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MULTIPLE ORGAN FAILURE IN PATIENTS IN THE INTENSIVE CARE UNIT

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Abstract:

Introduction: *Sepsis and multiple organ dysfunction syndrome (MODS) are considered clinical scenarios that most commonly seen in the critically ill patients in surgical settings. Developments in medicine have led to elder population, and have let critically ill and injured patients to survive, only to develop sepsis afterwards. It is estimated one million cases of sepsis in the US every year.*

Sepsis as a separate clinical entity was first described by Bone and coworkers in 1989, and can be recognized as the invasion of microorganisms and/or their toxins into the patient's bloodstream, in consideration to the patient's response to that infection is characterized by systemic inflammation. Sepsis is considered a hemostatic dysregulation and endothelial dysfunction, leading to compromise of both the circulatory system and intracellular homeostasis. The end result is cellular hypoxia and programmed cell death (apoptosis) which are responsible for organ dysfunction and death.

Aim of work: *In this review, we will discuss the most recent evidence regarding the multiple organ failure in patients in the intensive care unit*

Methodology: *We did a systematic search for Multiple organ failure in patients in the intensive care unit using PubMed search engine (http://www.ncbi.nlm.nih.gov/) and Google Scholar search engine (https://scholar.google.com). We only included full articles.*

Conclusions: *Sepsis and MODS remain to be an important cause of morbidity and mortality in the ICU settings. Sepsis includes the interaction between the infectious insult and the patient's inflammatory response, both of which are essential factors in the progression along the spectrum from sepsis to MODS. The inflammatory response is a complex one, that is known by a procoagulant state, endothelial injury, cardiac dysfunction, vasodilation, hypovolemia due to fluid shift, microcirculatory dysfunction, and hemodynamic collapse. MODS is usually manifest when this process results in the dysfunction or failure of more than one organ system. The recent standards of therapy for sepsis have been established, which adds a outline for evidence-based care. Timely recognition of the signs and symptoms of early sepsis, aggressive volume resuscitation to established endpoints, and appropriate support with vasopressors and antimicrobial medications are the goals of early resuscitative efforts. Eradication of the infection by achieving source control and providing proper antibiotic therapy is critical to the resolution of the septic process. In patients who progress to MODS, the clinician must work to support and maintain the homeostasis of the failing organ systems. Mortality rates from septic shock and MODS are getting better, but continue to be high. Doctors must embrace the reality that not all can be saved.*

Key words: *Multiple organ failure, intensive care unit, management, shock.*

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INTRODUCTION:

Sepsis and multiple organ dysfunction syndrome (MODS) are considered clinical scenarios that most commonly seen in the critically ill patients in surgical settings. Developments in medicine have led to elder population, and have let critically ill and injured patients to survive, only to develop sepsis afterwards. It is estimated one million cases of sepsis in the US every year [1].

Sepsis as a separate clinical entity was first described by Bone and coworkers [2] in 1989, and can be recognized as the invasion of microorganisms and/or their toxins into the patient's bloodstream, in consideration to the patient's response to that infection is characterized by systemic inflammation. Sepsis is considered a hemostatic dysregulation and endothelial dysfunction, leading to compromise of both the circulatory system and intracellular homeostasis. The end result is cellular hypoxia and programmed cell death (apoptosis) which are responsible for organ dysfunction and death.

In this review, we will discuss the most recent evidence regarding the multiple organ failure in patients in the intensive care unit

METHODOLOGY:

We did a systematic search for Multiple organ failure in patients in the intensive care unit using PubMed search engine (http://www.ncbi.nlm.nih.gov/) and Google Scholar search engine (https://scholar.google.com). We only included full articles.
The terms used in the search were: Multiple organ failure, intensive care unit, management, shock.

Incidence and Risk Factors

Sepsis is very common in the intensive care unit (ICU). It is estimated that about ten percent of patients in the ICU develop septic shock, with a mortality rates of around fifty percent.[3] Sepsis remains the number 1 cause of mortality in noncardiac ICUs, and patients who had surgery. It accounts for 1/3 of sepsis cases in the US [4]. In surgical patients, sepsis and septic shock are ten times more prevalent than perioperative myocardial infarction and pulmonary embolism, moreover it has the highest mortality rates.

