи часто происходит вместе с соседними структурами. При тупой травме за счет прямого воздействия травмирующего агента происходит перемещение подвижной трахеи к шейному отделу позвоночника, что сопровождается повреждением хрящей трахеи, ее мембранозной части и окружающих мягких тканей при сохранении целостности кожи.

Разрывы трахеи на расстоянии до 1 см от перстневидного хряща составляют не более 4% от всех разрывов трахеи. Полный разрыв трахеи или отрыв ее от гортани является крайне редкой патологией. Из-за выраженных дыхательных нарушений значительная часть пострадавших погибает на месте получения травмы.

В статье представлен клинический случай успешного лечения пациента З., 41 года, с полным отрывом трахеи от гортани. Причиной повреждения трахеи послужила тупая травма шеи во время автодорожного происшествия. Особенностью данного клинического случая является то, что пострадавший был доставлен в специализированное торакальное хирургическое отделение через 2 сут с момента получения травмы с функционирующей трахеостомой.

Заключение. Травма трахеи является потенциально смертельно опасным состоянием, поэтому ранняя диагностика трахеобронхиальных повреждений крайне важна, что позволяет провести своевременное оперативное вмешательство и снизить риск летального исхода. У пациентов с травмой головы, шеи и грудной клетки с несоответствующими клиническими данными, отсутствием эффекта от рекомендованных стандартных лечебных процедур клиницисту необходимо быть настороженным и исключить повреждения трахеи и бронхов.

Рентгеновская компьютерная томография и фибротрахеобронхоскопия настоятельно рекомендуются как надежные методы диагностики трахеобронхиальных повреждений. При проведении хирургического вмешательства необходимо стремиться выполнить первичный шов трахеи и избегать превентивной трахеостомии и отсроченных вмешательств, что сопряжено с худшим прогнозом и высокой частотой осложнений.

Ключевые слова: *трахея; гортань; травма трахеи; травма гортани; разрыв трахеи; отрыв трахеи.*

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A CLINICAL CASE OF SUCCESSFUL TREATMENT OF COMPLETE ABRUPTION OF THE TRACHEA FROM THE LARYNX

A.V. Mikheev, S.N. Trushin

Ryazan State Medical University, Ryazan, Russia

Tracheobronchial injuries as a consequence of chest blunt trauma are rare. Blunt traumas of the cervical part of the trachea are a rarer pathology presenting a serious diagnostic problem for a clinician. Traumas of the larynx and the trachea account for 40 to 80% of lethality. The trachea's cervical part is vulnerable despite that it is covered with the neck muscles, spine, clavicles, and mandible. In cut/stab wounds, the trachea's cervical part is often damaged together with the adjacent structures. In blunt trauma, under a direct action of a traumatizing agent, the mobile trachea displaces toward the spine, accompanied by damage to the tracheal cartilages, its membranous part, and the soft surrounding tissues with preservation of the integrity of the skin.

Tracheal ruptures along the distance up to 1 cm from the cricoid cartilage account for not more than 4% of all tracheal ruptures. A complete tracheal rupture and its abruption from the larynx are extremely rare pathology. Because of severe respiratory disorders, most victims die at the site where their injury occurred.

This article presents a clinical case of the successful treatment of patient Z., 41 years of age, with complete tracheal abruption from the larynx. The cause of tracheal damage was blunt neck trauma in a traffic accident. A peculiarity of this clinical case was that the victim arrived at a specialized thoracic surgery unit with a functioning tracheostomy two days after the trauma.

Conclusion. Tracheal trauma is a potentially fatal condition. Therefore, early diagnosis of tracheobronchial damage is essential since it permits timely surgical intervention and diminished risk of lethal outcome. When dealing with patients with trauma of the head, neck, and chest with non-corresponding clinical data and the absence of effective recommended standard therapeutic measures, a clinician should become alert and exclude the tracheal and bronchial damage.

X-ray computed tomography and fibrotracheobronchoscopy are strongly recommended as reliable methods to diagnose tracheobronchial damages. In a surgical intervention, it is necessary to perform the primary suture on the trachea, avoid preventive tracheostomy, and delay interventions associated with poorer prognosis and a high complication rate.

