DOI http://doi.org/10.30978/UTJ2024-3-59
УДК 617.54-001.45-089-072.1

ISSN 1605-7295 (Print)
ISSN 2522-1175 (Online)

Features of diagnosis and treatment of a polytrauma victim with predominant closed chest trauma with lung and diaphragm rupture. Clinical case

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The article describes a clinical case and presents clinical signs of traumatic rupture of the diaphragm and lung on the background of a wave-like course of the postoperative period. Open diaphragmatic injuries are more common than closed ones. In this case, the closed chest and abdominal trauma was sustained as a result of a road traffic accident. The injury was combined and severe, with signs of traumatic shock. The location of the diaphragmatic injury was on the right side, which is less common. The severe condition of the patient with respiratory failure (respiratory rate over 30 per minute) was an indication for artificial lung ventilation, which made it impossible to take complaints and anamnesis.

The individual spatial topography of the diaphragm depends on the size and location of the abdominal organs, body structure, and depends on the line of examination. The movement of internal organs into the pleural cavity indicates a diaphragmatic rupture, but in this case, the extrahepatic location of the diaphragmatic defect was covered by the liver, the lower lobe of the right lung, and adhesions, which led to the coverup of the diaphragmatic defect. Increased abdominal size due to polytrauma and mechanical ventilation in case of closed chest and abdominal trauma; increased air discharge through pleural drainage during video laparoscopy or increased abdominal size during video thoracoscopy; clamping of the pleural drainage with a spiral computed tomography of the chest and abdominal organs allows detecting pneumoperitoneum and pneumothorax, which indicates the presence of a defect in the diaphragm and lung. The use of video thoracoscopy, video laparoscopy, and spiral computed tomography does not always provide complete information about the existing damage to the diaphragm, so dynamic observation with control radiological examinations is preferred.

Keywords:
traumatic rupture of the diaphragm, traumatic rupture of the lung, polytrauma.

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Отримано • *Received*
25/06/2024
Прийнято до друку • *Accepted*
23/07/2024

Diaphragmatic injuries occur in 0.5—5.0 % of all combined injuries. The rupture of the organ in a closed injury occurs more often at the junction of its muscular and tendon parts. The size of the resulting defect can vary significantly (from 2 to 20 cm). Due to the anatomical features of the body, injuries to the left cupula predominate. Bilateral, multiple ruptures are rarely detected. Injury to the diaphragm in open trauma can be localized in any part of it. Due to the difficulty of diagnosis, 50—70 % of victims do not have a diaphragmatic defect detected during their lifetime. Patients die from severe combined thoracic or abdominal injuries, late complications of undiagnosed pathology. The prognosis largely depends on the nature of the injury and the size of the defect. About 50 % of patients with diaphragmatic rupture die from fatal complications before the diagnosis is done. Death in the postoperative period occurs in 35 % of cases, more often due to the presence of combined injuries [3].

It should be noted that the actual incidence of traumatic diaphragmatic rupture (TDR) is much higher, as a significant number of victims die during evacuation. The problem of diagnosing TDR in the acute period is one of the

most difficult. It is influenced by the severity of the general status of the victims, the nonspecificity of complaints and symptoms, and the damage to other organs and systems [6, 7].

The timely diagnosis of TDR becomes especially important in the presence of combined injuries, primarily traumatic injuries of the extremities, pelvis and head. Shockogenous polytrauma does not allow for a full range of diagnostic measures, among which a special place is given to radiological methods. In such cases, it becomes impossible to perform radiocontrast and radiodynamic examination methods. Thus, the difficulties in diagnosing TDR in combined trauma significantly increase the number of diagnostic and tactical errors and mortality. Despite the importance of the problem, the issues of indications and contraindications for the use of specific methods of diagnosing TDR and means of improving safety during these methods remain controversial, primarily in relation to the method of thoracoscopic diagnosis of diaphragmatic injuries [9].

