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DIAPHRAGMATIC RELAXATION: CLINICAL MANIFESTATIONS AND FORENSIC CONSIDERATIONS

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Abstract

Diaphragmatic relaxation is a rare but critical condition that can lead to severe respiratory complications. This article presents a clinical case of a 36-year-old female patient who presented with severe respiratory distress due to idiopathic left diaphragmatic relaxation, complicated by compression atelectasis and pulmonary embolism. The case underscores the need for heightened vigilance in diagnosing and managing diaphragmatic disorders, particularly in patients with unexplained respiratory symptoms. The findings highlight the importance of recognizing this condition early and considering surgical options as a treatment pathway. By bridging the gap between clinical practice and forensic analysis, this study seeks to improve the management of patients suffering from diaphragmatic dysfunction.

Keywords: *diaphragmatic relaxation, diaphragm dysfunction, surgical intervention, respiratory distress, idiopathic condition, diagnosis, case study.*

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Резюме

ДИАФРАГМАЛЬНАЯ РЕЛАКСАЦИЯ: КЛИНИЧЕСКИЕ ПРОЯВЛЕНИЯ И СУДЕБНО-МЕДИЦИНСКИЕ АСПЕКТЫ

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Диафрагмальная релаксация - редкое, но критическое состояние, которое может привести к тяжелым респираторным осложнениям. В этой статье представлен клинический случай 36-летней пациентки с тяжелым респираторным дистрессом из-за идиопатической левой диафрагмальной релаксации, осложненной компрессионным ателектазом и тромбоэмболией легочной артерии. Случай подчеркивает необходимость повышенной бдительности при диагностике и лечении диафрагмальных расстройств, особенно у пациентов с необъяснимыми респираторными симптомами. Результаты подчеркивают важность раннего распознавания этого состояния и рассмотрения хирургических вариантов в качестве пути лечения. Устраняя разрыв между клинической практикой и судебно-медицинским анализом, это исследование стремится улучшить лечение пациентов, страдающих дисфункцией диафрагмы.

Ключевые слова: *диафрагмальная релаксация, дисфункция диафрагмы, хирургическое вмешательство, респираторный дистресс, идиопатическое состояние, диагностика, исследование случая.*

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Түйіндеме

ДИАФРАГМАЛЫҚ РЕЛАКСАЦИЯ: КЛИНИКАЛЫҚ КӨРІНІСТЕРІ МЕН СОТ-МЕДИЦИНАЛЫҚ АСПЕКТІЛЕРІ

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Диафрагмалық релаксация — сирек, бірақ тыныс алу жүйесінің ауыр асқынуларына әкелуі мүмкін, өте ауыр көрініс беретін жағдай. Бұл мақалада идиопатиялық сол жақ диафрагмалық релаксацияның әсерінен ауыр тыныс алу бұзылысы бар 36 жасар науқастың компрессиялық ателектаз бен өкпе артериясының тромбоэмболиясына асқынған клиникалық жағдайы келтірілген. Бұл жағдай диафрагмалық бұзылыстарды диагностикалау және емдеу кезінде ерекше сақтық танытудың маңыздылығын көрсетеді, әсіресе түсініксіз тыныс алу бұзылыстары бар науқастарда. Зерттеу нәтижелері осы жағдайды ерте анықтаудың және емдеу жолы ретінде хирургиялық тәсілдерді қарастырудың маңызды екенін атап көрсетеді. Клиникалық тәжірибе мен сот-медициналық талдауды байланыстыра отырып, бұл зерттеу диафрагманың дисфункциясымен ауыратын науқастардың емдеу жолын жақсартуды мақсат етеді.

