

The use of ultrasound in diseases and injuries of the respiratory system

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Abstract

Ultrasound examination of the respiratory system is an easy and non-invasive method for diagnosing respiratory diseases and injuries. This method allows the assessment of damage, neoplastic and inflammatory changes and monitoring of chest therapy.

The article presents a review of the usefulness in diagnostics, including lung cancer, pleural disease and the limitations of this method. The use of ultrasound allows faster and in some cases more accurate diagnosis, translating into the speed of introduction and adjustment of treatment. The advantages of chest ultrasound will soon cause widespread use of it in this field of medicine, which will also translate into reduced costs and increased early detection of many diseases.

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Introduction

Ultrasound is a non-invasive method used in cardiovascular diseases or the assessment of abdominal organs pathology. The first tests began in the 70s of the last century. For several years, however, has been gaining recognition in assessing changes and pathologies of the respiratory system caused by pathogens or injuries. It enables constant monitoring of lesions as well as evaluation of treatment effectiveness, whereas in injuries it is quickly diagnosed. The ultrasound image is created as a result of sending and then

reflecting a wave of a certain frequency on the border of the media, the centers filled with air are, however, practically invisible because they are reflected by the wave. The examination is safe for staff and patient, does not require a lot of time and is relatively cheap. The next car of the ultrasound examination is its mobility, the small size of modern devices makes it possible to perform the examination not only in the conditions of the studio, but also in hospital wards or in the ambulance. This is undoubtedly a great advantage in cases of extensive injuries, but also epidemiological periods. The rest of the article presents the most

common changes in which the use of ultrasound is equally beneficial or more favorable than the standard method used in diagnostics — RTG.

Ultrasound diagnosis of the respiratory system

Respiratory diagnostics of the respiratory system made with the help of an ultrasound machine allows for quick and non-invasive assessment of the injury, which results in the correct adjustment of treatment and the ability to respond appropriately to changes in the patient's state of health. Chest injuries are the most common consequences of traffic accidents — they occur in 75% of collisions, while in 20% they are the result of the victim's death. Depending on the operating factor, a division into blunt and penetrating was established. Blunt injuries are most often caused by crushing, which may result in rib fractures or lung puncture. Penetrating injuries are most often associated with traffic accidents.

A 2015 survey showed that 87.25% of traffic accidents cause chest injuries, other injuries are caused by falls or as a result of improper sporting.

Ultrasound imaging diagnostics makes it possible to detect many consequences of injuries, including finding a picture of a local interstitial or interstitial-alveolar syndrome as a result of lung contusion, and in the case of trauma along with a fracture of the ribs, allows for visualization of the fracture and its consequences such as pneumothorax or pleural hematoma. In addition, it is possible to visualize edema and hematoma of soft tissues (Fig. 1)

Ultrasound diagnostics is also characterized by high sensitivity and specificity in the diagnosis of pneumothorax, which also surpasses routine chest X-ray. The test is performed in a lying or semi-sitting patient, which also reduces the risk of additional injury to the patient. The main symptom visible in ultrasound is the lack of slipping at the point of lung adhesion to the chest wall, which in the appropriate clinical context is characteristic of pneumothorax. This is visible in the study as a stratospheric symptom (fig. 2). At the same time, this point is important for assessing mantle edema or collapsed lung, because non-attachment of the pulmonary pleura to the pleural wall is one of its characteristic symptoms.

Fluid in the body cavities accumulates due to inflammatory and traumatic causes, studies show that ultrasound significantly exceeds the routinely used X-ray and computed tomography, because its sensitivity allows the detection of fluid in trace amounts, while the other mentioned tests require a minimum of tens of milliliters. In addition, due to the appropriate reflection of the wave by the ultrasound scanner, it is possible to approximate the nature of the fluid. Differentiation in the ultrasound image also allows differentiation of pathological changes in the respiratory system, because pathologies, e.g. pneumothorax, lung cancer have a different morphology.

Currently, the most common male cancer, while lung cancer is second to breast cancer. Survival above 5 years is around 10%. Lung ultrasound makes it possible to detect and localize the lesion, moreover, it



Fig. 1.

Rib fracture visible by ultrasound. The horizontally arranged arrow shows the surface of the rib and the vertical the place of cortical layer damage.

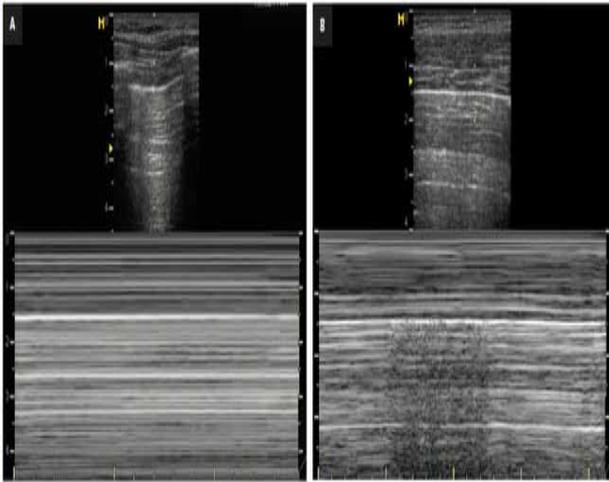


Fig. 2.