Older people are most susceptible to diaphragmatic rupture. This is due to a loss of strength due to an increase in the tendon centre. Diaphragmatic rupture occurs: in car accidents, in cases of falling from a great height. Due to the fact that the right cupula of the diaphragm is protected by the liver, an acute increase of intra-abdominal pressure leads to a rupture of the left cupula. Diaphragmatic rupture can be classified as a complex closed injury. It should be noted that more than 50 % of cases of diaphragmatic rupture are fatal [10].

Traumatic diaphragmatic injury has its own peculiarities in diagnosis and treatment, so we consider it necessary to share our own experience.

Objective is to demonstrate the peculiarities of diagnosis and treatment of a victim with polytrauma with a predominant closed chest injury with lung and diaphragm rupture.

Clinical case

Injured P., 51 years old, man, was involved in a road traffic accident, transported to the advanced surgical team in a severe status, where he received first aid, evacuated to the Military Medical Clinical Centre of the Northern Region of the Armed Forces of Ukraine, and hospitalized in the emergency department.

Diagnosis: Combined cranio-thoracic-skeletal trauma. Closed head injury. Mild brain contusion. Multiple abrasions of the face and scalp. Closed chest injury. Closed fracture of the first rib on the right, I—II ribs on the left. Post-traumatic pulmonitis. Closed abdominal injury. Contusion of the soft tissue of the anterolateral wall on the right. Open fracture of the right radial bone with displacement of the fragments. Closed fracture of the right thigh bone with displacement of the fragments. Closed fracture of the left thigh bone and left tibia with displacement of the fragments. Traumatic shock of the third degree. Surgery: laparocentesis, drainage of the abdominal cavity.

The injured man was admitted in severe general status condition on artificial lung ventilation. His level of consciousness is sopor. The right upper and lower limbs were immobilised with ladder-like splints. The injured man was taken to the emergency room, where he underwent anti-shock measures, chest and abdominal ultrasonography according to the FAST protocol («Sonosite Micromaxx, 2017»): no free fluid was detected. General clinical blood and urine tests, biochemical blood tests, blood coagulogram were collected and performed on the Respons 920 (Germany) and «Lab Analyt» (China), «HumaClot Duo Plus» (Germany), «Labline 40» and «Sunrise» (Austria) with additional equipment «Biorad» and «Biosan». A cranial, chest and abdominal spiral computed tomography (CT) was performed on a «Toshiba Activion 16» apparatus with a tomographic step of 0.5 mm, revealed a subarachnoid hemorrhage, a fracture of the first rib on the right, I—II ribs on the left, and a partial pneumothorax on the right. Control chest and abdominal radiographs, radiographs of the right upper and lower extremities were performed using the diagnostic radiographic complex KRD-50 «Indiascop-01» (Ukraine), revealed a fracture of the right radial bone with displacement of fragments, a fracture of the right thigh bone with displacement of fragments, a fracture of the left thigh bone and left tibia with displacement of fragments. Fibrogastroduodenoscopy and fibrobronchoscopy were performed on a video endoscopic stand «Olympus CV-170, 2017». Videolaparoscopy and videothoracoscopy were performed on the «Olympus Visera 4K UHD OTV-S400, 2021» video endoscopic stand.

The final diagnosis was done: Combined craniothoraco-skeletal trauma. Closed cranial injury. Mild brain contusion. Subarachnoid hemorrhage. Multiple abrasions of the face and scalp. Closed chest injury. Rupture of the middle lobe of the right lung. Rupture of the cupula of the diaphragm on the right. Pneumothorax. Closed fracture of the first rib on the right, the first and second ribs on the left. Emphysema of the face, neck, chest and torso. Coagulated right-sided hemothorax. Intra-hospital bilateral lower lobe pneumonia. Respiratory failure of the third degree. Closed abdominal trauma. Liver abrasions (AAST I). Pneumoperitoneum. Traumatic shock of the third degree. Acute renal failure.

The data of the chest spiral CT of the injured on admission are demonstrated in Fig. 1.