***Түйін сөздер**: диафрагмалық релаксация, диафрагманың дисфункциясы, хирургиялық емдеу, тыныс алу бұзылысы, идиопатиялық жағдай, диагностика, жағдайды зерттеу.*

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Introduction

Diaphragm dysfunction is a respiratory disorder characterized by impaired diaphragm movement, leading to symptoms such as dyspnea, exercise intolerance, and sleep disturbances. It is diagnosed through imaging tests and pulmonary function assessments [9]. A specific form of this dysfunction, diaphragmatic relaxation or elevation, refers to abnormal diaphragm positioning that can cause respiratory distress, particularly during exertion [16]. When the diaphragm is compromised by conditions such as diaphragmatic relaxation, patients may experience paradoxical diaphragm movement, leading to inadequate ventilation and oxygenation [8]. Diaphragmatic relaxation is a critical clinical condition that may result in severe respiratory complications, yet it is frequently underdiagnosed in both acute and chronic contexts. Typically, unilateral paralysis of the diaphragm is asymptomatic and often identified incidentally during X-ray examinations, presenting as dyspnea during significant physical exertion [19]. The etiology of diaphragmatic relaxation is diverse. Traumatic events can lead to diaphragmatic hernias or paralysis due to phrenic nerve injury [1,19]. Congenital conditions, including congenital diaphragmatic hernia, can severely impact respiratory function from birth. Neuromuscular diseases such as Amyotrophic Lateral Sclerosis or Spinal Muscular Atrophy contribute significantly to diaphragmatic dysfunction by weakening the respiratory musculature [7].

The clinical manifestations of diaphragmatic relaxation range from subtle respiratory symptoms to acute respiratory distress syndrome, depending on the severity and cause [14]. Globally, the incidence of diaphragmatic relaxation remains underreported, with few documented cases in the medical literature [2,11]. Recent studies have highlighted the significant impact of diaphragmatic relaxation on overall respiratory health, emphasizing the necessity for early detection and intervention [3]. The lack of awareness among healthcare professionals can delay diagnosis and treatment, exacerbating patient outcomes [4]. In this context, timely identification and intervention are essential to prevent life-threatening complications.

Forensic analysis of diaphragmatic relaxation is critical, as it can provide essential insights into the circumstances surrounding its onset, particularly in cases of trauma. Understanding the mechanisms of injury and the subsequent physiological responses is vital for accurate assessment and management [13].

This article aims to examine the clinical manifestations and forensic implications of diaphragmatic relaxation through a detailed case study, highlighting the importance of timely diagnosis and intervention.

Case Presentation

A 36-year-old female patient was admitted to the emergency department with unstable hemodynamics and complaints of significant weakness and chest pain. Her medical history was notable for episodes of syncope and persistent pallor. The patient described her symptoms as

having intensified over the previous two days, attributing them to a recent episode of physical exertion. In addition, the woman reported that she had been beaten on her abdomen and chest.

Objectively, the patient's general condition was severe due to accompanying abdominal syndrome, pain syndrome, and respiratory failure. The patient appeared severely distressed and assumed a forced posture. Upon examination, the patient exhibited severe dyspnea, with a respiratory rate of 22 breaths per minute and oxygen saturation of 78%. Both sides of the chest moved equally during breathing. The thorax was of normal shape, with no deformities. Auscultation: vesicular respiration, weakened in the lower parts of the left side, no wheezing. Auscultation revealed diminished breath sounds on the left side of her chest. These findings raised suspicion of diaphragmatic dysfunction. Heart rate was 90 per min, and her blood pressure was 110/80 mmHg.

Initial imaging, including chest X-rays and CT scans, revealed left diaphragmatic relaxation accompanied by compression of the left lung and a significant pleural effusion. Computed tomography of the chest and mediastinum showed a high position of the left diaphragm dome (relaxation), compression atelectasis of S7, S8, S9, and S10 segments of the left lung, and signs of pulmonary hypertension. The review radiograph showed an Rg-picture of the high standing of the left dome of the diaphragm, with compression of the lower parts of the left lung. Ultrasonography revealed 80 ml of free fluid in the left pleural cavity.

The next day, the patient experienced a cardiac arrest of the ventricular fibrillation type. After successful resuscitation, the patient underwent laparoscopic diaphragmatic plication. The procedure aimed to restore the diaphragm's normal anatomical position and improve respiratory mechanics. Anesthesia was total intravenous with mechanical ventilation.

