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**DIFFICULTIES IN THE DIAGNOSIS OF PNEUMONIA IN VICTIMS  
WITH BURN INJURY****ТРУДНОЩІ ДІАГНОСТИКИ ПНЕВМОНІЇ У ПОСТРАЖАЛИХ З ОПІКОВОЮ  
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**Abstract.** Burn injury is one of the most common types of injuries and is a severe medical, social, and economic problem. In Ukraine, up to 35 thousand people get thermal injuries every year. Pneumonia in patients with burns and airway injury (AI) is the most common complication at any stage of patient treatment, which worsens the prognosis and is often the cause of death. Early diagnosis of pneumonia and timely treatment is an urgent task especially in wartime. The study aimed to study the features of the course and informative criteria for the early diagnosis of pneumonia in patients with thermal burns, depending on the age, depth, area of the lesion, and the presence or absence of AI. We retrospectively analyzed 749 case histories and 92 acts of forensic examinations of patients who were treated in the burn center of Dnipro for three years at the age of 18-73 years, men - 494, women - 255 people with a total area of damage from 5 % to 95 % of the body surface. It has been established that pneumonia can develop at any stage of a burn injury. AI increases the incidence of pneumonia by 1.37 times. In patients under the age of 60 years, pneumonia developed in 38.1 % of cases with a lesion area  $\geq 40\%$ ; in patients older than 60 years - in half of the patients (53.6 %) with a smaller lesion area ( $\geq 20\%$ ). With deep burns in patients under 60 years of age, pneumonia was stated in 43.9 % with a lesion area of  $\geq 20\%$ , at the age of  $\geq 60$  years - in half (51.2 %) with a lesion area of 5 %. Standard clinical and laboratory diagnostic criteria for pneumonia are often offset by burn injury manifestations. Therefore, it is necessary to pay attention to risk factors; X-ray examination of the lungs in 2 projections is mandatory for 2-3 days in patients older than 60 years, even with a mild degree of burn injury without AI in the presence of concomitant pathology and all patients with the presence of AI, despite the absence of physical data in the lungs. Antibiotic therapy should be corrected considering the microbiological examination of sputum, wound surface, serological studies, and local resistance of microflora.

**Keywords:** burn injury, pneumonia, respiratory tract injury.

**Introduction.**

Burn injury is one of the most common types of injuries and is a severe medical, social, and economic problem. According to the WHO, in peacetime, in the structure of general injuries, burns occupied the 3rd place among all injuries. According to WHO, 30% of traumatic injuries are burns. In many high-income countries, mortality from burns is low, but non-fatal burns constitute a significant cause of morbidity, including prolonged hospitalization, disfigurement, and disability. In Ukraine, up to 35 thousand people get thermal injuries yearly [1]. The issue of burn injury in wartime is especially relevant. Burns received during military operations account for 2 to 5 % of combat injuries [2,3]. Group and mass burns have become more frequent, the number of patients with extensive deep burns has increased, and mortality has increased, which



amounts to tens of thousands of burn patients annually.

Pneumonia in patients with burns and airway injury (AI) is the most common complication at any stage of patient treatment, which worsens the prognosis and is often the cause of death [4,5]. Therefore, early diagnosis of pneumonia and timely treatment are urgent tasks at all stages of burn disease.

### **The aim of the study.**

The study aimed to study the features of the course and informative criteria for the early diagnosis of pneumonia in patients with thermal burns, depending on the age, depth, area of the lesion, and the presence or absence of AI.

### **Materials and methods.**

We retrospectively analyzed 749 case histories and 92 acts of forensic medical examinations of patients treated in the burn center of Dnipro for three years. The study included patients with thermal burns only. The age of patients is 18 to 73 years, men - 494, women - 255 people with a total burn area from 5 % to 95 % of the body surface. Deep dermal burns were diagnosed in half of the patients (51.3 %). All patients were divided by age category into two groups: group 1 - 18 to 60 years (458 people) and group 2 - over 60 years old (291 people). Each group of patients was divided into two subgroups: the 1st - without AI and the 2nd - with AI (138 patients from the first and 78 from the second group).

### **Results and discussion.**

In patients of the 1st group under the age of 60 with superficial burns, pneumonia developed in 38.1% of cases, and the area of the lesion was 40 % or more of the body surface, with deep burns - in 43.9% and the area of the lesion was  $\geq 20$  %. In the second group of patients aged 60 and older with superficial burns, pneumonia developed in 53.6% of cases and burn area  $\geq 20$ %, and deep burns - in 51.2% of cases and burn area  $\geq 5$ %. In patients of the 2nd group with superficial burns and an aggravated history (COPD, diabetes mellitus, pneumofibrosis, etc.), pneumonia developed with a smaller burn area - from 10 %.