Keywords*: trachea; larynx; trauma of trachea; trauma of larynx; rupture of trachea; abruption of trachea.*

Tracheobronchial trauma is understood as damage to the trachea *between the cricoid cartilage and the right or left major bronchi*. The frequency of traumatic damages to the trachea in blunt trauma of the chest and neck is not high and accounts for about 0.5-2% of cases. In contrast, damages to the major and lobar bronchi are more common and account for 2-5% of cases [1]. Lethality in laryngeal and tracheal trauma comprises 40-80% [1-4]. The majority of patients with complete tracheal abruption die at the site of getting trauma.

We present our own clinical case of complete tracheal abruption from the larynx with a favorable outcome.

Patient Z, 41 years old, was delivered to the reception room of Ryazan Regional Clinical Hospital two days after the trauma. He was a truck driver, and his safety belt was not fastened. At the moment of the motor accident, he struck the steering wheel with his neck.

From the accident site, he was taken to the central regional hospital by the ambulance

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team. On examination by the surgeon, he presented with complaints *of dull pain in the neck region, voice hoarseness, and swallowing pain*. On his chin region, a wound measuring 2.5 cm was present. Primary surgical debridement was performed, and stitches were applied. On palpation of his neck, *pain in the projection of the larynx and small non-increasing emphysema of the neck's soft tissues, and mild dyspnea* were found. The patient was transported to Ryazan's ENT-unit.

The patient was examined by an otorhinolaryngologist. On laryngoscopy, his *vocal cords were mobile on the left, but had restricted mobility on the right, were hyperemized, and edematous*. The right arytenoid cartilage moderately sagged into the laryngeal lumen and was edematous. *His breathing was loud on exertion, and his larynx was painful to palpation.*

During the day, the patient's condition remained stable. Next, evening, against the background non-productive cough, his condition sharply worsened: progression of emphysema of soft tissues, the buildup of dyspnea. An ENT specialist on duty made a cut on the neck for revision of the larynx and trachea. *Complete separation of the trachea from the larynx was identified. The distal end of the trachea was significantly displaced downward.* A tracheostomy tube was inserted into the trachea and advanced three cm distally from the place of rupture. The patient's condition stabilized; respiratory distress was relieved. The patient was transported to Ryazan Regional Clinical Hospital and hospitalized in the resuscitation unit.

On admission to the hospital, the patient's condition was severe. He had spontaneous adequate breathing through the tracheostomy tube. Soft tissue subcutaneous emphysema of the neck was determined. It was spreading to the chest below the levels of the clavicles, non-exertional, and with no increase in dynamic observation. During auscultation of his lungs, he had vesicular breathing. His respiratory rate was 18 per minute. Stable hemodynamics. Arterial pressure 120/70 mm Hg, heart rate 86 breaths per minute. His electrocardiography and general clinical laboratory tests within the norm.

X-ray computed tomography (X-ray CT) was performed: parietal pneumothorax on both sides, pneumomediastinum, injury of the larynx, emphysema of the soft tissues of the neck and the chest wall (Figure 1).

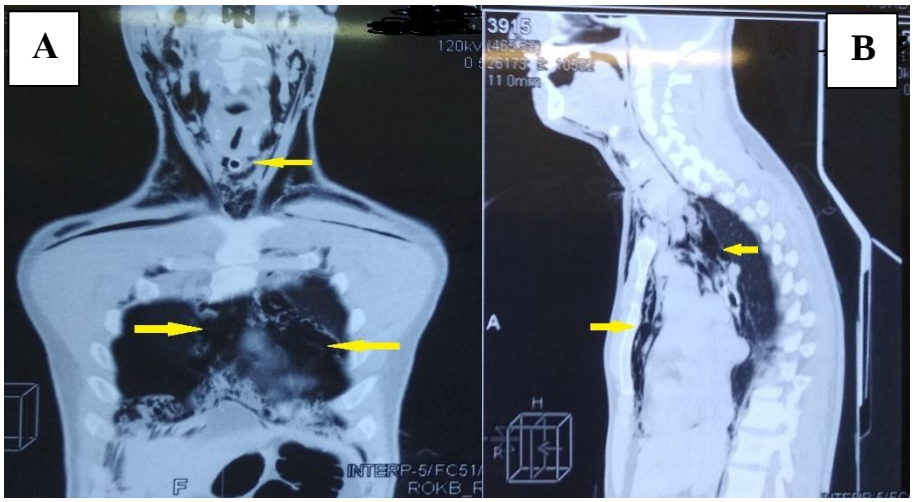

Fig. 1. X-ray computed tomography of chest organs, frontal (A), and sagittal (B) projections. Emphysema of soft tissues of the neck, of the chest, is determined (pointed to by arrows). The tracheostomy tube is visualized

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In fibrotracheobronchoscopy (FTB), an injury to the trachea along the anterior wall, pronounced edema, defects of the mucous membrane were visualized.

The patient was urgently operated on. In addition to the longitudinal incision previously made in ENT-clinic, a transverse incision was made, soft tissues were dissected by crossing the isthmus of the thyroid. In surgical revision, *a complete separation of the trachea from the laryngeal cartilages was identified with diastasis of the ends about 2 cm.* In the trachea, the earlier installed tracheostomy tube was visualized. The cricoid cartilage and the first tracheal ring were isolated, laryngotracheal anastomosis was applied with interrupted sutures (vicryl 3/0). In the water test, the zone of anastomosis was closed hermetically. The zone of the anterior sutures was additionally covered with a Tachocomb plate. The wound was sutured layer-by-layer. The chin was adducted to the chest and fixed with additional sutures (Figure 2). The patient was extubated in the operation room and brought to the resuscitation unit with spontaneous breathing recovered.

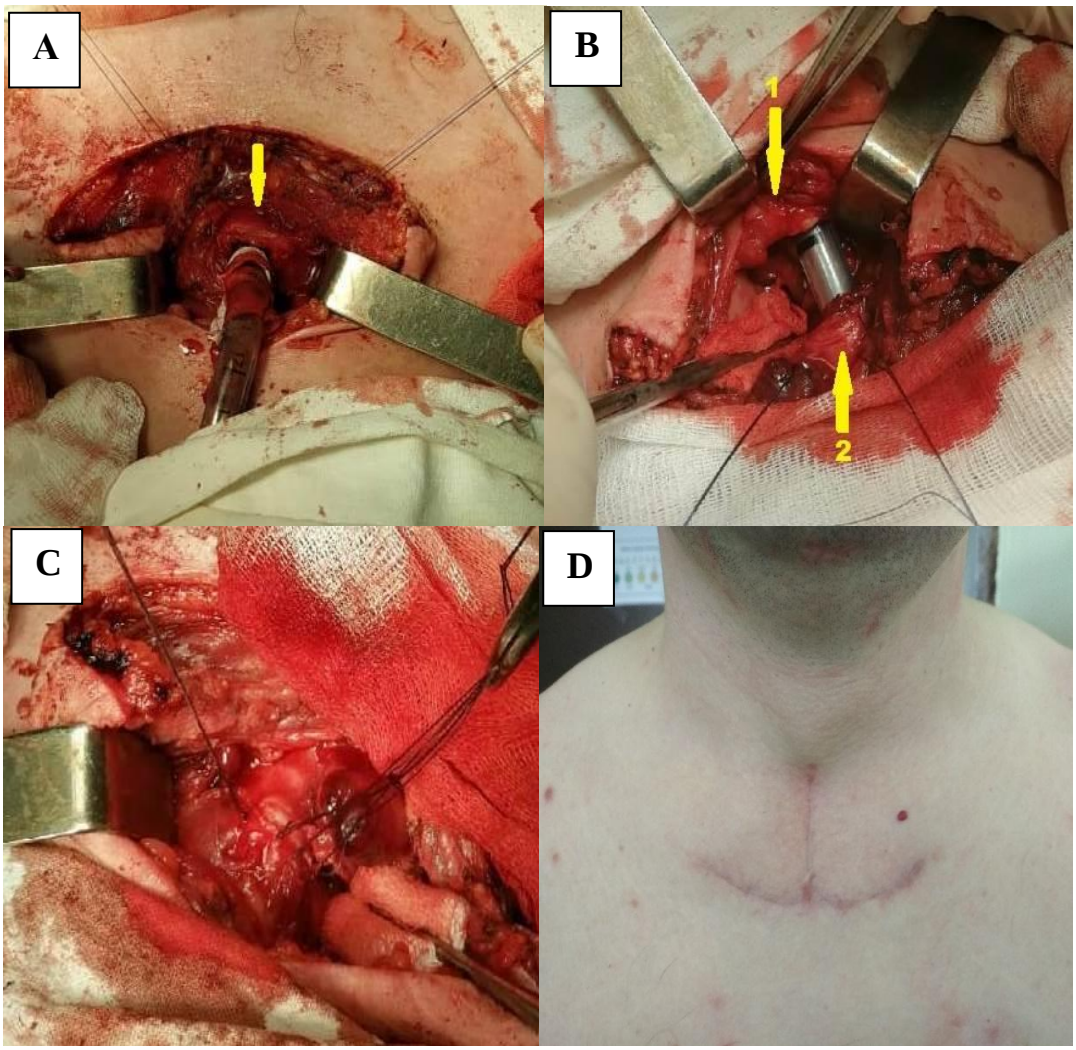

Fig. 2. Stages of surgery: wound revision, a complete separation of the trachea from the larynx, in the distal part tracheostomy tube is visualized (A); the patient is re-intubated (B); laryngotracheal anastomosis is formed, application of vicryl interrupted sutures on the anterior wall of the anastomosis (C); the final view of the postoperative wound (D).
Notes: 1 – larynx, 2 – trachea

The postoperative period ran smoothly. His apical pneumothorax and mediastinal emphysema were alleviated with drug therapy. No pleural punctures and draining of the pleural cavities and the mediastinum were required. In the control, FBS took nine days after the operation, some narrowing of the tracheal lumen in the place of suture application (by ¼), edema and hyperemia of the mucous membrane, granulation in small amounts were determined. Paresis of the left vocal cord.

In the 2-month follow-up, no signs of respiratory distress were found. In the control FBS, the trachea was freely patent, with no signs of obliteration and no granulations.

The patient's voice hoarseness persisted and was associated with injury to the left recurrent laryngeal nerve. The patient was observed by a phoniatrist.

Summarizing the given clinical case description, it is necessary to note that *blunt traumas of the cervical part of the trachea are rare and may present a serious problem even for experienced clinicians.* Complete tracheal ruptures or separation from the larynx as consequences of blunt chest trauma present an extremely dangerous condition with high lethality.