Surgeries: laparocentesis; drainage of the abdominal cavity, thoracentesis on the right, drainage of the pleural cavity by Bühlau; video laparoscopy, revision of the abdominal organs, diathermocoagulation of liver abrasion, rehabilitation and drainage of the abdominal cavity. xx.xx.202 xr — primary debridement of the right radiocarpal joint wound, open reduction, transcutaneous fixation of the right radial bone with pins, fixation of the right thigh bone with an external fixation apparatus (EFA) of the 'thigh bone femur-tibia' type, fixation of the left thigh bone and left tibia with EFA of the 'thigh bone-tibia' type. xx.xx.202xp — Redrainage of the right pleural cavity according to Bühlau. xx.xx.202xp — median transverse-longitudinal tracheotomy. xx.xx.202xp — drainage of the right pleural cavity according to Bühlau.

The signs of pneumoperitoneum were considered as a consequence of laparocentesis. During videolaparoscopy, a ruptured diaphragm on the right was not detected due to its extrahepatic location.

The data of chest spiral CT on the 4th day, following injury are demonstrated in Fig. 2.

In the course of treatment, haemodialysis, control chest and abdominal radiographs, chest and abdominal ultrasonography were done, positive dynamics was noted, but on day 9, following injury, signs of pneumothorax on the right and pneumoperitoneum appeared.

The data of chest spiral CT on the 9th day, following injury are demonstrated in Fig. 3.

Due to an increase in air discharge from the pleural cavity, which occurred after changing the position in bed, fibrogastroduodenoscopy was performed, perforation of the hollow organ was excluded. During chest and abdominal CT, the pleural drainage was clamped for diagnostic purposes, the abcupulan began to increase in size (CT data also confirmed this fact), which indicated the presence of a diaphragmatic defect.

The surgery was performed: Video-assisted thoracoscopy on the right, conversion, anterolateral thoracotomy on the right, revision of the pleural cavity, pleurolysis, decortication, suturing of the defect of the middle lobe of the right lung and the cupula of the diaphragm, sanation and redrainage of the right pleural cavity according to Bühlau.

During the operation, after three times disinfection of the surgical field with antiseptic solutions under general anesthesia, an access of 1.5 cm in diameter was made in the VI intercostal space along the middle axillary line on the right and in the IV intercostal space along the anterior axillary line on the right. Due to the impossibility of disconnecting the right lung from breathing (the victim has a tracheostomy), due to decreased oxygen saturation, the right pleural cavity was not accessible for examination. Conversion. An anterolateral thoracotomy was performed in the 5th intercostal space. An extensive adhesive process in the pleural cavity is determined. The adhesions were separated by blunt method. About 200 ml of old coagulated blood with fibrin is sanitised in the pleural cavity. Revision reveals a post-traumatic rupture of the right cupula of the

