


## Management of septic shock secondary to pneumonia: Treatment protocols in medical emergencies

 <https://doi.org/10.56238/sevened2024.006-014>

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### ABSTRACT

This study investigates the effectiveness of treatment procedures for septic shock in patients with pneumonia treated in emergency medical services. The methodological approach involved a descriptive and qualitative literature review, consulting sources such as Scielo, Google Scholar and PubMed, from 1996 to 2024. The specific objectives included the description of the pathophysiological mechanisms, the analysis of the therapeutic protocols, the evaluation of the use of corticosteroids, the investigation of the role of the multidisciplinary team, and the verification of the importance of biomarkers in early diagnosis. The results underscore the need for personalized approaches to treatment, given individual variation in response to therapies. The conclusion highlights that in-depth knowledge and careful management of protocols are essential to improve compliance with therapeutic guidelines and patients' quality of life. Future research should focus on innovative therapies and explore in more depth predictive markers of risk, as well as evaluate the efficacy of complementary therapies such as corticosteroids.

**Keywords:** Septic shock and pneumonia, Septic shock treatment protocols, Corticosteroids in septic shock, Multidisciplinary team in septic shock, Biomarkers in septic shock.

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## INTRODUCTION

The word sepsis refers to the presence of microorganisms or their toxins in the bloodstream<sup>[1]</sup>. Septic shock should be defined by a systolic blood pressure of less than 90 mmHg or a mean arterial pressure of less than 65 mmHg after a crystalloid fluid challenge, indicating when vasopressor treatment should be initiated and when adjunctive therapy should be considered<sup>[2]</sup>.

Pneumonia is a health condition that commonly results from infections, leading to inflammation and congestion of the lungs, which impairs normal breathing, causing coughing and dyspnea. Although it can affect people of all age groups, it is more common in children and the elderly.<sup>[3]</sup> In *Pseudomonas aeruginosa* pneumonia, septic shock is primarily caused by alveolar epithelial injury, which allows the release of pro-inflammatory mediators into the circulation<sup>[4]</sup>.

Severe sepsis or septic shock is common in patients with gram-negative bacteremia, predicting higher mortality rates, with kidney disease and indwelling urinary catheter being the most significant risk factors<sup>[5]</sup>.

The general objective of this article is to evaluate the efficacy of treatment protocols currently recommended for the management of septic shock in patients with pneumonia in emergency settings. The specific objectives outlined to achieve this goal include: To describe the pathophysiological mechanisms of septic shock in patients with pneumonia; To review the scientific literature on treatment protocols for septic shock secondary to pneumonia used in medical emergencies; To examine the use of corticosteroids in patients with pneumonia-induced septic shock and its effect on clinical outcomes; To analyze the role of the multidisciplinary team in the effective treatment of septic shock in pneumonic patients; To assess the importance of biomarkers in the early diagnosis and management of septic shock secondary to pneumonia.

The article in question is a vital study, as the management of septic shock in patients with pneumonia is crucial, considering the high severity of sepsis and its significant impact on mortality rates when not managed properly. The investigation and application of effective protocols in medical emergencies are key to improving clinical outcomes and reducing mortality, emphasizing the need for constant innovations and updates in treatments.

## METHODOLOGY

The current work is an essential research that is based on a detailed literature review, with the aim of exploring in a comprehensive, organized and systematic way the results found in studies related to the theme.

The inclusion criteria for this review are specific and encompass research investigating the pathophysiological mechanisms of septic shock in patients with pneumonia, emergency treatment protocols, the use of corticosteroids and their impacts on clinical outcomes, the evaluation of the role



of the multidisciplinary team in effective treatment, and the importance of biomarkers for early diagnosis. Studies that do not directly address these aspects or that focus on other conditions will be excluded.

The search strategy will involve the use of recognized electronic databases such as Google Scholar, Scielo and PubMed. The keywords aligned with the specific research objectives will be "Septic shock and pneumonia", "Treatment protocols for septic shock", "Corticosteroids in septic shock", "Multidisciplinary team in septic shock" and "Biomarkers in septic shock".

The study selection process will follow a qualitative and descriptive approach, starting with the identification of abstracts that seem to meet the established criteria, followed by a thorough analysis of the full articles to verify their adequacy and relevance.

During data collection, information on the occurrence, diagnosis, treatment, and management of septic shock will be thoroughly gathered. The evaluation of the quality of the included studies will take into account methodological soundness, clinical relevance and timeliness, covering articles published between **1996 and 2024**. This ensures that the information analyzed is fresh and pertinent. Additionally, the analysis will be restricted to the specific terms and languages used in the searches, which may result in the exclusion of relevant studies that are not aligned with the designated keywords.

