

**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

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DEDICATION

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

CONTENTS

	Page
▪ INTRODUCTION	1
▪ AIM OF THE WORK	3
▪ REVIEW OF LITERATURE	4
○ CHAPTER I: PATHOPHYSIOLOGY AND MANAGEMENT OF SEPTIC SYNDROME	4
○ CHAPTER II: FLUID RESUSCITATION AND FLUID RESPONSIVENESS MONITORING	35
○ CHAPTER III: ESOPHAGEAL DOPPLER MONITORING A MINIMALLY INVASIVE PROCEDURE	51
▪ PATIENTS AND METHODS	61
▪ RESULTS	65
▪ DISCUSSION	78
▪ CONCLUSION	84
▪ SUMMARY	85
▪ REFERENCES	89
▪ ARABIC SUMMARY	108

LIST OF FIGURES

No.	Title	Page
1	Inflammatory Responses to Sepsis	12
2	Inflammatory Responses to Sepsis	14
3	Pathophysiology of sepsis and multi-organ failure	18
4	Mechanisms of coagulopathy in sepsis	19
5	Venous return function curve superimposed on the cardiac function curve	42
6	Frank-Starling curves demonstrating relationship between change in preload to change in SV in a normal and failing ventricles	43
7	The effect of spontaneous breathing on the cardiac function curve	44
8	IVC diameter at end inspiration and IVC diameter at end expiration.	47
9	Passive leg raising. The passive leg raising test	48
10	Simultaneous fluctuations in arterial pressure and plethysmographic waveforms during mechanical ventilation	49
11	Cardiac Q-ODM™ esophageal Doppler Monitor	53
12	Receive and transmit ultrasound piezo-electric crystals	53
13	Nasal and oral positioning of esophageal probe in relation	55
14	Esophageal Doppler monitors waveform displaying stroke distance	55
15	Esophageal Doppler monitors waveform changes	56
16	Challenges faced in interpreting pulmonary artery pressures	58
17	Mean arterial blood pressure pre and post resuscitation in both groups	68
18	CVP pre and post resuscitation in both groups.	68
19	FTC pre and post resuscitation in both groups	69
20	PV pre and post resuscitation in both groups	69

LIST OF FIGURES

No.	Title	Page
21	SV pre and post resuscitation in both groups	70
22	ScVO ₂ pre and post resuscitation in both groups	70
23	Urine output pre and post resuscitation in both groups	71
24	Lactate pre and post resuscitation in both groups	71
25	p/f ratio pre and post resuscitation in both groups	72
26	Correlation between CVP on enrollment and % SV change	76
27	Correlation between SV change percentage and FTC enrollment	76
28	ROC curve in responders regards CVP value	77
29	ROC curve in responders regards FTC value	77

LIST OF TABLES

No.	Title	Page
1	Risk factors for sepsis	5
2	Sepsis; terminology and definitions	8
3	Severe Sepsis	9
4	Diagnostic criteria for sepsis	10
5	Common signs of acute organ system dysfunction in sepsis	11
6	The infection probability score	22
7	Determination of the quality of evidence	27
8	Factors determining strong Vs weak recommendation	28
9	Recommendations: initial resuscitation and infection issues	29
10	Invasive monitoring tools and their derived measurements	38
11	Esophageal Doppler Monitor Parameters	57
12	Demographics & characteristics of the Patients at Baseline	66
13	Fluid resuscitation volumes	67
14	Creatinine level pre and post resuscitation in both groups	72
15	Survivors' main parameters	74
16	Responder's main parameters	75

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 ₂ RA	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
PLA ₂	Phospholipase A ₂
PLR	Passive leg-raising
PO ₂	Partial pressure of oxygen
PPIs	Proton pump 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 documented 1, 6, 12, hours after fluid challenge and in 3 consecutive days. Five patients demonstrated an increase in stroke volume $\geq 10\%$ (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. Transesopahgeal 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 to 12–15 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