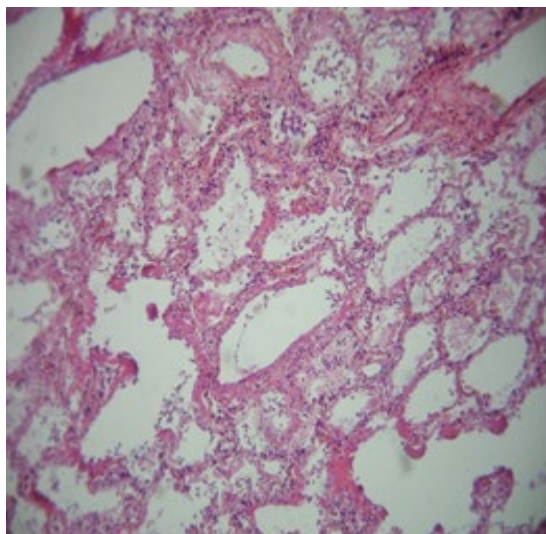
The development of pneumonia in patients of the second subgroup with AI was 1.37 times higher and did not depend on the patient's age.

Acts of a forensic histological study of the lungs of patients who died as a result of a burn showed that in 5.4 % of cases, foci of inflammation in the lungs appear on the first day after injury and are like vascular damage, followed by infection and the development (more often) of bronchopneumonia. In patients with deep burns with an area of  $\geq 40$  % and AI who died during the period of burn shock, 83.3 % of patients had pneumonic foci in the lungs, of which 22.2 % had areas of micro abscess formation.

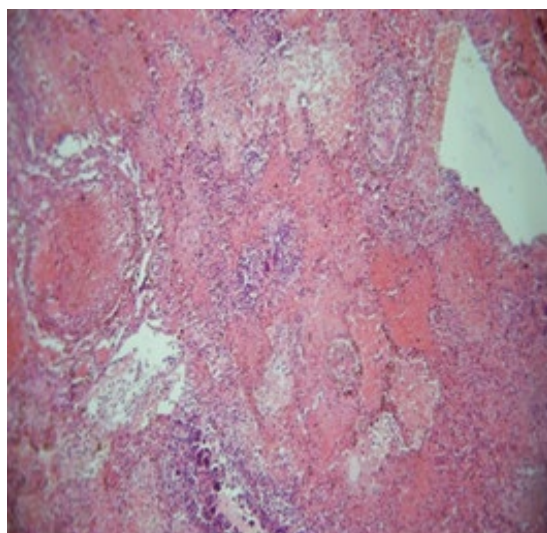
Figure 1 shows a micro preparation of lung tissue in the initial stage of pneumonia development: the interalveolar septa are thickened and swollen, moderately infiltrated with leukocytes; the alveoli are enlarged, significantly in some areas, with thinning and rupture of the walls of the alveoli; in the lumen of the alveoli, exudate, accumulation of leukocytes in the form of small groups, in the capillaries - sludge. Figure 2 shows a micro preparation of lung tissue with changes characteristic of developed pneumonia: the alveoli are enlarged, filled with exudate with an admixture of desquamated epithelium, leukocytes, macrophages, and erythrocytes. In some areas, the contours of the partitions are not traced – microabscesses (in the center of the micro preparation).



In the lumen of the vessels, blood clots (red, white, mixed). Multiple colonies of microorganisms in the lung tissue and the lumen of blood vessels.



