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# Pneumonia as an impediment to treat patients in the early period after stroke

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## Summary

Introduction: Infections are a common complication in the treatment of acute stroke. Among them, most often pneumonia, which contributes to increased mortality from stroke, prolong hospitalization, difficulties in care, reduce functional performance improvement and increased cost of treatment.

The aim of the work is less analysis of the causes and consequences of the development of pneumonia in the early period after stroke and identify predictors of pneumonia and the need to take preventive measures to prevent the development of disease.

Summary**:** Pneumonia developing in the early period after stroke affects the final outcome and contributes to longer hospitalization, deterioration of clinical status of patients and the results of functional improvement. Current methods to prevent the development of lung zaplenia require the involvement of the entire therapeutic team, which involves a large investment of time and cost of therapy. Therefore, constantly sought are more effective methods of prevention and treatment of pneumonia among stroke patients.

**Keywords**: stroke, infections, pneumonia, aspiration pneumonia

## Admission

Infections are a common complication in the treatment of acute stroke. Sources say that the infectious complications apply from 5% to 65% of patients. Several studies have shown that pneumonia occurs in 1% - 33% of patients and 2% - 27% suffer from urinary tract infections [1]. Epidemiological projections indicate that in the coming years will be a significant increase in the number of people over 65 years, which will translate into an increase in the incidence of stroke and related infectious complications. Among them, most often pneumonia, which contributes to increased mortality from stroke, prolong hospitalization, difficulties in care, reduce functional performance improvement and increased cost of treatment [2].

## Objective

The aim of the study is to analyze the causes and consequences of developing pneumonia as a complication of obstructive early period of rehabilitation and care of stroke patients. Indication of the difficulties that are associated with the occurrence of infections and to identify predictors of pneumonia and preventive measures to prevent the development of disease.

## The definition of pneumonia

In the literature describing the infections common neurological wards and intensive care meets with the concept of pneumonia associated with stroke (Stroke-associated pneumonia (SAP) [3]. This concept describes an infection that has developed during the first 72 hours after admission to the hospital [4]. A distinction is also acute lung inflammation associated with stroke, which develops within a month of the onset of stroke and chronic form, which occurs one month after [5].Pneumonia was also classified according to three categories: clinical found pneumonia, pneumonia caused by a commonly known bacteria or fungi or to a specific laboratory test results, and pneumonia in patients with impaired immunity. Clinically defined pneumonia is diagnosed in a situation when there is a new or permanent consolidation infiltration or at least one X-ray. In addition, there is one of the following clinical symptoms: fever, leukocytosis or leukopenia, as amended by the mental state in more than 70-year-olds in the absence of other causes. The current is then also a new purulent sputum or change in character of sputum so far, there is a new or already occurring

worsens coughing, wheezing are present, and gas exchange deteriorates. Pneumonia caused by bacteria or fungi is defined similarly. The diagnosis of complement positive culture from blood, pleural fluid, quantitative culture of bronchoalveolar lavage and lung parenchyma. Diagnosis was confirmed by the presence of one of the symptoms in the form of the presence of purulent sputum or coughing [3].

**The theories of the formation of pneumonia after stroke aspiration theory**

It is believed that pneumonia occurring after stroke is associated with the aspiration of the contents of the mouth during sleep. The risk factors in this situation are disturbances of consciousness and dysphagia. It is also assumed that the condition is associated with abnormal dopamine transmission [5]. The experiments conducted in guinea pigs have shown that blocking dopamine receptors D1, causes a decrease in the release of substance P from nerve endings and the inhibition of the swallowing reflex. Similarly low levels of substance P is present in the sputum of older people. After treatment with angiotensin converting enzyme ACE inhibitor (ang. Angiotensin-converting-enzyme inhibitors) were seen to increase in the serum substance P and improve the swallowing reflex [6,7].

**The decrease in resistance caused by stroke**

Immunosuppression after stroke is caused by activation of three systems: the sympathetic and parasympathetic the hypothalamic-pituitary-adrenal [5,6]. Studies Prassa et al., In mice aimed at explaining the effect of immunodeficiency after ischemic stroke on the occurrence of infection.After three days of ischemia in all test animals developed sepsis and pneumonia. Stroke causes extensive apoptosis of cells, Th1 helper change on Th2 cytokine production, bacteremia, and pneumonia [8]. In these same studies have also demonstrated that inhibition of the sympathetic nervous system decreases the risk of bacterial infection and the use of β-blocker, reduces death after stroke in the compound. It is caused bydefect associated with catecholamine early lymphocyte activation and is a key factor for impaired antibacterial immune response after stroke [9]. Activation of the sympathetic nervous system after acute ischemic stroke seems therefore play a key role in the mechanism of immunosuppression especially prominent in patients after major stroke [10].