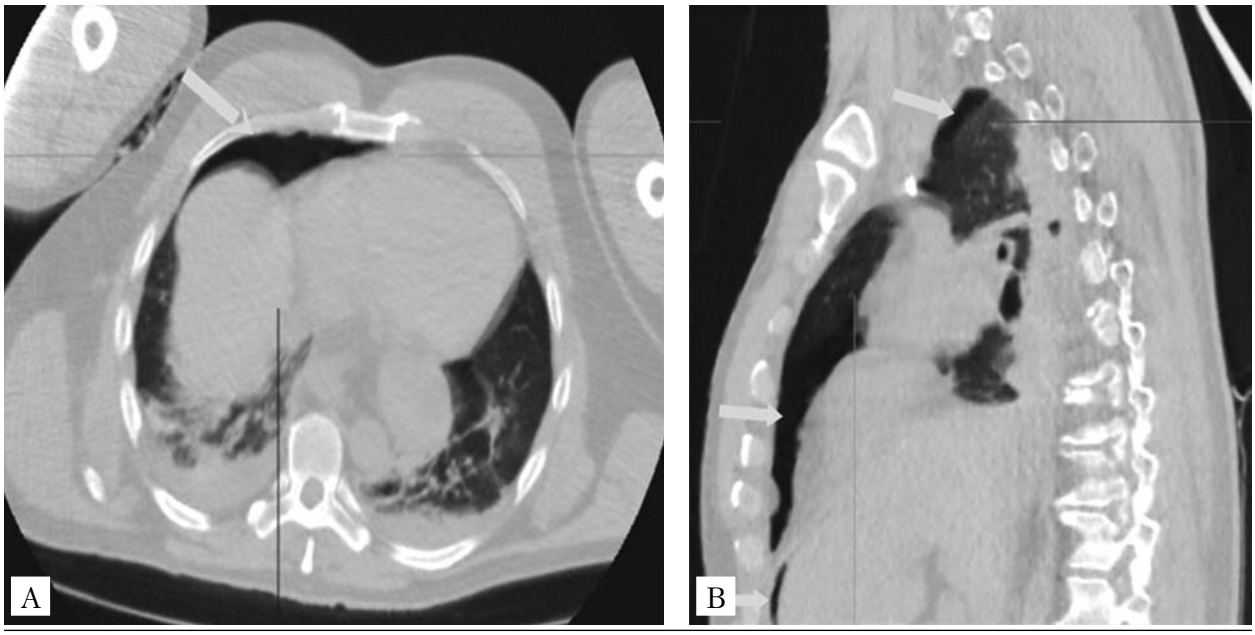

Figure 1. Chest CT scan at the time of admission: A — axial plane: partial right-sided pneumothorax, initial manifestations of posttraumatic pulmonitis; B — sagittal plane: partial right-sided pneumothorax, small pneumoperitoneum

diaphragm up to 12 × 4 cm in size, in which the liver is visualized — the defect is sutured. Further revision revealed that the upper and middle lobes of the right lung were adhered together, adhesions separated by blunt method. Decortication of the right lung was done. In the middle lobe of the right lung, multiple ruptures were detected, from which air was coming. Aerohaemostasis was achieved by suturing the ruptures. No other pathology was detected. The pleural cavity was irrigated with 3 litres of water-based antiseptic solution, sanitized and drained with 2 PVC drains 40 Fr and 28 Fr in the VI intercostal space of the posterior inguinal line on the right and along the middle subclavian line in the II intercostal space, Bühlau drainage was placed. Layer-by layer wound suturing. Aseptic dressings. Intraoperative ultrasonography of the peritoneal cavity demonstrated no free fluid.

Control chest radiography was prescribed to the patient.

The diaphragmatic rupture before and after suturing is demonstrated in Fig. 4.

The diaphragmatic defect was located on the right side at the junction of the muscular and tendon parts of the diaphragm, covered by adhesions in the pleural cavity and the lower lobe of the right lung,