The most common sources of sepsis include but not limited to surgical wound and organ space infections, pneumonia, urinary tract infections, and catheter-associated bloodstream infections. In hospital-acquired infections, nosocomial pneumonias are most common at about forty percent, after that urinary tract infection at twenty five percent. Catheter associated bloodstream infections increased with the higher use of central lines but have decreased over the past decade due to standardization of catheter insertion bundles. Surgical site infections also remains to decrease due to enhancements in perioperative antibiotics and sterile technique however it still accounts for ten percent of nosocomial infections.[5] Polymicrobial infections are more common in patients with organ space infections.

Pathogenic Stimulus

Before the diagnosis of sepsis can be established it is necessary to detect the presence of infection. Though the activation of the systemic inflammatory response syndrome (SIRS) is the final most common pathway results in MODS, signal pathways vary depending on the infecting organism. In gram-negative sepsis, it begins with the host immune response. It is mediated mainly by lipopolysaccharide from the bacterial cell wall. Lipopolysaccharide binds to CD14 and Toll-like receptor-4 receptors to induce activation of a transcription factor known as nuclear factor kappa-B [6,7].

Immunologic Response

Sepsis stimulates the host immune response that is extremely complex. The main chemical mediators are TNF-a and IL-1b, which are released by CD4 T cells and macrophages early in the infectious process. Inflammation is then augmented when these cytokines stimulates the release of many secondary mediators, including IL-6, IL-8, platelet activating factor, and others. The complement system also has a

significant role in the proinflammatory response. C5a is a cleavage product of the complement cascade that appears early in the septic process, and stimulates macrophages to produce proinflammatory mediators. There is some evidence that points to genetic variations in certain cytokines, like IL-6, TNF-a, and CD14.7–10. The normal inflammatory response to infection is a balance between proinflammatory and antiinflammatory processes. Moreover, the anti inflammatory response is more stimulated by the process of apoptosis, in which genetic programming leads to the "suicide" of immune-effector cells via a release of proteases.

Quantifying Organ Dysfunction

There are many published systems for the classification of the severity of organ dysfunction in critically ill patients. These systems focus mainly on the failure of individual organ systems, giving a score to each system based on the abnormality of a measurable value. Scoring systems allow for comparison of outcomes related to differing therapeutic approaches and attempt to match patients for severity of illness. Disease specific scoring systems endorse standardized assessment, enabling uniformity of research. Additionally, these scores allow a clinician to confirm the severity of the patient's illness. They support objective assessments of disease severity to confirm that a particular institution's mortality rate is similar to expected benchmarks. Finally, scores can be used to triage patients within an institution to confirm appropriate levels of care and monitoring.

These scoring systems use diverse methods. Some of them incorporate preexisting comorbidities and therapies undertaken before admission to the surgical ICU (including care given in other ICUs). Other systems focus on direct measurements of physiologic parameters and laboratory values.

Treatment of Sepsis

The Surviving Sepsis guidelines were revised in 2012, and provide a framework for the management of the septic patient [8]. In summary, Blood cultures should be gained before the beginning of antimicrobial treatment as long as the initiation of therapy is not delayed. Broad-spectrum antimicrobial therapy should be administered within one hour of diagnosis, and should have activity against all likely pathogens. Antifungal and antiviral therapies should be considered in patients with known immunocompromise or a history of organ transplantation.

Diagnosis and Management of Organ Dysfunction

Hypoperfusion when occurs with severe sepsis and septic shock can lead to endorgan damage and dysfunction. MODS is the final stage of this process.

Cardiovascular Derangements

Sepsis leads to the decrease of of cardiac function and peripheral vascular resistance, and an increase in microvascular permeability. Patients presents with manifestation of hyperdynamic circulation and volume loss into soft tissues. This will lead to poor oxygen delivery at the level of the tissue, with microvascular shunting a result of the vasodilation, and edema resulting in decreased oxygen diffusion across membranes into cells.

The first resuscitation stage should focus on the early goal-directed management, and should be done within six hours of the diagnosis of sepsis. Crystalloid resuscitation continues to be the standard of care.

Colloids and blood products are infrequently used in the beginning of resuscitation of a septic patient. Hydroxyethyl starch fluids are contraindicated. If the patient continues to deteriorate and still hypotensive in spite of adequate volume loading, vasopressor agents are recommended to maintain the goal mean arterial pressure.