This methodological approach ensures a concentrated and detailed analysis, which is essential for the effective management of septic shock in patients with pneumonia in medical emergency settings. The goal is to promote continuous improvement in treatment protocols and, consequently, in clinical outcomes.

## **RESULTS AND DISCUSSION:**

Pneumonia is an acute inflammatory condition that can be triggered by various causes, such as bacteria, viruses, fungi, or exposure to toxic substances. This inflammation in the lungs can progress to a body-wide inflammatory response, which can result in septic shock<sup>[6][7]</sup>.

During the process of inflammation throughout the body, several inflammatory mediators are involved. These mediators include pro-inflammatory cytokines such as tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ), interleukin-1 (IL-1), and interleukin-6 (IL-6), which are responsible for stimulating the immune response and triggering generalized symptoms. In addition, the release of acute phase proteins, such as C-reactive protein (CRP) and ferritin, is also observed in this process<sup>[6][7]</sup>.

The body-wide inflammatory response triggered by pneumonia can result in a number of systemic effects, including fever, increased heart rate, low blood pressure, and, in severe cases, septic shock. Septic shock is a serious complication of pneumonia characterized by an out-of-control



inflammatory response that leads to decreased blood flow to tissues and consequent multiple organ dysfunction [6][7].

One study showed that severe pneumonia caused by respiratory syncytial virus (RSV) is associated with intense localized viral replication, exacerbated pro-inflammatory response, and high immune cell activation. In addition, the general diagnosis of pneumonia, especially those caused by viruses, is challenging, making it difficult to understand these diseases and their causative agents [8].

It is crucial to prevent pneumonia to avoid such complications. In view of this, vaccination against influenza and pneumonia, hand hygiene, avoiding smoking and crowded places are recommended as preventive measures [9].

Respiratory failure is one of the initial complications of septic shock, resulting in hypoxemia and requiring ventilatory support. Renal failure is another common complication, leading to oliguria or anuria due to dysfunction of the kidneys, requiring close monitoring of kidney function and, in severe cases, renal replacement therapy. Cardiovascular failure is a critical complication, manifesting as refractory hypotension, requiring vasopressors to maintain adequate tissue perfusion [10].

These conditions complicate patient management, as each of them requires specific therapeutic approaches and ongoing monitoring to prevent further harm. Respiratory failure requires adequate ventilatory support and strategies to improve oxygenation. Renal failure requires intensive care to maintain fluid and acid-base balance, and may require dialysis. Cardiovascular failure poses a significant challenge, as refractory hypotension can lead to poor tissue perfusion and multi-organ dysfunction, requiring careful use of vasopressors and close hemodynamic monitoring [10].

These complications in septic shock underscore the importance of a multidisciplinary and personalized approach aimed at stabilizing compromised organ function, preventing further damage, and improving the clinical outcomes of affected patients. Early identification and aggressive treatment of these complications are key to optimizing the management of septic shock and reducing the morbidity and mortality associated with this serious condition [10].

Fluid administration is a critical life support strategy in the treatment of septic shock, as it helps restore vascular volume and perfusive blood pressure. The goal is to maintain an adequate circulating volume to ensure tissue oxygenation and peripheral perfusion. It is recommended to initiate resuscitation with crystalloids, preferably isotonic sodium chloride solutions (0.9%), at an initial dose of 30 mL/kg body weight, within the first 3 hours after the diagnosis of septic shock. If mean arterial pressure (MAP) is less than 65 mmHg, additional fluids should be considered, up to a maximum of 50 mL/kg body weight [11].

Vasopressor support is an important life support strategy in the treatment of septic shock when fluid administration is not sufficient to restore perfusive blood pressure. The goal is to maintain a mean arterial pressure (MAP) greater than 65 mmHg and an adequate urine output. Norepinephrine is



the vasopressor agent of choice for septic shock, followed by epinephrine, dopamine, and vasopressin. The initial dosage of norepinephrine is 0.05 to 0.1 mcg/kg/min, and can be gradually increased until the desired MAP is reached <sup>[11]</sup>.