Surgical recovery was complicated by acute pulmonary embolism. During the operation, the patient suffered a sudden cardiac arrest. Resuscitation measures were started: cardiopulmonary resuscitation. Against the background of an extremely severe condition, resistant to vasopressor therapy and intensive care measures, she progressed to asystole. There was no effect of resuscitation measures within 30 minutes, and biological death was stated. Final clinical diagnosis were: traumatic relaxation of the dome of the diaphragm on the left (J98.6); acute respiratory failure acute respiratory failure, grade 3 (J96.0); cardiac arrest with successful recovery of cardiac activity (146.0); Obesity 3rd degree (E 66.0); Pulmonary embolism (126.9). Obesity is due to excess energy. Clinical death from XX/XX/2024 successful resuscitation (3 min) TELA.

Following the initial clinical assessment, a forensic examination was conducted to evaluate potential causes of acute respiratory failure.

The external examination revealed no signs of trauma. There were no visible contusions, abrasions, or signs of injection, and the skeletal structure appeared intact with no pathological mobility. The absence of external trauma suggested that the patient's respiratory distress was primarily attributable to diaphragmatic dysfunction rather than external physical injury.

An internal forensic examination revealed several significant findings. The diaphragm exhibited relaxation, characterized by a loss of normal tension and an elevation of the left hemidiaphragm, which was pathologically high (at the level of the third rib). The left diaphragm appeared flabby, stretched, and gathered in folds, with thinning observed (Fig.1). It maintained a normal color, was free from hemorrhages, and exhibited a smooth surface without abnormal formations.

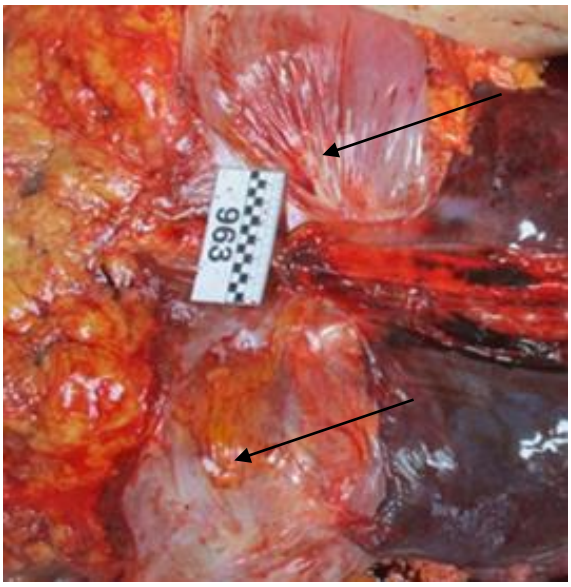

Figure 1. Diaphragm: on the left - flabby, stretched, gathered in folds, thin, of usual color, without hemorrhages, surface smooth, without any formations; on the right side - without features.

A forensic histological examination indicated weakly expressed dystrophic changes in the left diaphragmatic nerve (Fig.2) and focal hemorrhages in the surrounding connective tissue of the diaphragmatic nerve (Fig.3). Additionally, prominent stromal edema (Fig.4) and dystrophic changes in muscle fibers were noted, particularly on the left side of the diaphragm (Fig.5).

