CASE REPORT

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Importance of Artificial Intelligence-based Radiography in the Examination and Treatment of Patients with Subacromial Impingement Syndrome

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ABSTRACT

According to various estimates, shoulder pain covers 7-26% of all diseases faced by the global population. In addition, according to studies by Scandinavian scientists, up to 18% of the population's loss of working capacity and paid sick leave are caused by shoulder pain. According to experts, the number of these diseases is already approaching epidemic levels in Sweden, Finland, Japan, and the United States. Insurance payments for diseases caused by shoulder pain are second only to vertebrogenic pain. Subacromial impingement syndrome is the main cause of this pain. Diagnosis includes a complex of clinical and instrumental research methods. A reliable diagnosis of the presence of subacromial impingement syndrome, as well as the type, nature, and severity of subacromial muscle compression, is achieved using modern methods for visualizing the internal structures of the shoulder. It should be noted that radiography and ultrasound are important among them. To determine the model performance of artificial intelligence in detecting rotator cuff pathology using different imaging modalities and to compare its capability with that of physicians in clinical scenarios. Neck-shoulder syndrome is one of the most frequent causes of disability in the population, accounting for 18% of disability sheets. The treatment of pathologies attracts physicians of various specialties: orthopedic traumatologists, neurosurgeons, anesthesiologists, resuscitators, surgeons, neurologists, therapists, physiotherapists, and physical therapy physicians.

Keywords: Radiodiagnosis, impingement syndrome, shoulder joint, subacromial fibrosis, rotator cuff, etiopathogenetic factors, anatomical structure of the shoulder joint, radiography with artificial intelligence

INTRODUCTION

X-ray examination and treatment of subacromial impingement syndrome are among the most common radiological diagnostic procedures. Manufacturers of diagnostic software based on artificial intelligence (AI) technology are actively developing products to describe research data. Today, remote descriptions of X-ray studies are actively used in radiology diagnostics. With this organization of the diagnostic process, the doctor receives an image for description with a time delay and does not have direct contact with the X-ray technician conducting the study. Therefore, the quality of the examination directly depends on the qualifications of the X-ray technician.

X-ray imaging can be subject to errors, largely due to human factors, that make image interpretation and description difficult for both the radiologist and the AI software, which is worsened under high workload conditions.

Subacromial impingement is the most common type of shoulder impingement and occurs secondary to attrition between the coracoacromial arch and the underlying supraspinatus tendon or subacromial bursa, leading to tendinopathy and bursitis,, respectively.

CASE PRESENTATION

The prevalence of neck and shoulder pain among adults is 4%-7% and increases to 15%-20% at the age of 60-70 years [1]. The number of newly diagnosed cases per year per 1000 is 4-6 at the age of 40-45 years and 8-10 at the age of 50-65 years, with a predominance in women [2].

The structure of the shoulder joint is characterized by anatomical and functional complexity, which makes it a target for the development of various pathological changes under the influence of a number of factors leading to disruption of the stability and strength of articular structures. Damage

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to the rotator cuff can be caused by both external causes (reduction of the subacromial space, increase in the volume of the coraco-acromial arch, instability, overload of the shoulder joint) and internal (changes in vascularization, pathology of the microstructure of collagen fibers, tendon degeneration, etc.) [3].

Pain in the shoulder joint is one of the most common causes of disability in the population, accounting for 18% of sick leave certificates. Their growth is approaching an epidemic in Sweden, Finland, Japan, and the USA, and insurance claims for shoulder pain rank second to vertebrogenic pain.

Modern equipment for X-ray, magnetic resonance imaging, and computed tomography studies has high reproducibility and accuracy. However, these techniques can sometimes give false-positive results regarding changes in the structure of tissues, which can affect a specialist's diagnosis. In this case, the aim of experimental studies is to minimize diagnostic errors, increase accuracy, and make the interpretation of results more accessible.

1) Radiography and sonography make it possible to describe both direct and indirect symptoms of impingement syndrome.

2) The complete information regarding impingement syndrome is provided by a comprehensive X-ray and ultrasonographic study.