There is also evidence that the activation of the hypothalamic-pituitary-adrenal glucocorticoid secretion causing the adrenal gland [11]. Since glucocorticoids have anti-

inflammatory properties, may cause apoptosis of the T cell [12]. Both high as low levels of circulating cortisol is associated with increased mortality after stroke [11]. Activation of parasympathetic autonomic centers of the effect of peripheral cholinergic activity inhibitory cytokines released by nicotinic receptors in macrophages [13]. The neuroendocrine and autonomic centers are synchronized by the periventricular hypothalamic centers. The common operation of these systems causes a change in resistance of stroke [14]. This means that pneumonia associated with stroke is the sum of the existing aspirations, which cause the presence of pathogenic bacteria and immunological changes resulting from stroke due to immunosuppression [9].

**The microbiological data**

Pneumonia is the most frequently diagnosed during the first days after stroke [1]. According to microbiological data, then pneumonia is caused by infection or a hospital acquired aspiration syndrome. Most frequently detected strains include Staphylococcus aureus and Gram-negative bacteria such as Klebsiella pneumoniae, Pseudomonas aeruginosa, Escherichia coli and Enterobacter spp. It is also sometimes identified Streptococcus [1]. Gram-negative bacteria and Staphylococcus aureus cause aspiration pneumonia, but they are also known to nosocomial infections [15]. Streptococci are still the most commonly detected pathogens in acquired pneumonia [16].

Material collected from patients after a stroke is usually poor, and the additional difficulty in obtaining his cause neurological disorders and disorders of consciousness. Some suspected pneumonia in fact, are non-infectious aspiracyjnymi pneumonia, or infection can be caused by anaerobic bacteria. The role of anaerobic bacteria in the development of pneumonia, however, is so far unexplained [17].

Particularly high infection rate applies to patients in the intensive care unit, patients with severe stroke. Gates of infection are the catheters and mechanical ventilation [18,19]. The incidence of pneumonia is then 10-25% [4].

**Changes in bacterial flora patients in the intensive care**

Gram-positive bacteria are the majority in the microflora of the mouth healthy. These proportions tend to change in individuals residing in intensive care for more than 48 hours.

Then the gain advantage bacteria: Staphylococcus aureus, Streptococcus pneumoniae, Acinetobacter baumannii, Haemophilus influenzae, and Pseudomonas aeruginosa [20,21]. Biofilm on the surface of the teeth and tongue and periodontal disease patients create optimum conditions for growth of Gram-negative bacteria, resulting in the worsening of the patients' clinical and entails the need for particular care of oral cavity hygiene in this patient group [22,23,24] .

**Antibiotic resistance of Gram-negative bacteria**

Gram-negative bacteria are the most opportunistic in nature, which are the source of infection only in a situation of reduced immunity. Additionally, they are less sensitive to antibiotics, chemotherapeutic agents and disinfectants than Gram-positive bacteria. This is due to the presence of additional outer membrane providing an excellent barrier. Cell envelope of Gram negative bacteria are additionally equipped with MDR pump system (called. Multi-drug resistance), which are responsible for removal from the cell interior to the harmful substances including antibiotics, chemotherapeutic agents and disinfectants. The presence of these pumps is a major mechanism of acquiring resistance to antibiotics next inactivating enzymes antibiotic or the ability to change the structure of the protein at the target site of action of the antibiotic [25]. Reducing the effectiveness of antibiotic therapy associated with increased resistance among Gram-negative forces to seek non-pharmacological methods of prevention and treatment of pneumonia.

**The clinical condition of patients**

Another risk factor for the development of pneumonia is aggravating the clinical condition of patients. The risk is increased in patients who fail reflexes of coughing reflex, and particularly in patients with impaired consciousness [26]. Most cases of pneumonia caused by dysphagia. Literature indicates that dysphagia occurs in 37-78% of patients and increase the risk to 3-fold [27]. Therefore, in the literature a lot of space occupied publications devoted to the development of dysphagia aspect of pneumonia due to aspiration of content from the mouth, which is approximately 20% of the cases [28]. Stroke and the state immediately after are thus the most important predictors of aspiration pneumonia. As important also it indicates:dysarthria, hoarseness, volitional disorders involving reduced number of cough after swallowing and cough water [28].

Chronologically and clinically aspiration pneumonia was divided into two forms: acute, which develops before the end of the month and insidious or chronic form, which is disclosed in a later time [5.29]. Particular attention is paid to the necessity of screening patients before feeding. In patients with dysphagia of sudden onset (eg. In acute stroke), to quickly identify patients aspiring recommended to perform screening tests swallowing immediately after admission to the hospital before giving oral food, fluids or medications. Patients with a positive test result should be covered by the Recommendation "nothing by mouth" (recommendation also applies to drugs) until Neurologopedic accurate diagnosis [30]. An important role is played by the method of neurostimulation streamlines swallowing function. For this purpose, the stimulation of peripheral sensory system of the oral cavity and pharynx using stimuli of chemical, physical or electrical, direct stimulation of the motor cortex of the throat using transcranial magnetic stimulation rTMS (ang. Repetitive transcranial magnetic stimulation) [28].