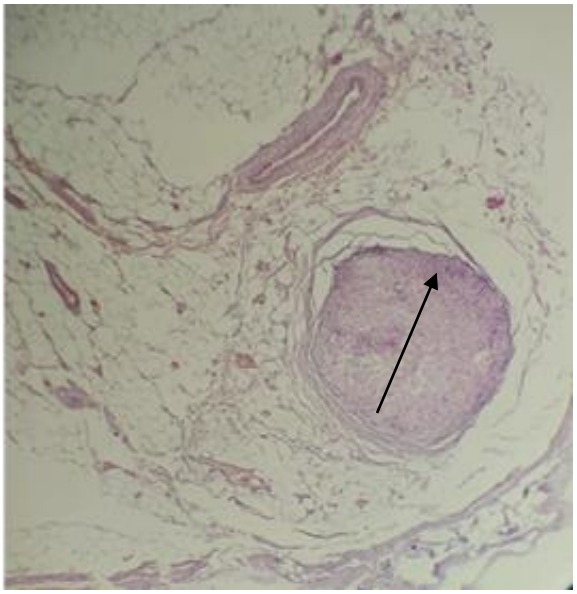

Figure 2. Diaphragmatic nerve (left): Mild dystrophic changes

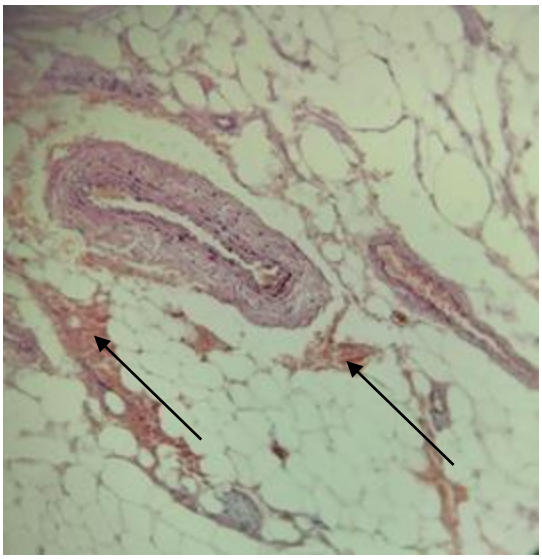

Figure 3. Diaphragmatic nerve (left): Focal hemorrhages in the surrounding fiber of the diaphragmatic nerve

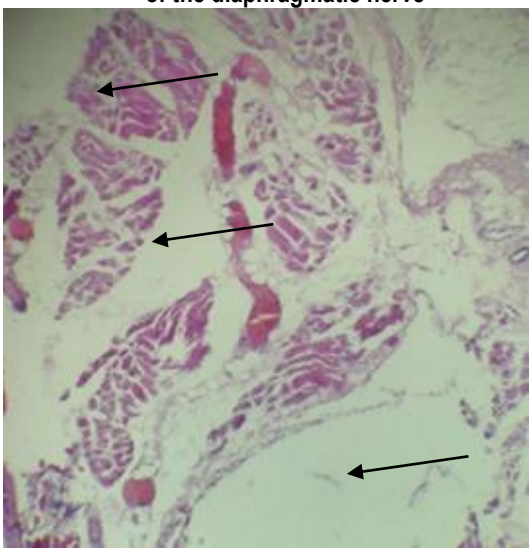

Figure 4. Diaphragm (left): Prominent stromal edema, dystrophic changes in muscle fibers

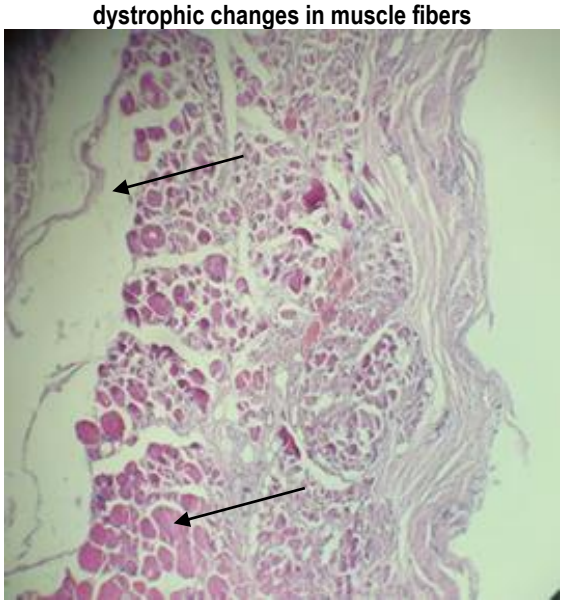

Figure 5. Diaphragm (left): Prominent stromal edema, dystrophic changes, and swelling of diaphragm muscle fibers.