In an epidemiological multicenter study of >12,000 workers in 18 countries, generalized pain in the cervical spine and shoulder was reported by 40.7% of participants and by 35.1% in the past year by 35.1%. Frozen shoulder syndrome is characterized by pain and limited mobility in the shoulder joint. Risk factors for frozen shoulder include:

1- Elderly age,

2- Injuries or surgical interventions in the shoulder joint,

3- Diabetes,

4- Cardiovascular diseases,

5- Cerebrovascular diseases,

6- Endocrine pathology,

7- Professions (carpenters, joiners, painters, plasterers, builders, installers, teachers),

8- Sports (volleyball, handball, water polo, tennis, boxing and martial arts),

9- Degenerative-dystrophic diseases of the cervical spine [2].

X-ray of the shoulder joint is considered the simplest and most informative research method, and it allows us to identify the primary signs of impingement syndrome.

At an early stage of pathology, the sensitivity of this technique is low, but signs of pathology can be detected as the process progresses. These changes manifest themselves as signs of rotator cuff ossifying tendinitis, narrowing of the subacromial space, degeneration of the acromioclavicular joint, local osteoporosis, etc. It has been proven that a narrowing of the acromioclavicular interval of less than 6-7 mm clinically corresponds to dislocation of the biceps brachii tendon in the presence of all layers.

The complexity of the anatomical structure of the shoulder joint, together with the multifactorial nature of subacromial impingement syndrome, has contributed to the emergence of research in the field of studying the structure of shoulder joint structures and new methods for diagnosing injuries. There is no unified diagnostic algorithm for examining patients with complaints of shoulder joint pain to verify rotator cuff impingement syndrome, which would facilitate the detection of early signs and eliminate additional expensive diagnostic methods.

DISCUSSION

In the framework of the study, we observed direct and indirect radiographic symptoms of subacromial impingement syndrome in 14 patients. We observed the following direct radiographic signs:

- Narrowing of the subacromial space to less than 7 mm;

- Signs of clavicular-acromial arthrosis (narrowing of the joint space, thickening and unevenness of closed plates, extraneous bone growths);

The indirect radiographic signs are as follows:

- Large bubble osteoporosis of the humerus;

- Thickening of the cortical layer and increased intensity of large bubbles at the attachment site of the supraspinatus tendon.

Our study revealed once again that radiographic examination can identify both direct and indirect symptoms of subacromial impingement syndrome.

Thus, considerable experience has been accumulated in the use of AI to diagnose various diseases. The quality of X-ray examination is an important parameter, which is often given the little time in diagnostic practice. Quality violations can lead to a decrease in the diagnostic value of images, underdiagnosis, and overdiagnosis, as well as malfunctions in diagnostic software based on AI technology. In this study, we demonstrate the effectiveness of transfer learning in classifying radiological images and identifying various quality defects [4].

We have created a Web tool that allows you to analyze diagnostic study data sets. All models integrated into this tool have high diagnostic accuracy metrics of more than 95%, which allows them to be used in clinical practice. Active use of the developed tool and its components will optimize the assessment of the quality of radiological studies for diagnostic and research purposes. Subsequently, the use of this tool can be scaled up for diagnostic studies of other modalities and anatomical areas.

Ethics

Informed Consent: Not necessary.

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REFERENCES

1. Yarikov A, Lobanov I, Perlmutter O, Fraerman A, Tarasov I. Neck-shoulder syndrome: modern interdisciplinary aspects of diagnosis and treatment. Bulletin of Science and Practice. 2022;8:320-40.
2. Zhan H, Teng F, Liu Z, Yi Z, He J, et al. Artificial Intelligence aids detection of rotator cuff pathology: a systematic review. Arthroscopy. 2024;40:567-78.
3. Andronikov EA, Diomidova VN, Nikolaev NS, Drandrov RN, Gogulina NV. Informative value of radiological methods for diagnosing subacromial impingement syndrome. Acta Medica Eurasica. 2023;101-13.
4. Ho CY, Sole G, Munn J. The effectiveness of manual therapy in the management of musculoskeletal disorders of the shoulder: a systematic review. Man Ther. 2009;14:463-74.