Available at the moment the data on the diagnosis and treatment of swallowing disorders and the prevention of pneumonia are still limited, but they show that the implementation of therapeutic agents to improve swallowing function causes a significant reduction in the amount of cases [31].

**The occurrence of infection and the age**

It has long indicated a predisposing factor for the development of the infection is advanced age [32]. Literature reports that present in the acute phase of stroke and systemic immune suppression inflammatory immune response associated with susceptibility to infection [33]. Such anti-inflammatory response occurs in patients in the acute phase following a stroke, including an excessive amount of anti-inflammatory cytokines and impaired cell-mediated immunity [34]. This may suggest that the immunological changes that occur in the early period after stroke increase susceptibility to infections.

Infections affect the outcome after a stroke, causing a worse functional outcome and mortality increase. Firstly infections cause immobilization, general weakness and delayed rehabilitation, which translates into an extension of hospitalization and generates higher costs of treatment [35]. Demographic projections point to the continuous increase in the proportion

of people over 65 years of age in the population of Europe, which will result in an increase in the incidence of stroke and occur in the course of infection [2].

**The impact of infection on ischemic stroke**

There are several mechanisms that cause infection or pneumonia associated with stroke result in deterioration of clinical status of patients [17]. Pneumonia associated with fever, electrolyte imbalance and hypoxia. Heat is enhanced cascade of inflammation caused by the accumulation of neutrophils in the injured tissue while hypothermia used as a therapeutic agent modulates the process [36]. Neuronal excitotoxicity due to increased release of neurotransmitters and free radicals is another mechanism of deteriorating condition of the patient associated with fever [37]. Electrolyte imbalance, especially hyponatremia can contribute to increased cerebral edema occurring after a stroke, which translates into increased long-term mortality [38]. Bacteria and liposaccharide in the blood, while causing the blood to clot and fibrinolytic system is activated, which may lead to broadening the area of ischemia and consequently to increase the stroke focus [39]. This will result in deterioration of the patient and reduce the possibility of returning to health.

**Patient care after a stroke in the prevention of pneumonia**

During acute treatment after a stroke is extremely important to intensive nursing care to prevent life-threatening multiorgan complications, including pneumonia. It is important to care for maintaining the patency of the airway, which is particularly important for patients who have difficulty in swallowing due to paralysis of the muscles of the throat and larynx. Indeed, they are at risk of aspiration derived food or secretions from the respiratory tract, resulting in the development of aspiration pneumonia. In order to prevent the development of this complication, it is important to early identification of patients suffering from disorders of speech and swallowing, and adjusting the diet with their capabilities, frequent suctioning secretions bearing and maintaining acid-base equilibrium [40].

Preventive nursing in the field of pulmonary complications should also include breathing exercisesperformed several times a day and regular change of positions including positions draining and oklepywania individual segments of the bronchial tree to the removal of secretions accumulating in the lungs during prolonged immobilization. These activities should be carried out in close cooperation with a physiotherapist, and preventive measures

should be involved the whole team treatment. Effective cooperation of all members of the care team can provide to minimize the risk of developing pneumonia, even among patients who had severe neurological incident. Early identification of patients at risk of infectious complications seems to be the key element that allows you to take appropriate preventive action [40]. In this respect, in the past few years, it has been proposed for use in patients with acute stroke antibiotic prophylaxis. The effectiveness of this method high hopes due to its ease of use, low cost and no need to engage additional personnel [41]. However, clinical trials conducted over the past 10 years have produced ambiguous or even negative results, as to the effectiveness of antibiotic therapy as a form of prevention, which contributed to a decline in the enthusiasm with which initially were treated with this method [42,43,44].

**Summary**

Infectious complications developing in the early period after stroke, particularly pneumonia, are a factor in determining the final results of the whole treatment process. Their presence contributes to longer hospitalization and often associated with the deterioration of the clinical condition of patients, which results in a reduction or even the necessity to stop the neurological rehabilitation methods, which then exerts the greatest effect of brain-damaged Neuroplastic. The development of infection is thus associated with a reduction in performance and functional improvement of patients condemns dependence on third parties. In the face of these consequences, it seems reasonable to prevent infection, the rapid identification of patients at particular risk of its development and immediate implementation of appropriate preventive measures. Traditional methods to prevent the development of lung zaplenia require the involvement of the entire therapeutic team, which involves a large investment of time and cost of therapy. Therefore, there is a constant need to search for new, more effective methods of prevention and treatment of pneumonia among stroke patients.

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