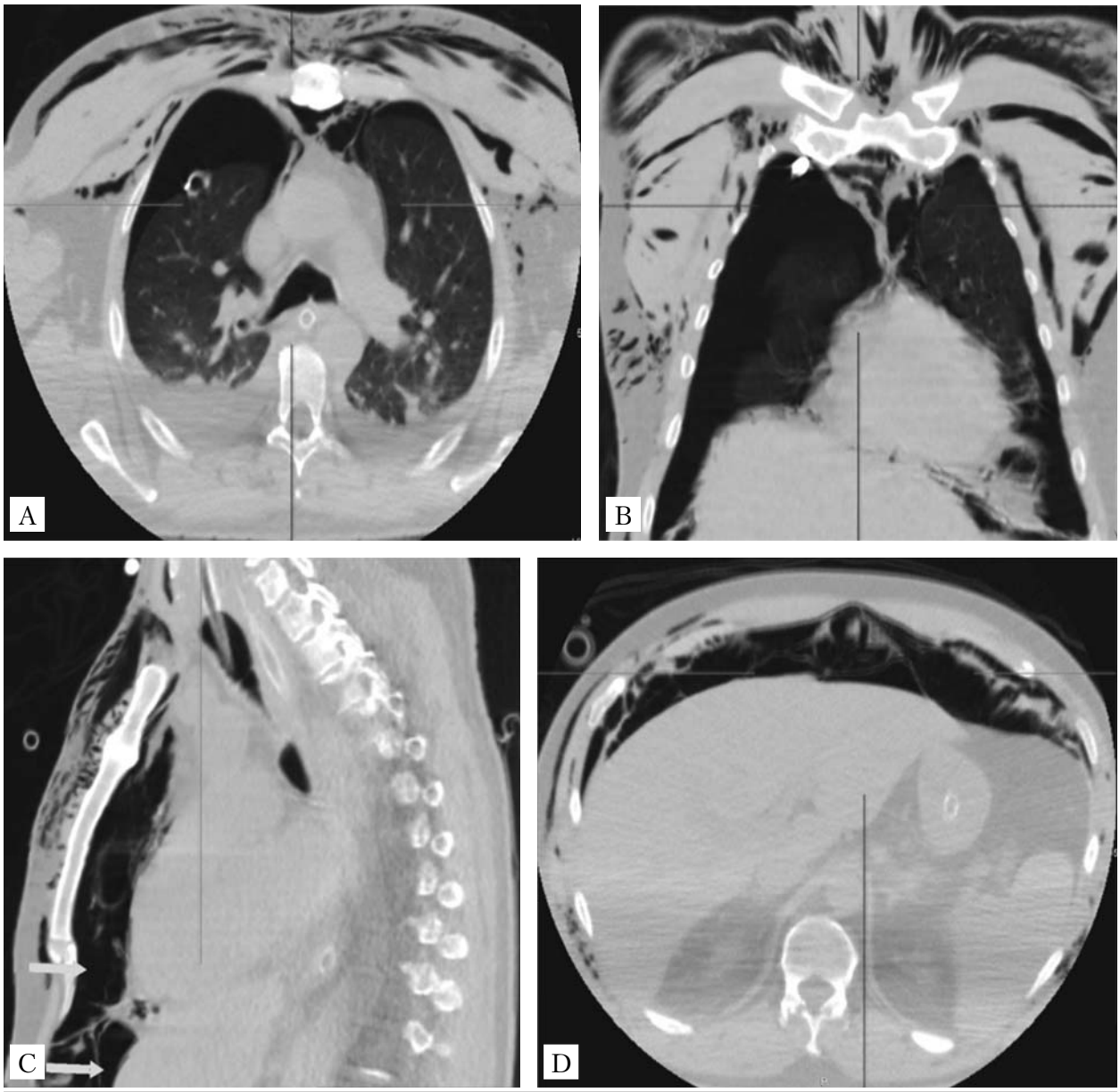

Figure 2. Chest CT scan on the 4th day after injury: A — axial plane: right-sided pneumothorax and pneumomediastinum, posttraumatic pulmonitis of the lower lobes of both lungs, emphysema of soft tissues; B — frontal plane: right-sided pneumothorax and pneumomediastinum, soft tissue emphysema; C — sagittal plane: pneumomediastinum, pneumoperitoneum, soft tissue emphysema; D — axial plane: pneumoperitoneum, soft tissue emphysema

which was initially affected by pulmonitis and then pneumonia. Changing the position of the injured in bed and the regression of the inflammatory process in the lung led to the opening of the junction between the pleural and abdominal cavities.

The clinical course of the postoperative period was without complications. The injured man underwent sanitatation fibrobronchoscopies. Subsequently, the patient was discharged for outpatient treatment in 3 weeks.

Open diaphragmatic injuries are more common [1, 2, 5] than closed ones. In this case, a closed chest and abdominal injury was sustained as a result of a road traffic accident. The injury was combined and severe, with signs of traumatic shock. The location of the diaphragmatic injury was right-sided, which is less common [8].

The patient's severe condition with respiratory failure (respiratory rate over 30 per minute) was an indication for artificial lung ventilation. This made it impossible to take complaints and anamnesis.