Stratosphere symptom - the image of the lung in the M projection has the same signal as the chest wall, which indicates the disappearance of the sliding movement on the pleural line.

outperforms computed tomography in the case of infiltration of the pleural wall and chest wall. Neoplastic etiology is most often characterized by a change with heterogeneous outlines and echogenicity, which maintain continuity in the chest wall, while at the same time enduring respiratory mobility and a sliding symptom. (Fig. 3).

Additional use of the Doppler function allows revealing the vessels of the lesion, which makes it possible to differentiate between benign and malignant lesions. An additional advantage of ultrasound used routinely is the possibility of a skin biopsy. Correctly used ultrasound apparatus allows for visualization of necrosis in the lesion, which contributes to the selection of the correct point of tissue collection for histopathological examination. The use of ultrasound also makes it possible to assess the advancement of TNM classification of lung cancers. The ultrasound will not only reveal the lesion, but also enable assessment of tumor invasion. An important element is also the

examination of supraclavicular areas and the abdominal cavity to detect metastatic foci. Studies show that the incidence of metastases in the supraclavicular nodes ranges between 5-42%.

The infective season also enables the use of ultrasound in the diagnosis of inflammatory changes in the respiratory system. The ease of implementation and its availability means that more and more often in GP surgeries it is possible to perform an examination. Available data show a greater effectiveness of ultrasound than chest X-ray, both of these tests also differ in the possibility of repeated performance and the consequences of their performance. Ultrasound used in the diagnosis of pneumonia gives a sensitivity of about 90%. However, the picture of pneumonia is not specific to diagnose a patient only on its basis. Diagnosis of Pneumonia also requires taking into account the patient's clinical condition and laboratory tests. The study is based on the contact of two centers with extremely different echogenicity. Lung parenchyma,



Fig. 3.

Lung tumor infiltrating the chest wall, resulting in destruction of the ribs.

being directly below the pleura, loses aeration, allowing the air barrier to disappear, resulting in a visible fragment of the lung. Lung inflammation is revealed in this study as an indistinct, irregular border with numerous artifacts (Fig. 4). The lesions characteristic of pneumonia have a polygonal or oval shape and are compatible with respiratory movements. Properly conducted treatment reduces the number of consolidations in direct proportion to the normalizing blood results and clinical condition. It is also worth emphasizing that the use of ultrasound to control inflammatory changes allows their frequent evaluation without complications arising from traditionally performed tests.

Summary

Ultrasound of the respiratory system is a new and rapidly growing field of imaging research. The review shows how extensive the possibilities of using ultrasound at low costs and minimal risk for the patient. The spread of the method enables faster and safer diagnostics, as a result of which the patient will receive a faster response to the disease process, correctly selected treatment, and the possibility of preventing the development of the disease. Ultrasound examination is the past of diagnostics of chest diseases and injuries, due to its low price and safety as well as availability.



References

1. Bandi V., Lunn W., Ernst A. et al.: Ultrasound vs CT in detecting chest wall invasion by tumor: A prospective study. *Chest*, 2008; 133: 881–886
2. Gnojek K, Kopański Z., Gajdosz R., Urazy klatki piersiowej w materiale Szpitalnego Oddziału Ratunkowego Szpitala Uniwersyteckiego w Krakowie *Journal of Clinical Healthcare* 2/2015, 11-20
3. Jaczewski G., Grabczak E., Krenke R., Zastosowanie USG w diagnostyce urazów klatki piersiowej, *Med. Prakt*, 2020
4. Kumaran M., Benamore R.E., Vaidhyanath R. et al.: Ultrasound guided cytological aspiration of supraclavicular lymph nodes in patients with suspected lung cancer. *Thorax* 2005; 60: 229–233.
5. Sowiński R. Ocena przydatności oligobiopsji cienkoigłowej niewyczuwalnych węzłów chłonnych nadobojczykowych wykonywanych pod kontrolą USG do wykrywania przerzutów raka płuca. Rozprawa na stopień doktora nauk medycznych. Pomorska Akademia Medyczna, Szczecin 2000.
6. van Overhagen H., Brakel K., Heijenbrok M.W. et al.. Metastases in supraclavicular lymph nodes in lung cancer: assessment with palpation, US, and CT. *Radiology* 2004; 232: 75–80.
7. Yuan A., Chang D.B., Yu C.J. et al. Color Doppler sonography of benign and malignant pulmonary masses. *Am. J. Roentgenol.*, 1994; 163: 545–549
8. Ziora D., Dzielicki J., Oklek K., Jastrzębski D., Cieśllicki J., Kozielski J. Ocena Przydatności badania palpacyjnego i biopsji Daniela w wykrywaniu przerzutów nowotworowych do węzłów z nad mięśni pochylonych i węzłów nadobojczykowych u chorych na raka płuca. *Pneumon Alergol Po* 1996; 64: 437–443

Fig. 4.

Unification of echogenicity in the course of pneumonia (asterisk). Horizontal arrows point to the aerated bronchogram and vertical arrows to the boundaries of consolidation, which is heterogeneous.