Update On VASOPRESSORS AND INOTROPES

IN TREATMENT OF SHOCK

Essay

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LIST OF ABBREVIATIONS

/	Per
µg	Microfgram
ABG	Arterial Blood Gases
ACC	American collage of cardiology
ACCF	American collage of cardiology foundation
AHA	American Heart Association
AMI	Acute Myocardial Infarction
Ca	Calcium
CABG	Coronary Artery Bypass Graft
CBC	Complete Blood Picture
CI	Contraindicated
Cm $H^{2}O$	Centimeter Water
CO	Cardiac Output
CO^{2}	Carbon Di Oxide
CS	Cardiogenic Shock
CT	Computed Tomography
DRSS	Dopamine Resistant Septic Shock
ECG	Electrocardiogram
ESC	European Society Of Cardiology
FFP	Fresh Frozen Plasma
GMBF	Gastric Mucosal Blood Flow
GRADE	Grade of recommendation, assessment, development and evaluation.
HBOCs	Hemoglobin Based Oxygen Carriers
HCL	Hydrochloric acid
HF	Heart failure
HS	Hemorrhgic Shock
HSD	Hyper Tonic Saline Dextran
HTS	Hyper Tonic Saline
ICU	Intensive Care Unit

IOBP	Intra Aortic Ballon Pump
Kg	Kilogram
LCOS	Low Cardiac Output Syndrome
MAP	Mean Arterial Blood Pressure
mg	Milligram
Min	Minute
mmHg	Millimeter Mercury
NSTEMI	Non ST Segment Elevation Myocardial Infarction
PCI	Percutaneous Intervention
pHi	Gastric Intramucosal pH
PLT	Platelet
PRBC	Packed Red Blood Cell
SBP	Systolic Blood Pressure
SCI	Spinal Cord Injury
SIRS	Systemic Inflammatory Response Syndrome
SOAP	Sepsis Occurrence In Acutely Ill Patient
STEMI	ST Segment Elevation Myocardial Infarction
SVR	Systemic Vascular Resistance
tPA	Tissue Plasminogen Activator
VAD	Ventricular Assisted Device

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INTRODUCTION

Shock is a pathophysiologic state characterized by a systemic reduction in tissue perfusion necessary to meet the metabolic needs of the tissues **[Otero, et al, ٢٠٠٦].** It is a final common pathway associated with regularly encountered emergencies including myocardial infarction, microbial sepsis, pulmonary embolism, significant trauma, and anaphylaxis.

Shock results in impaired tissue perfusion, cellular hypoxia, and metabolic derangements that cause cellular injury **[Mitchell, ٢٠٠٥]** and further propagating autonomic dysregulation and organ failure. These effects may be reversible, if the shock state is promptly recognized and corrected **[Blow, et al, ١٩٩٩]**. However, persistent hypoperfusion leads to irreversible tissue damage, progressive organ dysfunction, and can progress to death **[Mitchell, ٢٠٠٥].**

The management of shock first focuses on identifying the underlying cause, correction of perfusion deficits and maintenance of oxygen delivery. This is achieved by improving blood Pressure and cardiac output (CO) through the optimization of preload, augmentation of systemic vascular

resistance (SVR) and the increase of cardiac contractility **[Holmes, ٢٠٠٥]**.

To achieve these goals, a number of vasoactive agents can be used.Vasoactive agents are classically subdivided into two class types: vasopressors and inotropes **[Ellender and Skinner, ٢٠٠٨]**. Vasopressors modulate vasoconstriction and thereby augment venous return, thus increasing blood pressure **[Holmes, ٢٠٠٥]**.

Inotropes improve oxygen delivery and CO through an increase in rate and contractility **[Bourgoin, et al, ٢٠٠٥].**Vasopressor and inotropic agents function primarily through stimulation of adrenergic receptors or through the induction of intracellular processes that mimic sympathetic end points (increased cAMP). Most of these act directly or indirectly on the sympathetic nervous system with effects that vary according to the strength of sympathetic receptor stimulus and affinity **[Ellender and Skinner, ٢٠٠٨]**.

AIM OF WORK

This essay focuses on the basic pathophysiology of shock states and reviews the rationale regarding vasoactive drug therapy as well as inotropic drugs for management and cardiovascular support of shock within critical care units.