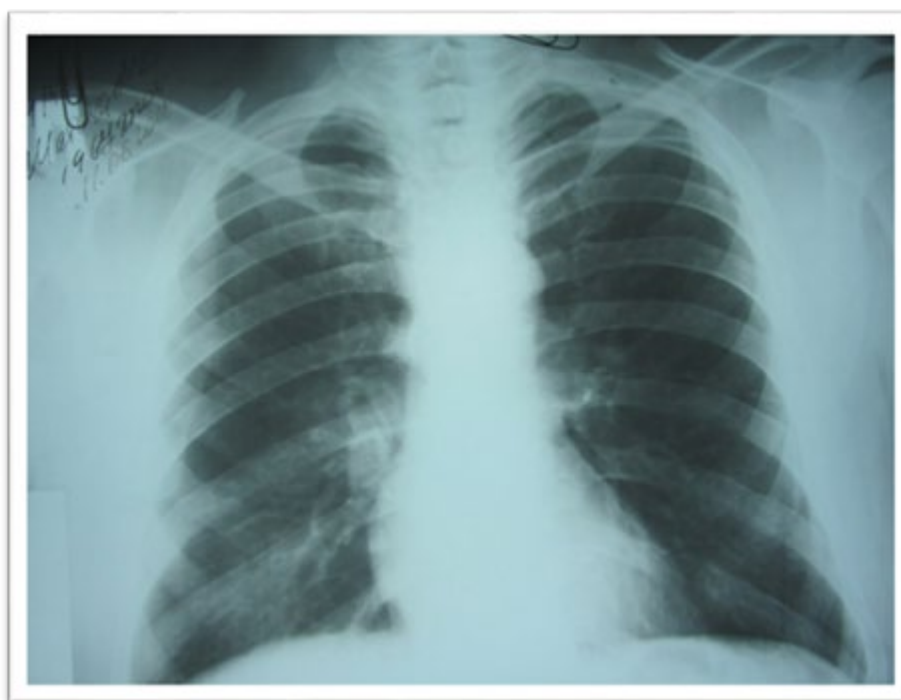
**Figure 1 - Pathological changes in the lung tissue (beginning pneumonia, stage of shock, and early toxemia)**



**Figure 2 - Pathological changes in the lung tissue (pneumonia).**

A comparison of clinical and pathoanatomical diagnoses showed that only 53.57 % of cases of pneumonia were diagnosed during life. This is due not only to the peculiarities of the course of a burn injury and early changes in the lung tissue in severely burned patients but also to the complexity of conducting physical and additional examination methods in a severe patient. The generally accepted criteria for the physical diagnosis of pneumonia, such as shortness of breath, cough, fever, and leukocytosis, are "leveled" by the manifestation of burn disease, multiple organ failure syndrome, and sepsis [6]. Sometimes full-fledged auscultation is impossible due to a chest burn, and a clinical blood test reflects a picture of an inflammatory response to injury, "masking" an increase in leukocytes and ESR in pneumonia. X-ray examination and CT scan of the lungs are priorities in detecting pneumonia, but their implementation is not always possible due to the severity of the patient's condition.

Figure 3 shows pneumonia that developed in a patient with severe burn disease on the 12th day of injury.



**Figure 3 - Pneumonia focuses in the lower lobe of the right lung in a 46-year-old man, thermal burn, Frank index 105 units**

*Authoring*

Considering these circumstances, conducting a retrospective analysis of the data of case histories and acts of forensic medical examinations, approaches to the diagnosis of pneumonia in patients with thermal burns remain as follows:

- regardless of the age category, in patients with superficial burns, the diagnosis of pneumonia is carried out according to the generally accepted algorithm. In patients of this group with AI, a microbiological examination of sputum is mandatory; in its absence, an assessment of a possible causative agent of pneumonia according to the microbial test of the wound surface;

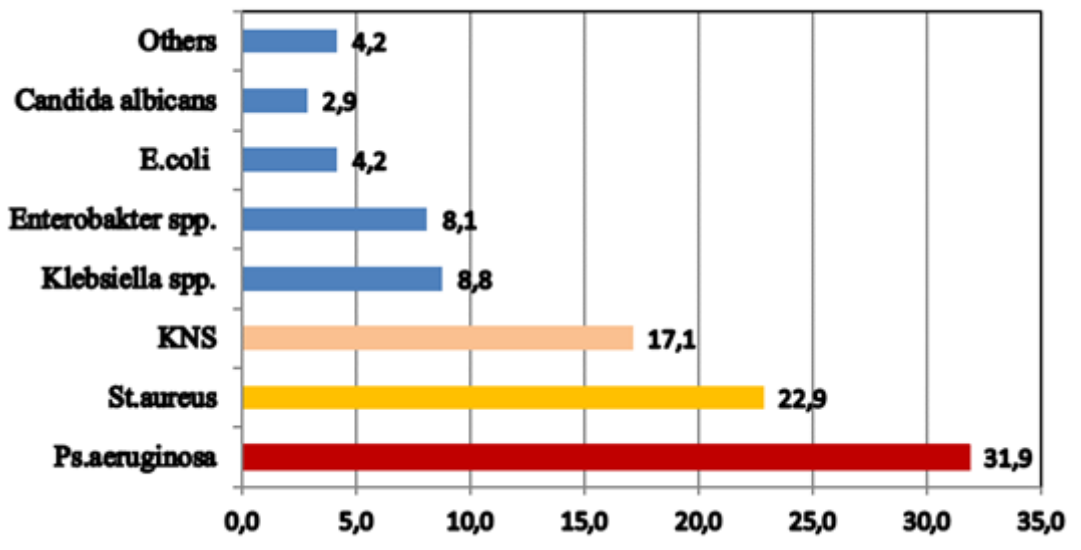
- in patients with deep burns  $\geq 20\%$  of the 1st age group and  $\geq 5\%$  of the 2nd age group, in addition to general clinical examinations, it is mandatory to conduct an X-ray of the lungs in two projections if pneumonia is suspected (even in the absence of an auscultatory picture in the lungs) - an increase in body temperature by  $\geq 1^{\circ}\text{C}$ , the occurrence or increase of shortness of breath, the rise in leukocytosis, the worsening of the general condition of the patient, an increase in the level of procalcitonin, CRP, etc., not explained by the course of the burn injury;