Examination of the lungs revealed a smooth and shiny surface, with the tissue displaying a purplish-red color interspersed with pale pink areas. The right lung is small-air to the touch, featuring multiple greyish-pink foci of acute emphysema slightly elevated above the surrounding pulmonary surface. In contrast, the left lung was sharply collapsed, demonstrating a doughy consistency, with similar greyish-pink foci of acute emphysema.

Microscopic examination of lung tissue samples from the left side indicated areas of compression atelectasis, characterized by collapsed alveoli and significant inflammatory changes (Fig.6). The alveolar walls were thickened, and there was an increase in interstitial fluid, suggestive of pulmonary edema.

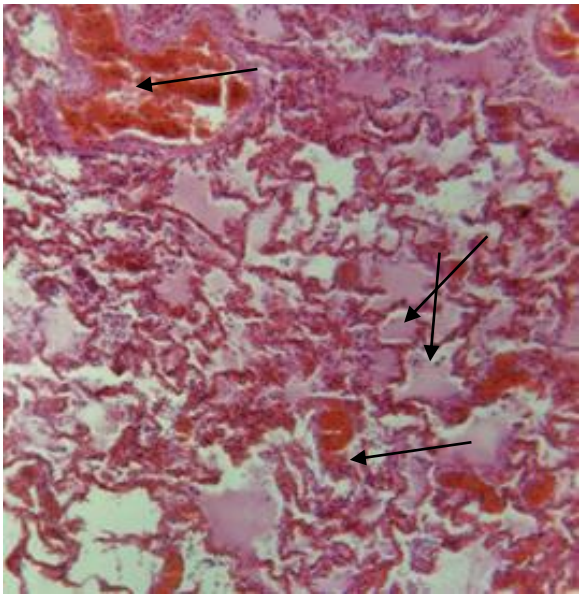

Figure 6. Lung (left): Multiple obturating erythrocyte thrombi in the lumen of pulmonary artery vessels of different caliber and capillaries of interalveolar septa. Large focal extra-alveolar and intra-alveolar hemorrhages of saturated red color. Foci of acute alveolar emphysema of various degrees of severity and spread, with thinning and defects of several interalveolar septa, which alternate with areas of collapsed alveoli. Alveolar edema.

The examination of the heart and vascular system revealed signs of strain consistent with acute respiratory distress and potential hypoxic injury. The right ventricle showed signs of hypertrophy, likely due to increased pulmonary artery pressure resulting from the compromised left lung. Histological analysis of the adrenal glands indicated nodular hyperplasia, which may have contributed to the patient's overall instability. The presence of edema in the lungs, alongside the noted pleural effusion, reinforced the diagnosis of acute respiratory failure. Forensic diagnosis: «Idiopathic (of unknown genesis) relaxation of the diaphragm on the left: distended, flabby diaphragm on the left, high pathological standing of the diaphragm dome at the level of the 3rd rib. (J98.6). Complication: Compression atelectasis (compression) of the left lung: sharply collapsed left lung, filling the pleural cavity by ¼, decreased airiness; foci of acute alveolar emphysema of varying severity and distribution, with thinning and defects

of several interalveolar septa, alternating with areas of collapsed alveoli. Pulmonary artery thromboembolism: the presence of mixed thrombus in the lumen of the pulmonary trunk, both pulmonary arteries, spreading to the branches of smaller caliber in the «tree» type…». Furthermore, toxicological analyses were conducted to rule out any substance abuse or poisoning as contributing factors to the patient's condition. The results were negative for common toxins and drugs, supporting the conclusion that the primary cause of her respiratory failure was related to the diaphragmatic dysfunction rather than external factors.

