UPDATED MANAGEMENT OF SEPTIC SHOCK

Essay

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in Intensive Care Medicine

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وَعَلَّمَكَ مَا لَمْ تَكُنْ
تَعْلَمُ وَكَانَ فَضْلُ اللهِ
عَلَيْكَ عَظِيمًا

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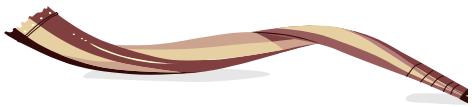

Nadia Mosbah

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List of Abbreviations

Abb.	Meaning
ACCP	American College of Chest Physicians
ACEP	American College of Emergency Physicians
ACT	Activated clotting time
ACTH	Adrenocorticotrophic hormone
ADH	Antidiuretic hormone
AIDS	Acquired immunodeficiency syndrome
AKI	Acute kidney injury
ALI	Acute lung injury
AMP	Adenosine monophosphate
ANP	Atrial natriuretic peptide
AP	Alkaline phosphatase
APACHE II	Acute Physiology and Chronic Health Evaluation II
APC	Activated protein c
aPTT	Activated partial thromboplastin time
ARDS	Acute respiratory distress syndrome
ARF	Acute renal failure
AT-III	Antithrombin-III
ATN	Acute Tubular Necrosis
ATP	Adenosine triphosphate
ATS	American Thoracic Society
BBB	Blood brain barrier
BP	Blood pressure
BUN	Blood urea nitrogen
CvO_2	Mixed venous oxygen content
CaO_2	Arterial oxygen content
CBC	Complete blood count
cGMP	Cyclic guanosine monophosphate

Abb.	Meaning
CHF	Congestive heart failure
CK-MB	Creatine kinase MB
CO	cardiac output
CPB	Cardiopulmonary bypass
CRF	Chronic Renal Failure
CRP	C-reactive protein
CVC	Central venous catheter
CVO	Circumventicular organs
CVP	Central venous pressure
DAD	Diffuse alveolar damage
DIC	Disseminated intravascular coagulation
DVT	Deep venous thrombosis
E. coli	Escherichia coli
EBM	Evidence- based medicine
EC	Endothelial cells
EGDT	Early goal-directed therapy
EPCs	Endothelial progenitor cells
ER	Emergency room
ESICM	European Society of Intensive Care Medicine
FDP	Fibrin degradation products
FiO۲	Fraction of inspired oxygen
FIX	Factor ۹
FIXa	Active factor ۹
FVIIa	Active factor ۷
FX	Factor ۱۰
FXIIIa	Active factor ۱۳
GCS	Glasgow Coma Score
GFR	Glomerular filtration rate

Abb.	Meaning
GIT	Gastrointestinal tract
Hb	Hemoglobin
HD	Hemodialysis
HIV	Human immunodeficiency virus
HPV	Hypoxic pulmonary vasoconstriction
HRV	Heart rate variability
HS	Heparin sulfate
ICU	Intensive care unit
IDDM	Insulin-dependent diabetes mellitus
IgG	Immunoglobulin G
IgM	Immunoglobulin M
IL-١ra	Interleukin-١ receptor antagonist
ILs	Interleukins
INR	International normalized ratio
IVIG	Polyclonal intravenous immunoglobulins
LDL	Low density lipoprotein
LMWH	Low molecular weight heparin
LPS	Lipopolysaccharide
LPS	Lipoproteins
MAP	Mean arterial blood pressure
MAS	Macrophage activation syndrome
MDR	Multiple drug resistance
MHC	Major histocompatability complex
MI	Myocardial infarction
MIC	Minimum inhibitory concentration
MIF	Macrophage migration inhibitory factor
MODS	Multiorgan dysfunction syndrome
MOF	Multiorgan failure