- patients with AI and aggravated anamnesis (COPD, bronchial asthma, pneumofibrosis, etc.), regardless of the age and severity of the burn, in addition to general clinical examinations, an X-ray / CT scan of the lungs is mandatory for 2-3 days. With the development of poorly amenable pneumonia to empirical therapy, a microbiological examination of the upper respiratory tract (sputum, priority - according to brush biopsy specimens or tracheobronchial washings during fibro bronchoscopy). X-ray control of the lungs should be carried out every 10-14 days, if necessary - more often.



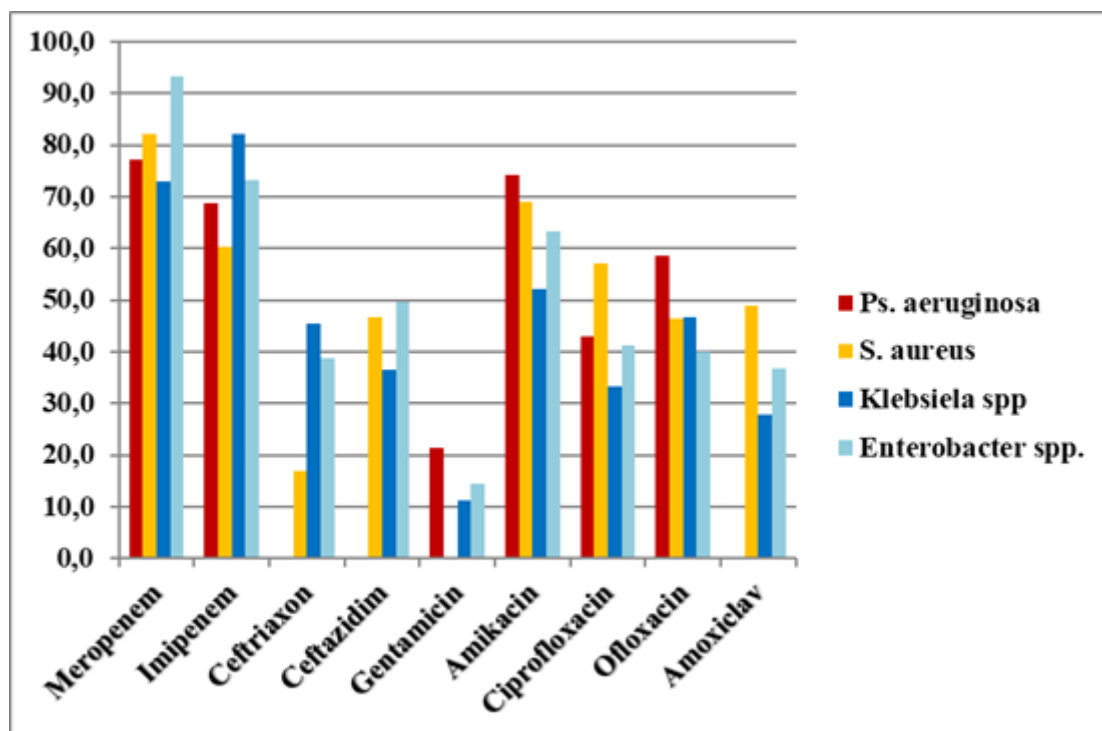


The choice of antibiotic therapy in patients with burn injury complicated by pneumonia should be based on the severity of the burn disease [7], microbiological data from the upper respiratory tract, and the microbial landscape of the wound surface [8,9].