Features of the individual spatial topography of the diaphragm depend on the line of investigation, the size and location of the abdominal organs, and

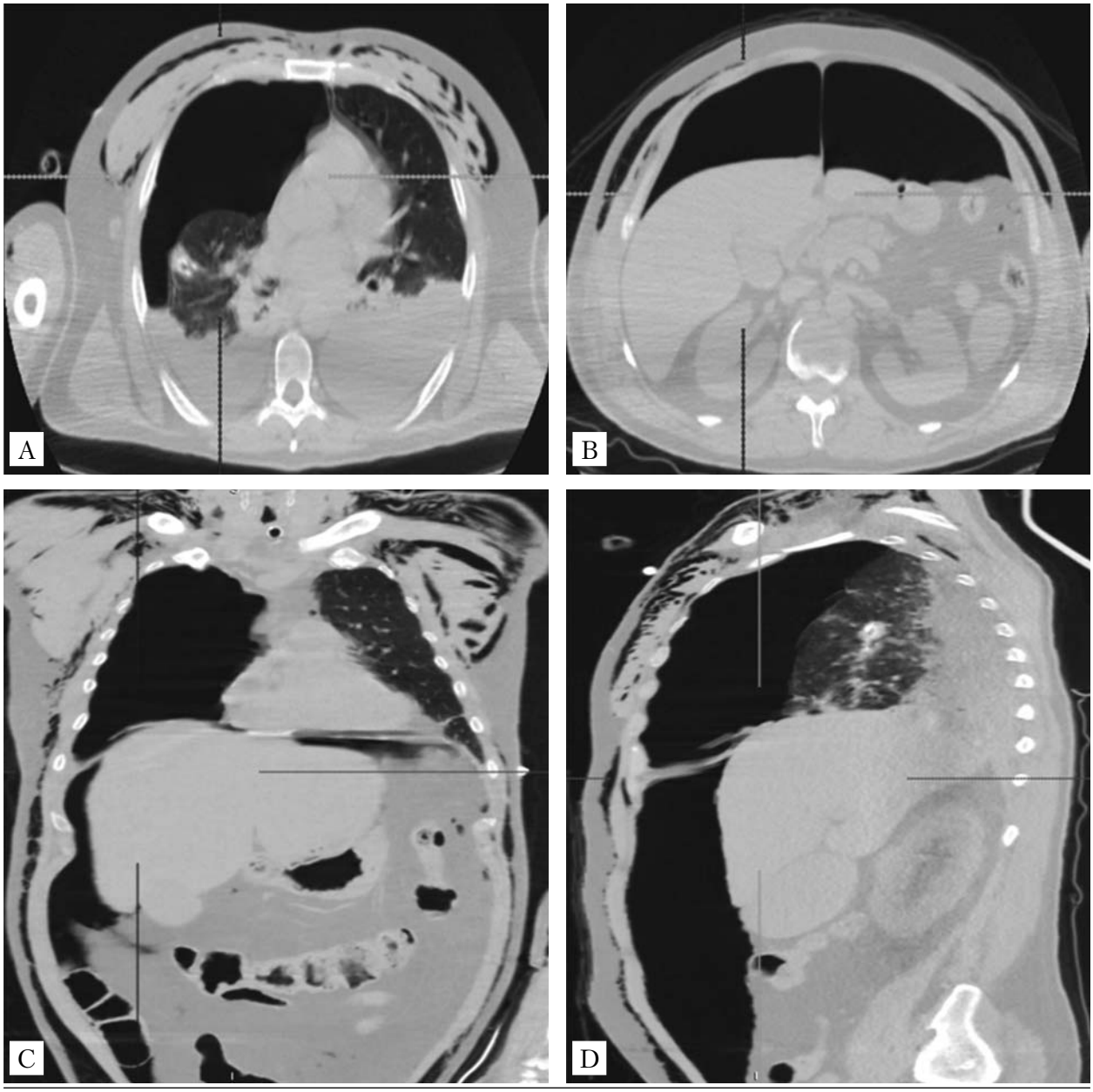

Figure 3. Chest CT scan on the 9th day after injury: A — axial plane: right-sided pneumothorax, bilateral lower lobe pneumonia, soft tissue emphysema; B — axial plane: pneumoperitoneum, soft tissue emphysema; C — frontal plane: right-sided pneumothorax, pneumoperitoneum, soft tissue emphysema; D — sagittal plane: right-sided pneumothorax, pneumoperitoneum, soft tissue emphysema

