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ASSESSMENT OF THE EFFECTIVENESS OF MULTISLICE COMPUTED TOMOGRAPHY (MSCT) IN THE DIAGNOSIS OF THORACIC ORGAN DISEASES IN MILITARY PERSONNEL

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Abstract:

The article analyzes the role of multislice computed tomography (MSCT) in the diagnosis of chest diseases and injuries in military personnel. The high diagnostic value of MSCT in military medical settings is substantiated, where rapid decision-making, imaging accuracy, and dynamic patient monitoring are crucial. The diagnostic capabilities of MSCT in chest trauma are examined, including penetrating injuries, rib fractures, pneumothorax, hemothorax, pulmonary contusion, and the development of acute respiratory distress syndrome. Particular attention is given to the use of MSCT in infectious lung diseases, including atypical pneumonia, as well as in bullous emphysema and spontaneous pneumothorax in young individuals of military age. The method enables detection of minimal structural changes in lung parenchyma, three-dimensional reconstruction of injuries, and effective follow-up assessment. The study concludes that MSCT represents a key imaging modality in military medicine due to its high sensitivity and comprehensive diagnostic capabilities.

Keywords: Multislice computed tomography (MSCT); chest trauma; pneumothorax; hemothorax; pneumonia; bullous emphysema; military personnel; military medicine.

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Introduction

Multislice computed tomography (MSCT) is one of the most advanced and effective diagnostic techniques for thoracic organ diseases, with its role in military medicine continuing to grow each year. Under conditions of combat operations, intensive training, and other factors inherent to military service, personnel are exposed to a wide range of thoracic diseases and injuries, including pneumonia, pleurisy, lung and rib damage, and various tumors. In such cases, accurate and rapid diagnosis becomes an integral component of effective treatment and life-saving interventions for military personnel.

Advantages of MSCT in the Diagnosis of Thoracic Organ Diseases

MSCT offers several significant advantages that make it particularly valuable in military medicine. The primary and most critical benefit is its high diagnostic accuracy, enabling detection of even minimal changes in thoracic structures. Unlike conventional radiography, MSCT provides high-resolution slice-by-slice images, facilitating detailed analysis of the lungs, heart, and other anatomical structures.

MSCT can identify vascular and pulmonary abnormalities such as emphysema, fibrosis, tumors, hemorrhages, and various forms of pneumonia—including atypical ones—that are difficult to diagnose with other methods. This is especially important in combat settings, where diseases may be triggered or complicated by external factors such as trauma, infections, or exposure to chemical agents or radiation. In these scenarios, multislice tomography not only supports diagnosis but also enables dynamic monitoring of patient status, which is critical for emergency management [1].

Furthermore, MSCT allows for three-dimensional image reconstruction, substantially improving the assessment of injuries and anomalies and aiding in planning subsequent therapeutic interventions, such as surgery or minimally

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invasive procedures. This is particularly relevant for multiply injured patients, where rapid evaluation of multiple organ systems is required.

MSCT in Chest Trauma Among Military Personnel

Chest trauma is one of the most common injury types and a leading cause of mortality among wounded individuals in both peacetime and military conflicts. Lung injuries occur in 75-80% of chest wounds, with primary impairments involving respiratory and circulatory function. Disruption of gas exchange often necessitates intensive respiratory support, and long-term functional respiratory impairments are common.

In combat and intensive training environments, the risk of trauma is elevated. MSCT of the chest (MSCT-Ogk) is mandatorily included in the diagnostic protocol for such patients, revealing signs of bronchopulmonary damage: rib and sternal fractures, parenchymal changes, hemothorax and pneumothorax, soft-tissue emphysema, abscesses, and atelectasis. One of the main reasons for using MSCT in military medicine is its high sensitivity in detecting these injuries.

In most cases (up to 90%) of penetrating chest wounds, the lung—closely adjacent to the parietal pleura—is damaged, often accompanied by concurrent internal bleeding (hemothorax) and pneumothorax. In extensive parenchymal disruption and crush injuries, acute respiratory distress syndrome develops in 50–60% of cases, with mortality ranging from 10–40%. Pathogenetic mechanisms include alveolar blood imbibition, edema due to rapidly increased intrathoracic pressure, interalveolar septal rupture with cyst formation, and subsequent gas exchange impairment, potentially leading to long-term respiratory dysfunction. Bacterial complications (pneumonia) occur in 25–30% of cases, and pneumofibrotic changes may develop beyond the described cavities/cysts [5].