Pathophysiology of Shock

Shock is the pathophysiologic state characterized by significant reduction of systemic tissue perfusion, resulting in decreased tissue oxygen delivery. This creates an imbalance between oxygen delivery and oxygen consumption. Prolonged oxygen deprivation leads to cellular hypoxia and derangement of critical biochemical processes at the cellular level, which can progress to the systemic level **[Chittock and Russell, ١٩٩٦].**

Pathophysiology:

Include effects at cellular and systemic level

a) Cellular effects of shock :- include cell membrane ion pump dysfunction, intracellular edema, leakage of intracellular contents into the extracellular space, and inadequate regulation of intracellular pH. **[Hinshaw, ١٩٩٦].**

b) Systemic effects of shock:- include alterations in the serum pH towards acidosis , endothelial dysfunction, and further stimulation of inflammatory and anti-inflammatory cascades leading to myocardial dysfunction,ARDS, shock liver ,alteration in conscious

level and changes in renal function due to renal ischemia . **[Hinshaw,١٩٩٦].**Systemic tissue perfusion is determined by:

١- Cardiac output (CO): is the product of heart rate and stroke volume. The stroke volume is related to preload, myocardial contractility, and afterload. and the heart rate is related to sympathetic stimulation

٢- Systemic vascular resistance(SVR): is governed by vessel length, blood viscosity, and the inverse of vessel diameter. Decreased systemic tissue perfusion is a consequence of diminished CO or SVR. Both do not need to be decreased: Either can be elevated if the other is disproportionately low. As an example, SVR is decreased and CO is elevated in hyperdynamic shock **[David , ٢٠١٠].**In this setting, complex interactions between humoral and microcirculatory processes cause patchy regional blood flow and reduced effective tissue perfusion, resulting in derangement of cellular metabolic processes **[Shoemaker, ١٩٩٦].**

Sympathoadrenal Response In Shock:

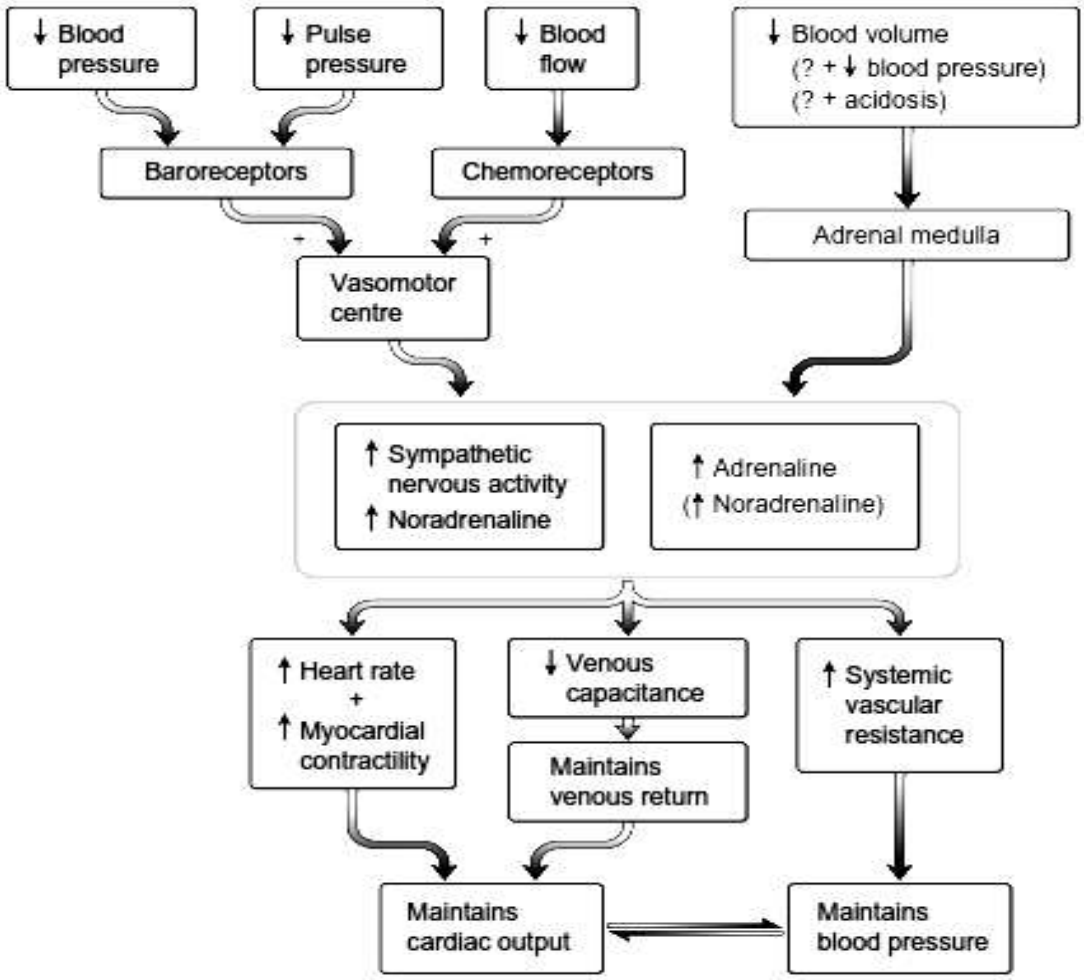

Figure (١) The sympathoadrenal response in shock Shock,*sepsis and multi-organ failure .Intensive care (٢٠٠٥).*