Discussion

Diaphragmatic relaxation is often overlooked in clinical practice, despite its potential to cause significant respiratory compromise. The pathophysiology often involves an imbalance between the diaphragm's forces and thoracic cavity dynamics, resulting in abnormal positioning [8]. While unilateral and bilateral diaphragmatic dysfunction can lead to respiratory failure, unilateral dysfunction is more common [7,9]. Various etiological factors contribute to diaphragmatic relaxation, including congenital defects and nerve damage; however, many cases remain idiopathic [6]. Research increasingly focuses on perioperative diaphragm protection, as diaphragmatic dysfunction can facilitate atelectasis by negatively affecting lung and chest wall mechanics. For instance, *Hu et al.* (2024) highlight the need to monitor diaphragm function during the perioperative period to mitigate complications associated with mechanical ventilation [4]. Mechanical ventilation, while critical for respiratory support, may lead to «myotrauma» (injury to muscle tissue due to mechanical ventilation) and subsequent diaphragmatic dysfunction (DD). The mechanisms of myotrauma are often linked to inadequate mechanical ventilation support, resulting in patient-ventilator asynchrony (PVA). Understanding these mechanisms is essential for developing myotrauma prevention strategies, focusing on appropriate inspiratory effort levels to avoid over- and under-assistance [3].

Various methods exist for tracking diaphragm activity, though their applicability varies in critically ill patients. While measuring transdiaphragmatic pressure following magnetic stimulation of the phrenic nerves is the gold standard, more practical methods like diaphragmatic ultrasound have proven useful for evaluating diaphragm function, particularly in critically ill patients [5,12]. This non-invasive technique enables clinicians to monitor diaphragm morphology and function effectively, enhancing diagnostic accuracy and expediting treatment decisions [15,17].

The diverse causes of diaphragmatic dysfunction necessitate a comprehensive approach to diagnosis and management. A multidisciplinary approach is crucial in managing patients with diaphragmatic disorders. *Di Buono et al.* (2020) emphasize the importance of early surgical intervention in congenital cases to prevent long-term complications such as pulmonary hypoplasia [2]. Early recognition and referral to surgical specialists can significantly enhance outcomes. Rapid identification of diaphragmatic dysfunction in trauma cases can facilitate timely surgical interventions, potentially reducing morbidity and mortality. Advances in minimally invasive surgical techniques allow for more effective management of diaphragmatic issues, reducing recovery times and associated morbidity. Case studies, such as *Migliore et al.* (2017), illustrate the clinical implications of severe diaphragm dysfunction and highlight the need for targeted interventions [11]. Surgical interventions, such as diaphragmatic plication, have shown promise in restoring normal diaphragm function and alleviating respiratory distress [10,18]. Rehabilitation strategies, including deep diaphragmatic breathing exercises, can improve respiratory function post-injury [3]. *Liu et al.* (2024) emphasize that diaphragmatic breathing not only increases lung capacity but also enhances overall respiratory efficiency [8].

In conclusion, the interplay between clinical practice and forensic analysis is crucial for understanding diaphragmatic dysfunction. Early recognition, effective diagnostic tools, and appropriate management strategies can significantly enhance patient outcomes. Integrating forensic insights into clinical assessments improves our understanding of diaphragmatic dysfunction and contributes to more effective treatment protocols, ultimately leading to better recovery trajectories for affected patients.

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Contribution of the authors: *Each of the authors made an equal contribution.*

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References:

1.*Abdellatif W., Chow B., Hamid S., Khorshed D., Khosa F., Nicolaou S., Murray N.* Unravelling the Mysteries of Traumatic Diaphragmatic Injury: An Up-to-Date Review // Can Assoc Radiol J. 2020. №3(71). P. 313-321.

2.*Di Buono G., Agrusa A., Amato G., Bonventre G., Ricupati F., Romano G.* Successful laparoscopic management of congenital diaphragmatic relaxation: A case report // Int J Surg Case Rep. 2020. №77S. P. S25-S28. DOI: 10.1016/j.ijscr.2020.09.055.

3.*Dubé B-P., Dres M.* Diaphragm Dysfunction: Diagnostic Approaches and Management Strategies // Journal of Clinical Medicine. 2016. №5(12). P. 113. DOI: 10.3390/jcm5120113.

4.*Hu J., Guo R., Li H., Wen H., Wang Y.* Perioperative Diaphragm Dysfunction // Journal of Clinical Medicine. 2024. № 2(13). P. 519. DOI: 10.3390/jcm13020519.

5.*Itagaki T., Akimoto Y., Takashima T., Oto J.* Ultrasonographic Assessment of the Diaphragm // Diagnostics. 2024. № 14(14). P. 1481. DOI: 10.3390/diagnostics14141481.