Respiratory Derangements

The range of acute lung injury and acute respiratory distress syndrome (ARDS), known for tachypnea, hypoxia, and hypocapnia usually needs mechanical ventilation. The PaO2/FiO2 ratio is a well-known and objective measure of the severity of this process, and a ratio of less than three hundred mm Hg is the generally accepted threshold for the diagnosis for mild ARDS, 100 to 200 mm Hg for moderate ARDS, and less than 100 mm Hg for severe ARDS.[9] Another criterion for the diagnosis of ARDS includes fluffy bilateral infiltrates seen on chest radiography in the absence of congestive heart failure.

Management of acute respiratory failure is usually supportive. Care should be taken to avoid the deleterious effects of alveolar collapse, barotrauma, and volutrauma. Lower tidal volumes with higher respiratory rates may be beneficial [10]. Positive end-expiratory pressure should be used to avoid alveolar collapse and resultant atelectasis induced trauma. In patients with refractory hypoxemia, prone positioning or the institution of airway pressure release ventilation may facilitate alveolar recruitment.

Gastrointestinal Derangements

In critical care unit, those who need prolonged mechanical ventilation or have a coagulopathy are at

risk for stress gastritis and ulcer formation. These patients are managed with either histamine receptor blockers or proton pump inhibitors. Intolerance of enteral feedings is common in this setting and could reflect postoperative opioid use, surgical ileus, pulmonary or intraabdominal infection, or a combination of these factors.

Hepatic failure could also happen, either due to ischemic hepatitis, ICU jaundice, or venous congestion in the setting of cardiac dysfunction. Ischemic hepatitis is characterized by high transaminase, an increased international normalized ratio, and hypoglycemia, and is managed with resuscitation [11].

Renal Derangements

Acute renal failure (ARF) is considered a common characteristic in MODS, and sepsis is the main cause of ARF in the ICU [12]. ARF is the rapid loss of glomerular filtration rate over a period of time and is often identified as an increase in plasma creatinine and blood urea nitrogen levels. Early dysfunction is often due to renal hypoperfusion during the shock state while late dysfunction can be due to toxic injury. The main causes of ARF in patients with MODS are either prerenal or renal. Postrenal causes are uncommon.

Hematologic Derangements

Patients with MODS usually have perturbations in hematologic function. Thrombocytopenia is seen in up to fifty percent of ICU patients, and could be linked to poor prognosis [13]. Low platelet counts could be worsened by recent surgical intervention and acute blood loss. Sepsis could lead to DIC, which is the result of aberrant activation of the clotting cascade, combined with the activation of fibrinolytic mechanisms. DIC results in the consumption of platelets and clotting factors, leading to depletion and simultaneous hemorrhage and thrombosis. DIC is considered a state of thrombocytopenia concurrent with prolonged activated prothrombin and activated partial thromboplastin times, decreased fibrinogen, and increased fibrin degradation products.

Management of hematologic changes is supportive. Packed red blood cell transfusion is indicated if the patient has a hemoglobin level of lower than seven g/dL, and should be undertaken to achieve a goal between seven and nine. Platelet transfusion should be reserved for patients with levels of less than 10,000 mm3 Cryoprecipitate should be administered to keep fibrinogen levels greater than 80 to 100 mg/dL.

Endocrine Derangements

The three most common alterations in endocrine function in sepsis and MODS are insulin deficiency, adrenal deficiency, and vasopressin deficiency. Insulin deficiency presents as hyperglycemia, which could affect the immune function and wound healing. Preserving glucose levels using insulin has been shown to decrease mortality. Functional adrenal deficiency could present as hypotension unresponsive to pressor therapy, but remains to be difficult to diagnose in critically ill patients [14,15].

Prognostic Indicators

There are many factors affect the prognosis and outcomes in sepsis, however can be divided into three main groups: The site and type of infection, the severity, and the timing and appropriateness of therapy [16,17].