The renin-angiotensin system in shock:

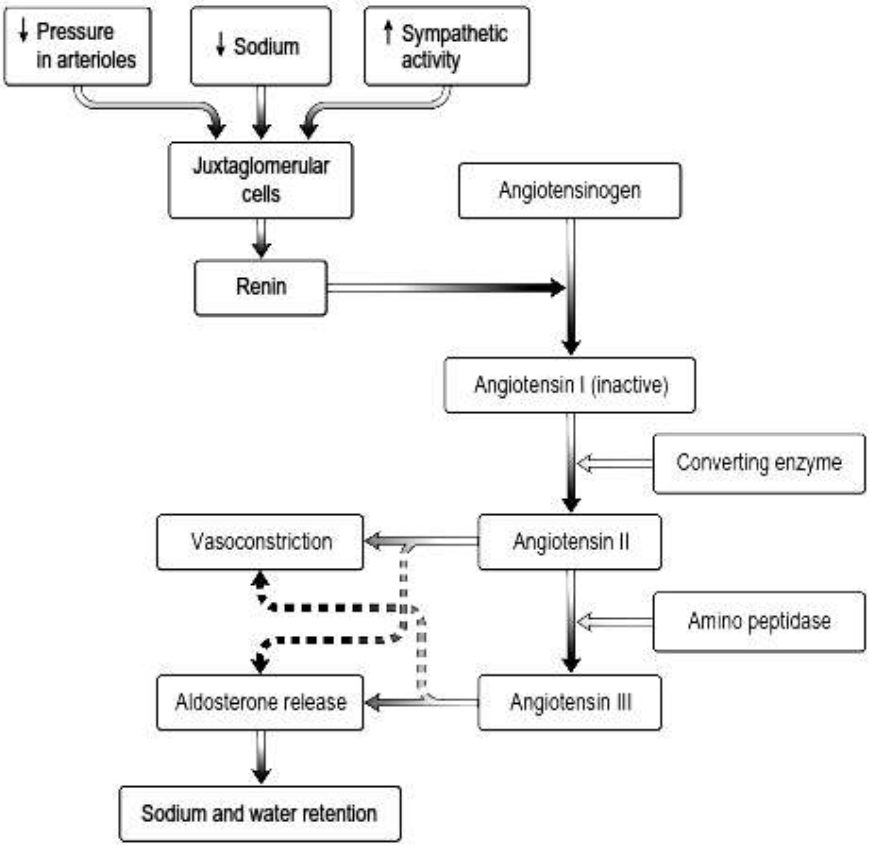

Figure (٢): The renin-angiotensin system in shock .*Shock ,sepsis and multi-organ failure .Intensive care (٢٠٠٥).*

Types of shock: four types of shock states are recognized hypovolemic, cardiogenic, obstructive and distributive **[Hinshaw, ١٩٩٦].**

١- Hypovolemic shock is a consequence of decreased preload due to intravascular volume loss. The decreased preload diminishes stroke volume, resulting in decreased cardiac

output (CO). The systemic vascular resistance (SVR) is typically increased in an effort to compensate for the diminished CO and maintain perfusion to vital organs **[Hinshaw, ١٩٩٦].** As shock progresses, catecholamines, antidiuretic hormone, and atrial natriuretic receptors respond to the perceived loss of volume by vasoconstriction of arterioles and muscular arteries and by increasing the heart rate. The aim of these compensatory

Mechanisms is to increase cardiac output and maintain perfusion pressure. Urine output drops somewhat and thirst is stimulated to maintain circulating blood volume. Anxiety may be related to the release of catecholamines and to mild decreases in cerebral blood flow. A person who is bleeding briskly also may develop tachypnea and hypotension.

As hypovolemia worsens and tissue hypoxia ensues, increases in ventilation compensate for the metabolic acidosis Produced by increased carbon dioxide production. Compensatory mechanisms are eventually overwhelmed by volume losses, and blood flow to the renal and splanchnic vasculature decreases and systolic blood pressure declines

[Guillermo Gutierrez ,٢٠٠٤]. Hypovolemic shock can be divided into two categories, according to etiology: