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Colloids versus crystalloids for renal Protection in septic shock

Essay

Submitted for Partial Fulfillment of Master Degree in Intensive Care

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2016

Acknowledgment

Thanks first and last to **ALLAH** *as we owe Him for His great care, support and guidance in every step in our life.*

***I would like to express my deep gratefulness to Prof.Dr. Sherif Farouk Ibrahim**, Professor of anesthesia,I.C.U and Pain managementFaculty of Medicine - Ain Shams University, for his concern, his guidance and continuous encouragement. I consider myself very fortunate to work under his supervision.*

***I am grateful to Dr. Hanaa Mohamed Abd Allah El-Gendy,** Ass.Professor of anesthesia, I.C.U and Pain management Faculty of Medicine - Ain Shams University, for her generous and continuous help and valuable suggestions as well as her desire to achieve perfection. Her great help was very impressive and her meticulous reading and enormous assistance should be appreciated.*

***I am also grateful to Dr. AmrSobhyAbdElkway,** Lecturer of anesthesia, I.C.U and Pain management Faculty of Medicine - Ain Shams University for his generous and continuous help and valuable suggestions as well as his desire to achieve perfection. His great help was very impressive and his meticulous reading and enormous assistance should be appreciated.*

I must also express my thanks to all my family, my dear wife & my friends who supported me in this essay .

Also, I want to thank my god father Dr. Hossam Fayed

Dr.Mohamed Kamal Ayoub

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LIST OF ABBREVIATIONS

AKI	Acute Kidney Injury
APC	Activated Protein C
aPTT	activated Partial Thromboplastin Time
ARDS	Acute Respiratory Distress Syndrome
ARF	Acute Renal Failure
ATN	Acute Tubular Necrosis
BBB	Blood-Brain Barrier
CARS	Compensatory Anti-inflammatory Response Syndrome
CI	Cardiac Index
CO	Cardiac Output
CO2	Carbon Dioxide
COP	Colloid Osmotic Pressure
CVP	Central Venous Pressure
DAMPs	Damage-Associated Molecular Patterns
DIC	disseminated intravascular coagulation
DPsl-aCO2	Gradients between sublingual pressure of carbon dioxide and arterial pressure of carbon dioxide
GI	Gastro Intestinal
H+	Hydrogen ion
HA	Weak acids
HCO3−	Bicarbonate anion
HES	Hydroxyethyl Starch
ICU	Intensive Care Unit
IL	Inter Lukens
IM	Intravital Microscopy
iNO	inducible Nitric Oxide
INR	International Normalized Ratio
kw	Dissociation of water
LDF	Laser Doppler Flowmetry

LiDCO	Lithium Dilution Cardiac Output
LR	Lactated Ringer's
LV	Left Ventricular
LVEDV	Left Ventricular End-Diastolic Volume
MAP	Mean Arterial Pressure
MARS	Mixed Anti-inflammatory Response Syndrome
MFI	Microvascular Flow Index
MMDS	Mitochondrial Distress Syndrome
MS	Molar Substitution
MW	Molecular Weight
NIRS	Near Infrared Spectroscopy
NO	Nitric Oxide
NS	0.9% Saline
OH^-	Hydroxyl Ion
OPS	Orthogonal Polarization Spectral
PAC	Pulmonary Artery Catheter
PAMPs	Pathogen--Associated Molecular Patterns
PAOP	Pulmonary Artery Occlusion Pressure
PARs	Protease-Activated Receptors
PCO2	Pressure Of Carbon Dioxide
PCWP	Pulmonary Capillary Wedge Pressure
pHi	Gastric Mucosal Ph
PiCCO	Pulse Contour Continuous Cardiac Output
PLR	Passive Leg Raising
PPV	Pulse Pressure Variation
PRECISE	Study of IL13-PE38QQR Compared to GLIADEL Wafer in Patients With Recurrent Glioblastoma Multiforme
PslCO2	Sublingual Pressure Of Carbon Dioxide
RCLM	Rexectance-Mode Confocal-Laser-Scanning Microscopy
ROC	Receiver Operator Curve Characteristics
RRT	Renal Replacement Therapy
RV	Right Ventricular

SAFE	Saline Versus Albumin Fluid Evaluation
SBP	Systolic Blood Pressure
ScVO2	Mixed Central Venous Oxygen Saturation
SD	Slandered Deviation
SDF	Side Stream Dark Field
SID	Strong Ion Difference
SIRS	Systemic Inflammatory Response Syndrome
SVV	Stroke Volume Variation
TLRs	Including Toll-Like Receptors
TLRs	Toll-Like Receptors
TNF	Tumor Necrosis Factor
TT	Thrombin Time
VASST	Vasopressin In Septic Shock Study
VISEP	Efficacy Of Volume Substitution And Insulin Therapy In Severe Sepsis
WBC	White Blood Cells

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Introduction

Introduction

Sepsis is a syndrome clinically defined as the body's systemic inflammatory response to infection. Severe sepsis and septic shock are the end results of the body's maladaptive and inappropriate response to pathogenic microbes, resulting in organ dysfunction, tissue hypoperfusion and dysoxia, and ultimately death **(Nduka and Parrillo, 2009).**

Mortality rates with severe sepsis and septic shock range from 25% to over 75%, with higher rates of death in patients with multi–organ dysfunction and prolonged hypoperfusion**(Annane*et al.*, 2003).**

In patients with severe sepsis and septic shock, acute renal failure (ARF) is an independent factor for mortality. One of the most important recommendations is volume expansion that could also prevent ARF **(Dennen*et al.*, 2010).**

Early, aggressive volume resuscitation in septic patients with low cardiac output has been shown to modulate the inflammatory process and reduce the need for vasopressor therapy **(Rivers *et al.*, 2008).**

Crystalloid therapy with fluids such as 0.9% sodium chloride (saline) solution or Ringer's lactate solution have long been regarded as standard of care in severe sepsis or septic

shock.. Evidence has shown that total fluid gain (positive fluid balance) during ICU stay is correlated with increased hospital mortality. In addition, the employment of conservative fluid strategies have been shown to improve lung function, increase days without ventilator support, and reduce ICU length of stay **(Shum *et al.*, 2011).**

However, the type of fluid, especially the use of colloids, for volume expansion in septic shock remains a matter of debate. The use of hydroxyethylstarch (HES) is not related to better outcomes when compared to isotonic crystalloids. In addition, use of HES has been associated with the development of an impaired renal function **(Hartog*et al.*, 2011).**

CHAPTER I

Pathophysiology of sepsis

Pathophysiology of sepsis

Severe sepsis and septic shock are major challenges in intensive care units (ICU) and major healthcare problems, affecting millions of people around the world each year, killing one in four (and often more), and increasing in incidence **(Dombrovskiy *et al.*, 2007).**

Sepsis is defined as the presence (probable or documented) of infection together with systemic manifestations of infection. Severe sepsis is defined as sepsis plus sepsis-induced organ dysfunction or tissue hypoperfusion (**Tables 1** and **2**). The performance improvement bundles, which are included, a distinction is made between definitions and therapeutic targets or thresholds. Sepsis- induced hypotension is defined as a systolic blood pressure (SBP) < 90 mm Hg or mean arterial pressure (MAP) < 65 mm Hg or a SBP decrease > 40 mm Hg or less than two standard deviations below normal for age in the absence of other causes of hypotension, Septic shock is defined as sepsis-induced hypotension persisting despite adequate fluid resuscitation. Sepsis-induced tissue hypoperfusion is defined as infection-induced hypotension, elevated lactate, or oliguria (**Levy *et al.*, 2003).**

Table 1: Diagnostic Criteria for Sepsis

Infection, documented or suspected, and some of the following:
General variables Fever (> 38.3°C) Hypothermia (core temperature < 36°C) Heart rate > 90/min–1 or more than two sd above the normal value for age Tachypnea Altered mental status Significant edema or positive fluid balance (> 20 mL/kg over 24 hr) Hyperglycemia (plasma glucose > 140 mg/dL or 7.7 mmol/L) in the absence of diabetes
Inflammatory variables Leukocytosis (WBC count > 12,000 μL–1) Leukopenia (WBC count < 4000 μL–1) Normal WBC count with greater than 10% immature forms Plasma C-reactive protein more than two SD above the normal value Plasma procalcitonin more than two SD above the normal value
Hemodynamic variables Arterial hypotension (SBP < 90 mm Hg, MAP < 70 mm Hg, or an SBP decrease > 40 mm Hg in adults or less than two sd below normal for age)
Organ dysfunction variables Arterial hypoxemia (Pao2/Fio2 < 300) Acute oliguria (urine output < 0.5 mL/kg/hr for at least 2 hrs despite adequate fluid resuscitation) Creatinine increase > 0.5 mg/dL or 44.2 μmol/L Coagulation abnormalities (INR > 1.5 or aPTT > 60 s) Ileus (absent bowel sounds) Thrombocytopenia (platelet count < 100,000 μL–1) Hyperbilirubinemia (plasma total bilirubin > 4 mg/dL or 70 μmol/L)
Tissue perfusion variables Hyperlactatemia (> 1 mmol/L) Decreased capillary refill or mottling

WBC = white blood cell; **SBP** = systolic blood pressure; **MAP** = mean arterial pressure; **INR** = international normalized ratio; **aPTT** = activated partial thromboplastin time, **SD:** slandered deviation

(Dellinger *et al.*, 2013)

Table 2: Severe Sepsis:

Severe sepsis definition = sepsis-induced tissue hypoperfusion or organ dysfunction (any of the following thought to be due to the infection)
Sepsis-induced hypotension
Lactate above upper limits laboratory normal
Urine output < 0.5 mL/kg/hr for more than 2 hrs despite adequate fluid resuscitation
Acute lung injury with Pao2/Fio2 < 250 in the absence of pneumonia as infection source
Acute lung injury with Pao2/Fio2 < 200 in the presence of pneumonia as infection source
Creatinine > 2.0 mg/dL (176.8 μmol/L)
Bilirubin > 2 mg/dL (34.2 μmol/L)
Platelet count < 100,000 μL
Coagulopathy (international normalized ratio > 1.5)

(Dellinger *et al.*, 2013)

☒ Epidemiology:

- ***Incidence***

Sepsis is responsible for 2% of hospital admissions, with approximately 50% of these patients requiring the intensive care unit (ICU). Severe sepsis accounts for 10% of all ICU admissions. The rising incidence is postulated to be secondary to the increases in the aging population, the