CONCLUSIONS:

Sepsis and MODS remain to be an important cause of morbidity and mortality in the ICU settings. Sepsis includes the interaction between the infectious insult and the patient's inflammatory response, both of which are essential factors in the progression along the spectrum from sepsis to MODS. The inflammatory response is a complex one, that is known by a procoagulant state, endothelial injury, cardiac dysfunction, vasodilation, hypovolemia due to fluid shift, microcirculatory dysfunction, and hemodynamic collapse. MODS is usually manifest when this process results in the dysfunction or failure of more than one organ system. The recent standards of therapy for sepsis have been established, which adds a outline for evidence-based care. Timely recognition of the signs and symptoms of early sepsis, aggressive volume resuscitation to established endpoints, and appropriate support with vasopressors and antimicrobial medications are the goals of early resuscitative efforts. Eradication of the infection by achieving source control and providing proper antibiotic therapy is critical to the resolution of the septic process. In patients who progress to MODS, the clinician must work to support and maintain the homeostasis of the failing organ systems. Mortality rates from septic shock and MODS are getting better, but continue to be high. Doctors must embrace the reality that not all can be saved.

REFERENCES:

1. **Lagu T, Rothberg MB, Shieh MS, et al.2003** Hospitalizations, costs, and outcomes of severe sepsis in the united states 2003 to 2007. Crit Care Med 2012;40(3): 754–61.
2. **Bone RC, Fisher CJ Jr, Clemmer TP, et al.1989** Sepsis syndrome: a valid clinical entity.

methylprednisolone severe sepsis study group. Crit Care Med 1989;17(5): 389–93.
3. **Vincent JL, Sakr Y, Sprung CL, et al.** Sepsis in European intensive care units: results of the SOAP study. Crit Care Med 2006;34(2):344–53.
4. **Angus DC, Linde-Zwirble WT, Lidicker J, et al.2001** Epidemiology of severe sepsis in the united states: analysis of incidence, outcome, and associated costs of care. Crit Care Med 2001;29(7):1303–10.
5. **Richards M, Thursky K, Buising K.2003** Epidemiology, prevalence, and sites of infections in intensive care units. Semin Respir Crit Care Med 2003;24(1):3–22.
6. **Medzhitov R, Preston-Hurlburt P, Janeway CA Jr.1997** A human homologue of the drosophila toll protein signals activation of adaptive immunity. Nature 1997; 388(6640):394–7.
7. **Gordon AC, Lagan AL, Aganna E, et al.2004** TNF and TNFR polymorphisms in severe sepsis and septic shock: a prospective multicentre study. Genes Immun 2004; 5(8):631–40.
8. **Dellinger RP, Levy MM, Rhodes A, et al.2013** Surviving sepsis campaign: international guidelines for management of severe sepsis and septic shock: 2012. Crit Care Med 2013;41(2):580–637.
9. **ARDS Definition Task Force, Ranieri VM, Rubenfeld GD, et al.2012** Acute respiratory distress syndrome: the Berlin definition. JAMA 2012;307(23):2526–33.
10. Ventilation with lower tidal volumes as compared with traditional tidal volumes for acute lung injury and the acute respiratory distress syndrome. the acute respiratory distress syndrome network. N Engl J Med 2000;342(18):1301–8.
11. **Taylor BE, McClave SA, Martindale RG, et al.** Guidelines for the provision and assessment of nutrition support therapy in the adult critically ill patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (.
12. **Andrikos E, Tseke P, Balafa O, et al.2009** Epidemiology of acute renal failure in ICUs: a multi-center prospective study. Blood Purif 2009;28(3):239–44.
13. **Tsirigotis P, Chondropoulos S, Frantzeskaki F, et al.2016** Thrombocytopenia in critically ill patients with severe sepsis/septic shock: prognostic value and association with a distinct serum cytokine profile. J Crit Care 2016;32:9–15.
14. **Bollaert PE, Charpentier C, Levy B, et al.1998** Reversal of late septic shock with supraphysiologic doses of hydrocortisone. Crit Care Med 1998;26(4):645–50.
15. **Briegel J, Forst H, Haller M, et al.1999** Stress doses of hydrocortisone reverse hyperdynamic septic shock: a prospective, randomized, double-blind, single-center study. Crit Care Med 1999;27(4):723–32.
16. **Labelle A, Juang P, Reichley R, et al.2016** The determinants of hospital mortality among patients with septic shock receiving appropriate initial antibiotic treatment*. Crit Care Med 2012;40(7):2016–21.
17. **Shorr AF, Tabak YP, Killian AD, et al.2006** Healthcare-associated bloodstream infection: a distinct entity? insights from a large U.S. database. Crit Care Med 2006; 34(10):2588–95.