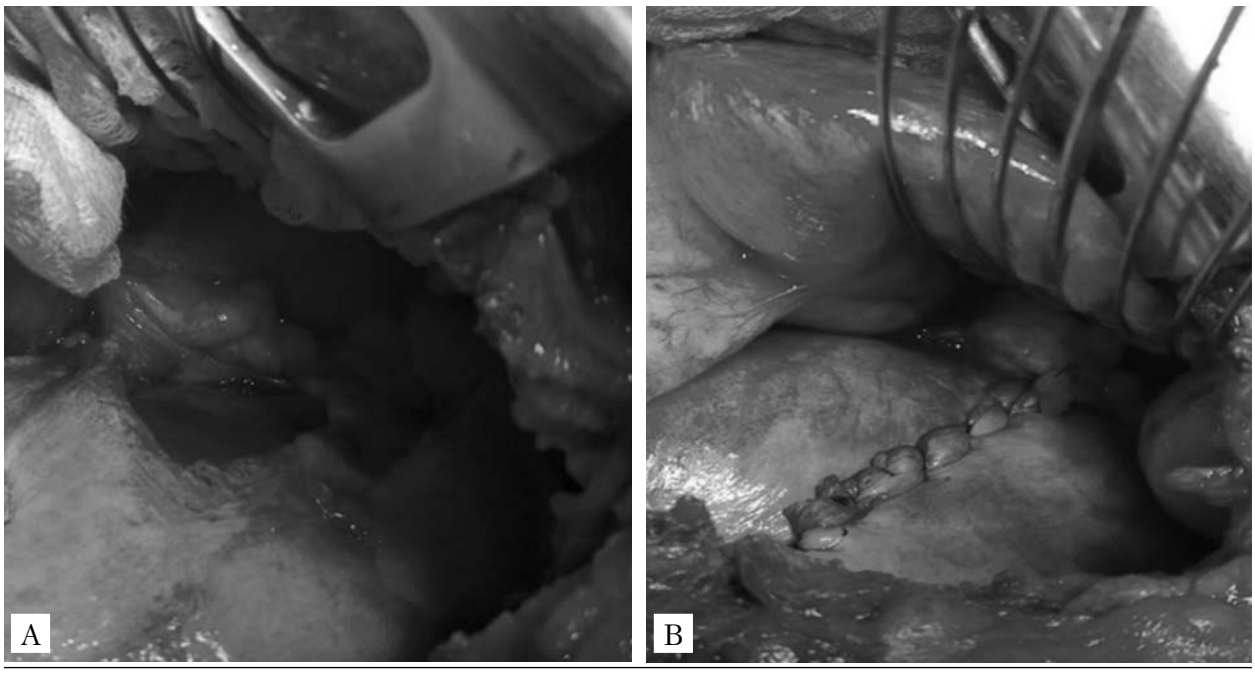

Figure 4. Ten days after a closed chest injury with a diaphragmatic rupture: A — diaphragmatic rupture before suturing; B — sutured diaphragmatic after suturing

the body structure determine the clinical manifestations of the injury [4, 10].

The movement of internal organs into the pleural cavity indicates a diaphragmatic rupture, but in this case, the extrahepatic location of the diaphragmatic defect was covered by the liver, the lower lobe of the right lung, and adhesions, which led to the cover of the diaphragmatic defect.

Clinical signs in the wavy course of the postoperative period, such as an increase in abdominal size in the setting of polytrauma and artificial lung ventilation in case of closed chest and abdominal trauma; increased air discharge through the pleural drainage during video laparoscopy or an increase in abdominal size during video thoracoscopy; clamping of the pleural drainage with the performance of spiral computed tomography of the chest and abdominal organs allows detecting pneumoperitoneum and pneumothorax and indicates the presence of a defect in the diaphragm and lung.

