A COMPARISON OF TRANSESOPHAGEAL DOPPLER CORRECTED SYSTOLIC FLOW TIME WITH CENTRAL VENOUS PRESSURE TO GUIDE FLUID RESUSCITATION IN SEPTIC SHOCK: A PROSPECTIVE RANDOMIZED TRIAL

Thesis

Submitted for partial fulfillment of the MD degree in
ANESTHESIA

By

MAHMOUD SALEM SOLIMAN
(M.B., B.Ch.; M.Sc. Faculty of Medicine, Cairo University)

Supervised by

PROF. DR. WALEED IBRAHEEM HEMIMY
Professor of Anesthesiology,
Faculty of Medicine, Cairo University

DR. AHMED MOHAMED MUKHTAR
Assistant Professor of Anesthesiology,
Faculty of Medicine, Cairo University

DR. AHMED ZAGHLOUL FOAAD
Lecturer of Anesthesiology,
Faculty of Medicine, Cairo University

FACULTY OF MEDICINE
CAIRO UNIVERSITY
2014

بسم الله الرحمن الرحيم

ACKNOWLEDGEMENT

For ALLAH the merciful, the compassionate, I kneel to express my gratitude for all the countless gifts I have been offered, including those who gave their hands to enable me to fulfill this work.

My true appreciation is to Dr. ***WALEED HEMEMY****, Professor of Anesthesia, for his great help, outstanding support, for his sympathy, kindness and constructive advice and for treating me in a friendly way.*

I am deeply thankful to Dr. ***AHMED MOHAMED MUKHTAR****, Assistant Professor of Anesthesia, for his meticulous supervision, kind guidance, valuable instructions and generous help.*

I wish to thank Dr. ***AHMED ZAGHLOUL****, Lecturer of Anesthesia, for his great efforts, important contributions and his generous help to maintain an updated and wonderful ICU.*

I would like to express my deep sense of gratitude to all team of our SICU for helping me with continuous encouragement to bring this work to the attempted goal.

MAHMOUD SALEM SOLIMAN
2014

DEDICATION

THIS WORK IS DEDICATED TO
THE SOUL OF MY ***FATHER***

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LIST OF ABBREVIATIONS

±S.D	± standard deviation
°C	Degree Celsius
ABG	Arterial blood gases
ACTH	Adrenocorticotrophic hormone
APACHE	Acute physiology, age and chronic health evaluation
ARDS	Acute respiratory distress syndrome
AUC	Area under curve
BNP	B-type natriuretic peptide
bpm	Beat per minute
CO_2	Carbon dioxide
CRP	C-reactive protein
CVP	Central venous pressure
DPB	Diastolic blood pressure
dPOP	Dynamic pulse oximetry plethysomography
ECG	Electrocardiogram
EDM	Esophageal Doppler monitoring
EGDT	Early goal directed therapy
FFP	Fresh frozen plasma
FIO_2	Fraction of inspired O_2
FTC	Flow time corrected to heart rate
H_2RA	H_2-receptor antagonist
HR	Heart rate
IL	Interleukin
IVC	Inferior vena cava
IVCI	Inferior vena cava index
LMWH	Low molecular weight heparin
LV	Left ventricle
LVEDA	Left ventricle end diastolic area
MAP	Mean arterial pressure
MD	Minute distance
MIF	Macrophage migration inhibitory factor
min	Minute / Minutes
mm	Millimeter / Millimeters
mm Hg	Millimeter mercury
NE	Norepinephrine
NMBs	Neuromuscular blockers
O_2	Oxygen
PAC	Pulmonary artery catheter

PAOP	Pulmonary artery occlusion pressure
PCO_2	Partial pressure of CO_2
PCT	Procalcitonin
$P_{CV}O_2$	Central venous oxygen pressure
PEEP	Positive end expiratory pressure
PLA2	Phospholipase A_2
PLR	Passive leg-raising
PO_2	Partial pressure of oxygen
PPIs	Proton pumb inhibitors
PPV	Pulse pressure variation
Pra	Pressure of right atrium
PV	Peak velocity
$PvCO_2$	Mixed venous CO_2 partial pressure
PvO_2	Mixed venous oxygen partial pressure
RA	Right atrium
ROC	Receiving operating characteristic
RV	Right ventricle
RVEDVD	Right ventricle end diastolic diameter
RVEDVI	Right ventricle end diastolic index
S.D	Stroke distance
SaO_2	Arterial oxygen saturation
SBP	Systolic blood pressure
$ScVO_2$	Central venous oxygen saturation
SIRS	Systemic inflammatory response syndrome
SOFA	Sequential organ failure assessment
SPV	Systolic pressure variation
SV	Stroke volume
SVR	Systemic vascular resistance
SVRI	Systemic vascular resistance index
SVV	Stroke volume variation
TEE	Transesophageal echocardiography
TNF	Tumor necrosis factor
TPN	Total parental nutrition
TREM	Triggering receptor expressed on myeloid cells
TTE	Transthoracic echocardiography
VPV	Ventilation induced plethysmographic variation
VTE	Venous thromboembolic
WBCs	White blood cells

ABSTRACT

Aortic corrected flow time (FTc) is easily measured by Doppler techniques. Recent data using transoesophageal Doppler suggest that it may predict fluid responsiveness in critical care. This use of FTc has not previously been evaluated in septic shock, only one preliminary study have incorporated transcutaneously measured FTc. Denoting its importance in prediction of fluid responsiveness in septic patient Furthermore, no comparison has been made between transesopahgeal FTc and central venous pressure. The aim of our study was to compare FTc, central venous pressure as predictors of fluid responsiveness in septic shock patients without cardiac dysrhythmia. This was a prospective study of 46 consecutive adult septic shock patients (in sinus rhythm; 44 out of 46 patients were mechanically ventilated) treated with intravenous fluid challenge (500 ml over 15 minutes) guided with CVP in control group and guided by FTC in Doppler group in a surgical tertiary intensive care unit. There were no statistically significant differences between the two groups at baseline, except for lower APACHE (P = 0.039) levels in the Doppler group than in the control group. Haemodynamic assessment incorporating transesophageal aortic Doppler (CardioQ®) measurements occurred shortly before and 1,6,12,hours after fluid challenge. Concurrent with initial assessment, blood samples were withdrawn and laboratory measurements documented1, 6,12, hours after fluid challenge and in 3 consecutive days. Five patients demonstrated an increase in stroke volume ≥10% (responders). Percent change in stroke volume strongly correlated with baseline FTc (r=-0.6831, P=0.000) but not central venous pressure (r=-0.0864, P=0.56). Baseline FTc <332 ms discriminated responders from non-responders [AUC = 0.989, 95% confidence interval = 0.954 to 1.023; P = 0.01)]. Our data support FTc as a better predictor of fluid responsiveness than central venous pressure in septic shock. Transesophagreal aortic Doppler FTc offers promise as a simple, completely non-invasive predictor of fluid responsiveness and should be evaluated further.

Key Words:

Haemodynamics, septic shock, Doppler, FTC, CVP

INTRODUCTION

INTRODUCTION

Septic shock is an extremely complex disorder whose deranged hemodynamics results from the interplay of hypovolemia, vasodilatation, peripheral blood pooling, and extravasation of fluid into the interstitial space.

Intravenous fluids remain the corner stone of treating patients with septic shock. The goal of fluid resuscitation in severe sepsis and septic shock is not merely achieving a predetermined value, but rather optimizing systemic oxygen delivery (cardiac preload, afterload, arterial oxygen content, contractility or stroke volume).

Surprisingly, dosing intravenous fluid during resuscitation of shock remains largely empirical. Too little fluid may result in tissue hypoperfusion and worsen organ dysfunction; however, over-prescription of fluid also appears to impede oxygen delivery and compromise patient outcome. Several studies demonstrated that positive fluid balance was associated with increased mortality and the duration of mechanical ventilation.[1-2]

In a randomized, controlled, single-center study, early quantitative resuscitation improved survival for emergency department patients presenting with septic shock.[3]

The 2012 Surviving Sepsis Guidelines suggest the infusion of intravenous fluids until achieving a central venous pressure of 8–12 mmHg and raise this target to12–15 mm Hg in patients with mechanical ventilation.[4]

However, there are no recommendations as to when it is appropriate to discontinue or to reduce the rate of administration of intravenous fluid.

The measurement of descending aortic blood flow via an esophageal ultrasound probe offers an alternative method of monitoring circulatory status. Measured parameters include peak velocity (PV) and systolic flow time [FTc, corrected for heart rate (HR)]. PV ($cm.s^{-1}$) is an index of left ventricular contractility whilst FTc reflects ventricular preload. Concurrent changes in PV and FTc reflect changes in afterload. The technique has been validated extensively compared with pulmonary artery catheters and is now widely used in adult anesthesia and intensive care units practice. [2,4]

To the best of our knowledge there is only one published small study on the use of transcutaneous FTc in patients with septic shock. [2]

Moreover, no study has previously evaluated the use of transesophageal Doppler to guide fluid therapy in patients with septic shock.

AIM OF THE WORK