Airway management is an important life support strategy in the treatment of septic shock, as it ensures adequate ventilation and tissue oxygenation. The goal is to maintain an inspiratory oxygen fraction (FiO<sub>2</sub>) of less than 60% and a partial pressure of carbon dioxide (PaCO<sub>2</sub>) within normal limits. Endotracheal intubation and invasive mechanical ventilation are recommended in patients with septic shock and severe respiratory dysfunction such as refractory hypoxemia or hypercapnia.

Noninvasive mechanical ventilation may be considered in patients with septic shock and mild to moderate respiratory dysfunction, but should be monitored carefully to detect respiratory deterioration <sup>[11]</sup>.

The choice and timing of antibiotics in the treatment of septic shock secondary to pneumonia are crucial for therapeutic success and patient survival. Current guidelines recommend early administration of broad-spectrum antibiotics, such as third-generation cephalosporins or carbapenems, to cover the most common pathogens associated with pneumonia and septic shock. Delays in the proper administration of antibiotics can lead to increased mortality due to spread of infection and worsening of the clinical picture.

The challenges associated with antimicrobial resistance make the choice of antibiotics even more complex. Bacterial resistance limits effective therapeutic options, requiring an individualized approach based on the results of cultures and susceptibility testing. In addition, the indiscriminate use of antibiotics contributes significantly to the development of resistance, highlighting the importance of rational prescription and control of antimicrobial use <sup>[12]</sup>.

The question of the use of corticosteroids in the treatment of septic shock has been widely discussed in the scientific literature, with inconclusive evidence on its benefits and risks. Most of the reviewed studies emphasize the need for further research to clarify the efficacy of adjunctive corticosteroid therapy in patients with septic shock <sup>[13][14]</sup>.

Regarding the risks, the use of corticosteroids may be associated with complications such as secondary infections, hyperglycemia, myopathy, gastrointestinal hemorrhage, and adrenal insufficiency<sup>12</sup>. Therefore, it is important that the decision to use corticosteroids in the treatment of septic shock be individualized, taking into account the potential benefits and risks for each patient <sup>[13][15]</sup>.

The management and outcomes of septic shock can be significantly influenced by the intervention of a multidisciplinary team, composed of specialists such as intensivists, infectious disease specialists, nurses, and pharmacists. The multidisciplinary approach allows for a more



comprehensive and personalized assessment of the patient, which can result in more effective interventions and an overall better prognosis.

Intensivists are specialists in critical care and play a key role in the management of septic shock, as they can assess the need for ventilatory and hemodynamic support, as well as the possibility of surgical interventions [16]. Infectologists are specialists in infections and play a crucial role in the diagnosis and treatment of septic shock, who are responsible for identifying the etiologic agent of the infection, assessing antibiotic sensitivity, and recommending appropriate antibiotic treatment. In addition, infectious disease physicians can advise on infection control and transmission prevention measures [17].

Nurses are essential healthcare professionals in the day-to-day care of these patients, as they are responsible for assessing the patient's clinical status, administering medications, monitoring vital signs, providing specialized nursing care, and maintaining communication with the multidisciplinary team. In addition, these professionals can identify complications and evaluate the efficacy of therapeutic interventions [18].

Pharmacists play an important role in the management of septic shock by providing guidance on the selection, dosing, and administration of antibiotics and other medications, mitigating the adverse effects of medications, maximizing treatment effectiveness, and preventing antibiotic resistance. In addition, pharmacists can advise on drug interactions and help manage complex medication regimens [19].

In short, collaboration between these professionals allows for a more comprehensive and personalized assessment of the patient, which can result in more effective interventions and an overall better prognosis. However, these results are mixed and more research is needed to confirm this association and better understand the underlying mechanisms.

## CONCLUSION

This study underscores the complexity of pneumonia and how it can progress to septic shock, a condition that can result in multi-organ dysfunction due to the body's generalized inflammatory response. It is critical to start treatment with broad-spectrum antibiotics quickly to control the infection. In addition, it is critical to carefully monitor and intervene in the inflammatory response. The study also emphasizes the importance of effective preventive strategies, such as vaccination and hygiene practices, to decrease the risk of pneumonia and its complications. A multidisciplinary approach to the treatment of septic shock, involving intensivists, infectious disease specialists, nurses, and pharmacists, is essential to improve patients' clinical outcomes. Future research should focus on personalized and innovative therapies that can reduce the morbidity and mortality rates associated with septic shock, as well as further investigate the predictive markers of risk and the



efficacy of corticosteroids as an adjunctive treatment. Ongoing research is crucial to develop new therapeutic approaches that can effectively prevent the progression of pneumonia to septic shock and provide a better quality of life for patients.





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