Abb.	Meaning
MRSA	Methicillin-resistant Staphylococcus aureus
NO	Nitric oxide
OER	Oxygen extraction ratio
PACs	Pulmonary artery catheters
PAF	Platelet activating factors
PC	Protein C
PCT	Procalcitonin
PCWP	Pulmonary capillary wedge pressure
PEEP	Positive end-expiratory pressure
PG	Prostaglandins
PMNs	Polymorphnuclear neutrophils
PROWESS	Protein Worldwide Evaluation in Sever Sepsis
RCT	Randomized controlled trial
rhAPC	Recombinant human activated protein C
ROS	Reactive oxygen species
RRT	Renal replacement therapy
$S^{-}vO_{2}$	Mixed venous oxygen saturation
SAFE	Saline versus albumin fluid evaluation
SaO_{2}	Oxygen saturation of arterial blood
SBP	Systolic blood pressure
SCCM	Society of Critical Care Medicine
$ScvO_{2}$	Central venous oxygen saturation
SD	Standard deviation
SIRS	Systemic inflammatory response syndrome
SOFA	Sepsis-related Organ Failure Assessment
SSC	Surviving sepsis campaign
sTREM-١	Soluble triggering receptor expressed on myeloid cell-١

Abb.	Meaning
SvO_2	Venous oxygen saturation
TAFI	Thrombin-activatable fibrinolysis inhibitor
TF	Tissue factor
TFPI	Tissue factor pathway inhibitor
Th_1	Type ١ helper lymphocytes
Th_2	Type ٢ helper lymphocytes
TLRs	Toll-like receptors
TM	Thrombomodulin
TNFR	Tumor necrosis factor receptors
TNF-α	Tumor necrosis factor-alpha
t-PA	Tissue plasminogen activator
TPN	Total parentral nutrition
TSS	Toxic shock syndrome
TX	Thromboxane
UFH	Unfractionated heparin
UOP	Urine output
uPA	Urokinase-type plasminogen activator
Va	Active factor ٥
VIIIa	Active factor ٨
VO_2	Oxygen consumption
vs.	Versus
VTE	Venous thromboembolism
vWF	von Willebrand factor
WBC	White blood cell count

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Introduction

Sepsis is defined as a systemic inflammatory response syndrome, such as fever, tachypnea, tachycardia, or leukocytosis, in response to a culture-proven or clinically suspected infection. Later, the grading system of sepsis was modified to include severe sepsis, septic shock, and refractory septic shock ***(Levy et al., ٢٠٠٣).***

The occurrence of septic shock seems to peak in the sixth decade of life. Predisposing factors include male sex, non-white ethnic origin in North Americans, co- morbid diseases, malignancy, immunodeficiency or immunocompromised states, chronic organ failure, alcohol dependence, and genetic factors ***(Annane et al., ٢٠٠٥).***

The pathophysiology of septic shock is not precisely understood, but it involves a complex interaction between the pathogen and the host's immune system. The normal physiologic response to localized infection includes the activation of host defense mechanisms that result in the influx of activated neutrophils and monocytes, the release of inflammatory mediators, local vasodilation, increased endothelial permeability, and activation of coagulation pathways. These mechanisms are in play during septic shock, but on a systemic scale, leading to diffuse endothelial

disruption, vascular permeability, vasodilation, and thrombosis of end-organ capillaries. Endothelial damage itself can further activate inflammatory and coagulation cascades, creating in effect a positive feedback loop, and leading to further endothelial and end-organ damage ***(Hotchkiss and Karl, ٢٠٠٣).***

Although the use of biomarkers has significantly improved the diagnosis and management of other acute diseases, such as coronary artery disease and pulmonary embolism; yet, there is no single accepted biomarker or combination of biomarkers for use in patients who have suspected sepsis. There are some biomarkers under current investigation ***(Shapiro et al., ٢٠٠٩).***

The initial selection of antimicrobial therapy should be broad enough to cover all likely pathogens and be able to penetrate in adequate concentrations into the presumed source of sepsis. An antifungal agent should be included in the antimicrobial milieu for presumed fungal sepsis ***(Labelle et al., ٢٠٠٨).***

Other treatment options are the steroids which are used in specific conditions and the recombinant human-activated protein C which is used with specific limitations. Vasopressors and inotropes are used when there is need to restore adequate

hemodynamic function and to preserve tissue perfusion in sever sepsis and septic shock ***(Mullner et al., ٢٠٠٤).***

Septic shock has a high death rate. The death rate depends on the patient's age and overall health, the cause of the infection, how many organs have failed, and how quickly and aggressively medical therapy is started ***(Munford, ٢٠٠٨).***