6.*Kaufman M.R., Ferro N., Paulin E.* Phrenic nerve paralysis and phrenic nerve reconstruction surgery // Handb Clin Neurol. 2022. №189. P. 271-292.

7.Kokatnur L., Vashisht R., Rudrappa M. Diaphragm Disorders // StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024. URL: https://www.ncbi.nlm.nih.gov/books/NBK470172/. (accessed 11.11.2024).

8.*Liu H., Wiedman C.M., Lovelace-Chandler V., Gong S., Salem Y.* Deep Diaphragmatic Breathing - Anatomical and Biomechanical Consideration // Journal of Holistic Nursing. 2024. № 1(42). P. 90-103. DOI: 10.1177/08980101221149866.

9.*McCool F. D., Manzoor K., Minami T.* Disorders of the Diaphragm // Clin Chest Med. 2018. № 2(39). P. 345-360. DOI: 10.1016/j.ccm.2018.01.012.

10. *Mergentay A., Kulov D.B., Bekembayeva G.S., Koikov V., Omarkulov B., Mussabekova S. A.* The analysis of the working load of general practitioners in the Republic of Kazakhstan // Research Journal of Pharmacy and Technology. 2019. № 5(12). P. 2283-2288. DOI: 10.5958/0974-360X.2019.00381.0.

11. *Migliore M., Borrata F., Monaco E., Criscione A.* Massive relaxation of the diaphragm // European Journal of Cardio-Thoracic Surgery. 2017. №4(52). P. 827. DOI: 10.1093/ejcts/ezx183.

12. *Menis A.A., Tsolaki V., Papadonta M.E., Vazgiourakis V., Mantzarlis K., Zakynthinos E., Makris D.* The Relationship of Diaphragmatic Ultrasound-Based and Manometric Indices With Difficult Weaning in Tracheostomized Patients // Respir Care. 2024. №respcare. P.11782. DOI: 10.4187/respcare.11782.

13. *Mussabekova S.A., Burkova E.I., Dobler K.E., Muldasheva B.S., Atmtaev Zh.Zh.* Sudden infant death syndrome as a result of thymic-lymphatic dysgenesis // J CLIN MED KAZ. 2024. №1(21). P.97-100. DOI: 10.23950/jcmk/14266.

14. *Petrof B.J.* Diaphragm Weakness in the Critically Ill: Basic Mechanisms Reveal Therapeutic Opportunities // Chest. 2018. № 6(154). P.1395-1403.

15. *Santana P.V., Cardenas L.Z., Albuquerque A.L.P.* Diaphragm Ultrasound in Critically Ill Patients on Mechanical Ventilation-Evolving Concepts // Diagnostics. 2023. № 6(13). P. 1116. DOI: 10.3390/diagnostics13061116.

16. *Sefton E.M., Gallardo M., Kardon G.* Developmental origin and morphogenesis of the diaphragm, an essential mammalian muscle // Dev Biol. 2018. № 2(440). P. 64-73. DOI: 10.1016/j.ydbio.2018.04.010.

17. *Suttapanit K., Wongkrasunt S., Savatmongkorngul S., Supatanakij P.* Ultrasonographic evaluation of the diaphragm in critically ill patients to predict invasive mechanical ventilation // J Intensive Care. 2023. № 1(11). P. 40. DOI: 10.1186/s40560-023-00690-3.

18. *Zwischenberger B.A., Kister N., Zwischenberger J.B., Martin J.T.* Laparoscopic Robot-Assisted Diaphragm Plication // Ann Thorac Surg. 2016. № 1(101). P.369-371. DOI: 10.1016/j.athoracsur.2015.05.118.

19. *Uryasev O.M., Glotov S.I., Ponomareva I.B., Almazova E.V., Zhukova L.A., Alekseeva E.A.* Dysfunction of the diaphragm // Medical News of North Caucasus. 2022. № 3(17). P. 317-322. DOI: 10.14300/mnnc.2022.17079.

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