MSCT not only precisely identifies injuries but also assesses their severity. It enables rapid evaluation of pleural and soft-tissue status, facilitating prompt

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decisions on surgical intervention. Dynamic monitoring is particularly valuable in multiply injured patients, allowing ongoing adjustment of treatment strategies. A key advantage of MSCT is its multi-level diagnostic capability - simultaneously detecting bony (rib fractures) and soft-tissue (pneumothorax, hematoma) abnormalities - greatly enhancing diagnostic accuracy and speed [2].

MSCT in the Diagnosis of Infectious Thoracic Diseases in Military Personnel

Under conditions of intense physical exertion, high stress, and increased infection risk among military personnel, accurate diagnosis of pneumonia and other lung infections is crucial. Unlike traditional methods, MSCT precisely identifies inflammatory parenchymal changes, determines the extent of involvement, and assesses infection spread.

This is particularly important during seasonal infections (e.g., influenza) or outbreaks/pandemics within military units. Timely MSCT-based diagnosis enables rapid severity assessment and prompt treatment initiation, preventing complications such as respiratory failure and sepsis [3].

MSCT as a Tool for Monitoring and Preventing Diseases in Military Personnel

MSCT is valuable not only for diagnosis but also for long-term health monitoring. In military service - with prolonged physical loads, overexertion, and adverse environmental exposures - regular MSCT examinations detect early thoracic changes that may be clinically silent.

MSCT aids in preventing conditions such as chronic obstructive pulmonary disease (COPD) or emphysema, which may arise from chronic exertion and exposure to dust or airborne chemicals.

In young military-age individuals, bullous disease is common and frequently complicated by pneumothorax. Spontaneous pneumothorax - air accumulation in the pleural cavity due to abnormal communication with airways - often results

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from progressive thinning and rupture of subpleural emphysematous bullae. The term “bullous lung disease” is synonymous with “bullous emphysema.” Literature reports high spontaneous pneumothorax rates in young adults with connective tissue dysplasia. According to Nechaeva G.I., spontaneous pneumothorax occurred in approximately 10% of 18–35-year-old patients with connective tissue dysplasia signs. Vasilenko G.P. and Vereshchagina G.N. introduced the term “dysplastic lung,” highlighting spontaneous pneumothorax as its primary manifestation, with a tendency toward recurrence and higher postoperative complications. Genetic markers of connective tissue dysplasia are nearly 9 times more common in bullous emphysema patients than in unaffected individuals [6]. Timely MSCT detection of such changes enables prevention of serious diseases and optimization of prophylactic strategies [4].

Radiation Safety and Optimization of MSCT Protocols in Military Medicine

Despite its high diagnostic informativeness, radiation exposure remains a key concern in military applications of MSCT. Military personnel often require repeat scans for trauma and infectious lung monitoring, necessitating strict adherence to radiation safety principles.

The foundational ALARA principle (As Low As Reasonably Achievable) minimizes dose while preserving diagnostic value [7]. In military medicine - predominantly involving young adults - this principle is especially critical due to potential long-term cumulative effects [8].

Protocol optimization includes:

- Low-dose scanning modes for inflammatory lung diseases;
- Automatic tube current modulation;
- Limiting scan range to clinically justified volumes;
- Iterative reconstruction algorithms [9].

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Modern MSCT scanners reduce effective dose to 1–3 mSv while maintaining high sensitivity for pneumonia and traumatic injuries [10]. Thus, dose optimization balances safety and diagnostic efficacy.

Role of MSCT in Medical Triage During Combat Trauma

In combat, MSCT serves as a key tool for verifying thoracic injuries and plays a significant role in casualty triage. Rapid imaging determines injury extent and surgical priority [11].

It is particularly informative for:

- Combined injuries;
- Suspected major vascular damage;
- Massive hemothorax;
- Occult pulmonary injuries.

Three-dimensional reconstruction improves assessment of anatomical relationships, guiding optimal treatment [12]. Studies indicate that early MSCT in chest trauma reduces diagnostic errors and improves survival in polytrauma patients [13].

Prospects for MSCT Development in Military Medicine

Promising advancements include artificial intelligence (AI) integration for MSCT image analysis. Automated systems enable quantitative assessment of lung involvement, detection of subtle pneumothorax signs, and prognostic modeling [14].

Enhanced contrast protocols expand capabilities for vascular injuries and thromboembolic complications, crucial in combined trauma [15].

Conclusions

MSCT, as a highly sensitive modality, facilitates detection of atypical pneumonias, trauma, and even effects from chemical agents or radiation. This is essential in combat conditions.

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