**Figure 4 - Results of microbiological examination of the wound surface in patients with thermal burns (n=552). The frequency of the presence of microflora species in the wound in patients with thermal burns (in %)**

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**Figure 5 - The results of the sensitivity of the microflora from the surface of the burn wound to various antibiotics (n=552). Sensitivity of microflora from the surface of a burn wound to various antibiotics**

Authoring



When conducting a microbiological study of the wound surface in the first 48-72 hours, a monoculture was sown in 77.8 %, mixed flora - in 22.2 % of cases. A negative result was obtained in 12.3 %. When sowing from the wound during the first 12-14 days, a negative result was obtained in 29.7 %, monoculture - in 56.19 %, the association of two microbes - in 37.46 % and three or more microorganisms were sown - in 6.35 % of cases.

The results of the sensitivity of the microbial flora of the wound surface to various antibiotics were obtained (Fig. 5).

Of the 175 cases of detection of *Ps. aeruginosa*, 12.4 % of the microorganism had absolute resistance to the available antibiotics. Out of 126 detection cases, this percentage was 16.5 for *St. aureus*.

### **Conclusion.**

1. Pneumonia in patients with thermal burns can develop at any stage of the burn injury.

2. In patients under 60, pneumonia developed in 38.1 % of cases with a lesion area of 40 % or more. In contrast, in patients of the older age category (60 years and above), half (53.6 %) were diagnosed with pneumonia in smaller affected areas – 20 % or more.

3. Pneumonia in patients under the age of 60 with deep burns was diagnosed in 43.9 % of cases with a lesion area of 20 % or more, while in half of the patients from the older age group (51.2 %), it developed already with a lesion area of 5 %.

4. Damage to the respiratory tract increases the incidence of pneumonia by 1.37 times.

5. Standard clinical and laboratory diagnostic criteria for pneumonia, as a rule, are leveled by manifestations of a burn injury, so it is necessary to pay attention to the risk factors for pneumonia, which seriously aggravate its course even during the healing of wounds.

6. X-ray examination of the chest in 2 projections is mandatory for 2-3 days in patients older than 60 years, even with a mild degree of burn injury without AI in the presence of concomitant pathology and all patients with AI, despite the absence of physical data in the lungs.

7. Antibiotic therapy should be corrected by monitoring the microbial landscape of sputum, wound surface, serological studies, and local resistance of microflora.

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**Анотація.** Опікова травма є одним із найпоширеніших видів травматизму і становить серйозну медичну, соціальну та економічну проблему. В Україні щороку термічні поразки зазнають до 35 тис. осіб. Пневмонія у хворих з опіками та ураженням дихальних шляхів (УДШ) є найчастішим ускладненням на будь-якому етапі лікування пацієнта, що погіршує прогноз та часто є причиною летального результату. Рання діагностика пневмонії та своєчасне лікування є актуальним завданням особливо у воєнний час. Метою дослідження було вивчення особливостей перебігу та інформативних критеріїв ранньої діагностики пневмонії у постраждалих з термічними опіками залежно від віку, глибини та площі ураження, наявності чи відсутності УДШ. Було ретроспективно проаналізовано 749 історій хвороби та 92 акти судово-медичних досліджень пацієнтів у віці 18-73 років, які перебували на лікуванні в опіковому центрі м. Дніпро протягом трьох років; чоловіків було – 494, жінок – 255 із загальною площею поразки від 5 до 95 % поверхні тіла. Встановлено, що пневмонія може розвинути на будь-якій стадії опікової травми, а УДШ збільшує випадки розвитку пневмонії у 1,37 рази. У пацієнтів віком до 60 років пневмонія розвивалася у 38,1 % випадків при площі ураження  $\geq 40$  %, у пацієнтів віком від 60 років – у половини хворих (53,6 %) при меншій площі ураження ( $\geq 20$  %). При глибоких опіках у пацієнтів віком до 60 років пневмонія констатована у 43,9 % при площі ураження  $\geq 20$  %, у віці  $\geq 60$  років – у половини (51,2 %) при площі ураження 5 %. Стандартні клініко-лабораторні діагностичні критерії пневмонії часто нівелюються проявами опікової травми, тому необхідно звертати увагу на фактори ризику, результати рентгенологічного дослідження ОГП у 2-х проекціях обов'язково на 2-3 добу у хворих віком від 60 років навіть за легкого ступеня опікової травми без УДШ та супутньої патології та у всіх хворих з наявністю УДШ, незважаючи на відсутність фізикальних даних у легенях. Корекцію антибактеріальної терапії слід проводити з урахуванням мікробіологічного дослідження мокротиння, ранової поверхні, серологічних досліджень та регіональної резистентності мікрофлори.

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