In blunt traumas, damage to the trachea's intrathoracic part and major bronchi comprise 62%, of the cervical part – 23%, and of lobar bronchi – 15% [1,4,5-7]. The main cause of trauma of the cervical part of the trachea is a direct blow on the area of the neck with a blunt object. Traffic accidents account for 59% of all causes. The second leading cause is traumas from crushing (27%). Less common causes are sport-related injuries. In the literature, there are reported cases of injury of the trachea in combat sports, American or classic football, and rugby. Other, more rare causes include falling from the height on the stairway, on the rails, on other blunt objects, suicide (hanging), hitting against a stretched rope, a blow with a pipe, a stick, others [3,5,7].

Inside the chest, the trachea is reliably protected against external influences along a sufficient length by the sternum and adjacent organs. Its cervical part is most vulnerable despite being protected by soft tissues and muscles of the neck, spine, clavicles, and lower jaw. The cervical part of the trachea is often injured together with neighboring structures in the case of cut/stab wounds.

The mechanism of injury to the cervical trachea in blunt trauma continues to be studied. At present, three theories exist describing the mechanism of the injury to the trachea and bronchi resulting from blunt trauma. According to the *first theory*, trachea-bronchial injuries result from a sudden chest compression in the anteroposterior direction and expansion in the transverse direction. The *second theory* suggests that tracheal injury is caused by a sharp rise of pressure in the airways' lumen due to chest compression and reflex closure of the glottis. Anatomically lungs are fixed and immobile in the region of bifurcation of the trachea and the initial parts of major bronchi. However, in the pleural cavity, they are free and may be displaced. According to the *third theory*, the sudden deceleration of the transport vehicle in a vehicle accident, a shear force causes the rupture of the fixed trachea or major bronchi [6].

These mechanisms may occur both independently and simultaneously. This explains the more common (80%) location of the tracheal rupture at the distance of 2.5 cm from the bifurcation in case of blunt trauma of the chest [6-9]. Tracheal ruptures at a distance up to 1 cm from the cricoid cartilage comprise more than 4% [9]. Direct blows on the neck region are mostly associated with damage to the laryngeal cartilages, often preserving the integrity of the skin. Injury to the trachea in blunt neck trauma may be caused by relative immobility of the trachea due to its fixation with connective tissue and compression of it between a traumatizing

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agent and the spine. Rupture and separation of the trachea from the larynx may probably occur in a rapid hyperextension of the neck at the moment of trauma.