The use of video thoracoscopy, video laparoscopy, and spiral computed tomography does not always provide complete information about the existing damage to the diaphragm, so dynamic observation with control radiological examinations is preferred.

Conclusions

An increase in abdominal size in the setting of polytrauma and mechanical ventilation in closed chest and abdominal trauma, an increase in air discharge through pleural drainage during video laparoscopy, or an increase in abdominal size during video thoracoscopy suggests a diaphragmatic defect.

In the case of an undulating course of the postoperative period, clamping of the pleural drainage with a clamp and performing spiral computed tomography of the chest and abdominal organs allows to detect pneumoperitoneum and pneumothorax, which indicates the presence of pulmonary and diaphragmatic rupture.

The change in the position of the injured person in bed led to a deterioration of his status due to the separation of the pleural adhesions and the opening of the junction between the abdominal and pleural cavities.

The use of video thoracoscopy, video laparoscopy, and spiral computed tomography does not always provide complete information about the existing diaphragmatic injuries.

Evaluation of complaints, anamnesis, objective and laboratory, and instrumental examination data in the dynamics allows to diagnose the existing pathology of the lungs and diaphragm.

Conflicts of interest: none.

Authorship contributions: conception and design, critical revision of the article — E. M. K.;
acquisition of data — V. V. M., S. A. S., V. O. B.;
analysis and interpretation of data, drafting the article — V. V. N., O. H. P.

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Особливості діагностики та лікування постраждалого з політравмою при переважанні закритої травми грудної клітки із розривом легені та діафрагми. Клінічний випадок

Розглянуто клінічний випадок. Висвітлено клінічні ознаки травматичного розриву діафрагми та легені на тлі хвилеподібного перебігу післяопераційного періоду. Частіше трапляються відкриті ушкодження діафрагми, ніж закриті. У наведеному клінічному випадку закрита травма грудної клітки і живота була отримана внаслідок дорожньо-транспортної пригоди. Травма була поєднаною та тяжкою з ознаками травматичного шоку. Правобічна локалізація ушкодження діафрагми, що трапляється рідше. Тяжкий стан хворого з дихальною недостатністю (частота дихання — понад 30 на хвилину) був показанням для проведення штучної вентиляції легень, що унеможливлювало збір скарг і анамнезу.

Індивідуальна просторова топографія діафрагми зумовлена розмірами і розташуванням органів черевної порожнини, тілобудовою та залежить від лінії дослідження. Переміщення внутрішніх органів у плевральну порожнину свідчить про розрив діафрагми, але в наведеному випадку позапечінкове розташування дефекту діафрагми було прикрито печінкою, нижньою часткою правої легені та спайковим процесом. Збільшення розміру живота на тлі політравми та штучної вентиляції легень при закритій травмі грудей і живота, збільшення скидання повітря крізь плевральний дренаж під час відеолапароскопії, збільшення розміру живота під час відеоторакоскопії, перетиснення затискачем плеврального дренажу з виконанням спіральної комп'ютерної томографії органів грудної клітки та органів черевної порожнини дає змогу виявити пневмоперіонеум і пневмоторакс, що засвідчує наявність дефекту діафрагми та легені. Використання відеоторакоскопії, відеолапароскопії та спіральної комп'ютерної томографії не завжди надає повну інформацію щодо наявних ушкоджень діафрагми, тому перевагу слід віддавати динамічному спостереженню й виконанню контрольних променевих досліджень.

Ключові слова: травматичний розрив діафрагми, травматичний розрив легені, політравма.

ДЛЯ ЦИТУВАННЯ

Khoroshun EM, Makarov VV, Negoduyko VV, Shypilov SA, Borodai VO, Petiunin OH. Features of diagnosis and treatment of a polytrauma victim with predominant closed chest trauma with lung and diaphragm rupture. Clinical case. Ukrainian Therapeutic Journal. 2024;3:59-65. http://doi.org/10.30978/UTJ2024-3-59.