Typical clinical manifestations of tracheal trauma are neck pain, pain in swallowing, shortness of breath, cough, hemoptysis, and disorders in phonation. Physical examination of the victim reveals widespread subcutaneous emphysema (35-85%), bruises, and hematomas of soft tissues, which are prone to rapid progression, cyanosis, pneumothorax (20-50%), hemoptysis (14-25%). Also, dysphonia and paralysis of the vocal cords are noted in 46% of patients [9]. In patients with a partial breakage of the integrity of the trachea without its displacement, a false paratracheal passage through the soft tissues can form, which can support independent breathing. In such patients, the development of subcutaneous emphysema and the progression of dyspnea may be delayed. Such partial tracheal injuries may be overlooked in patients with severe polytrauma. The frequency of early misdiagnosis can reach 35-68% [6,11]. *A peculiarity of a partial tracheal rupture is a gradually increasing shortness of breath, hoarseness, the appearance of hemoptysis, and subcutaneous emphysema. With a complete rupture, the skin of the neck's anterior surface can perform oscillatory movements in breathing. Palpation through this mobile area may identify a tracheal defect.*

On suspicion of trauma of the trachea, an urgent X-ray and endoscopic examinations are indicated. *It should be emphasized that up to 10% of patients with tracheobronchial damage may not have any alterations on X-ray in the early posttraumatic period.* A standard chest X-ray may reveal pneumothorax, pneumomediastinum, and emphysema of soft tissues of the neck and chest. However, these signs should not be considered specific. Emergency FBS is indicated in all cases of suspicion of tracheal and bronchial integrity breakage. Besides, FBS permits to perform intubation and place the tube distally from the place of injury.

The main task of first aid is to provide airway patency. In the literature, there is a continuing dispute as to the best method to do it in the best way–by tracheal intubation or tracheostomy. Blind intubation without an exact understanding of the character of the tracheal damage is extremely dangerous. It is linked with a probability for extratracheal intubation that may lead to irreversible damage of the airways, asphyxia, and death of the patient.

Lethality remains high. Bertelsen and Howitz, based on an analysis of 1187 autopsies of victims of road accidents, found that 33 patients (0.03%) had tracheobronchial injuries. Of them, 27 died immediately after the accident, and 24 had severe traumas. About 82% (27 patients) died at the scene of the accident.

Thus, a significant number of patients with complete tracheal abruption die at the scene of trauma. In our patient, the primary tracheal defect was probably covered with a flap of the separated mucous membrane (that was identified intraoperatively). Later on, with the progression of tissue edema and intensive coughing, the final separation of the trachea and the larynx occurred with the development of a critical state that required urgent surgical intervention. Unfortunately, the absence of technical capabilities did not permit the primary laryngotracheal anastomosis to be performed immediately and avoid tracheostoma application.

Conclusion

Tracheal trauma is a potentially fatal state. Therefore, early diagnosis of tracheobronchial injuries is of paramount importance to permit performing timely surgical intervention and reduce the risk of lethal outcome. When dealing with patients with trauma of the head, neck, and chest with non-corresponding manifestations and the absence of effective recommended standard therapeutic measures, a clinician should be alert and exclude tracheal and bronchial damage.

X-ray computed tomography and fibrotracheobronchoscopy are strongly recommended as reliable diagnostic methods of tracheobronchial injuries. In surgical intervention, it is necessary to try to make the primary tracheal suture, avoid preventive tracheostomy, and delayed interventions, associated with poorer prognosis and a high frequency of complications.

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Информация об авторах [Authors Info]

***Михеев Алексей Владимирович** – к.м.н., доц., доцент кафедры факультетской хирургии с курсом анестезиологии и реаниматологии, ФГБОУ ВО Рязанский государственный медицинский университет им. акад. И.П. Павлова Минздрава России, Рязань, Россия. [**Alexey V. Mikheev** – MD, PhD, Associate Professor, Associate Professor of the Department of Faculty Surgery with the Course of Anesthesiology and Resuscitation, Ryazan State Medical University, Ryazan, Russia.]
SPIN: 7573-0479, ORCID ID: 0000-0001-6936-1451, Researcher ID: W-8712-2018. E-mail: almiheev77@mail.ru

Трушин Сергей Николаевич – д.м.н., проф., зав. кафедрой факультетской хирургии с курсом анестезиологии и реаниматологии, ФГБОУ ВО Рязанский государственный медицинский университет им. акад. И.П. Павлова Минздрава России, Рязань, Россия. [**Sergey N. Trushin** – MD, PhD, Professor, Head of the Department of Faculty Surgery with the Course of Anesthesiology and Resuscitation, Ryazan State Medical University, Ryazan, Russia.]
SPIN: 4679-3870, ORCID ID: 0000-0003-0470-6345, Researcher ID: X-9102-2018.

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