Electrical Cardiometry versus Echocardiography in Assessment of Hemodynamic Status in Preterm Neonates with Septic Shock

Abstract:

Background: Severe sepsis combined with hypotension or the requirement for vasopressors in newborns is known as neonatal septic shock and occurs even when the body is receiving enough fluids to revive it.

Hemodynamic monitoring in this condition can be through clinical assessment or using invasive and non-invasive tools like functional Echocardiography. Electrical Cardiometry (EC) has emerged as a continuous and non-invasive measurement of (CO) cardiac output. It has FDA approval and has been verified for usage in newborns.

Methods: All preterm infants admitted to the NICU who have been diagnosed with septic shock and have a gestational age between (34 0/7 and 36 6/7 weeks). 80 healthy neonates who were allocated for gestational age and sex made up the control group. Electrical cardiometry assessment was carried out throughout the first, second,third days of sepsis symptoms and prior discharge.

Results: In warm septic shock group;cardiac output (CO),stroke volume (SV), and cardiac index measured by electrical cardiometry (EC)had been substantially greater at the second evaluationcontrasted to last evaluationsin comparison to control group. There was no significant difference as regard contractility index (ICON) between both readings in both groups. Systemic vascular resistance (SVR) was significantly lower at 2nd evaluationin comparison to last evaluationsthan in control group. In cold septic

shock group, SV, CO and cardiac index measured by EC were substantially lower at 2nd evaluationcontrasted to last evaluationsin comparison to control group. ICON was significantly lower at 2nd readings in comparison to last readings in both groups. SVR was significantly higher at 2nd evaluationin cold septic shock in contrast to control group.

Conclusion: Electrical cardiometryis a valuable tool of bedside hemodynamic monitoring and management in cases with neonatal septic shock.

Keywords: septic shock, electrical cardiometry, inotropes.

INTRODUCTION-

Background:

Among the the most frequently occurring diseases in the newborn intensive care unit (NICU) is neonatal sepsis, which has a high morbidity and fatality rate. (1)

The main newborn risk factors for infection are low birth weight and prematurity. (2)

circulatory instability affects many children with sepsis; premature infants are more at risk because of the peculiarities of their circulatory function and reserve. (3)

Depends on the core pathophysiology, sepsis could harm the circulatory system and cause many forms of shock states, including septic shock. (4)

even though cold shock may also happen, septic shock more often manifests in the form of vasodilatory shock in the newborn period. (3)

Early identification of circulatory impairment in ill neonates helps physicians to make prompt therapeutic choices and objectively track patient response to therapy. (5)

Doppler measurements on an echocardiography are the most popular non-invasive method for estimating CO, although it is technically challenging and relatively intermittently practicable. (6)

A non-invasive, continuous technique for calculating cardiac output (CO) is electrical cardiometry (EC) (Xu et al., 2021). EC is frequently suggested as a method for measuring hemodynamics that is reliable, safe, and accurate. also has FDA validation and approval for use in newborns (7)

In this research, we aimed to determine the most effective cardiovascular care and the responsiveness of such treatment by evaluating the hemodynamic state and cardiac function in infants with septic shock.

Methods:

80 healthy controls who were allocated for gestational age and sex to the preterm babies and (40 cases) who had been confirmed to have septic shock in this quasi-expermintal research over a period of two years. The cases group consisted of all premature newborns admitted to the NICU who had septic shock along with gestational ages between (34 0/7 and 36 6/7) weeks and met Haque's 2005 diagnostic criteria of neonatal sepsis. (Figure 1), (8).

Full-term newborns, preterm neonates with gestational ages under 34 weeks, IDM, IUGR, major congenital malformations, structural cardiac disorders with the exception of hemodynamically insignificant PDAs with sizes less than 1.5 mm (9), PFO, and tiny ASDs were all excluded from the research. With an Apgar score of less than 5 at 5 minutes, a failure to tolerate adhesive skin leads, instances requiring high

frequency mechanical breathing, Hydropsfetalis, and all surgical cases, there is evidence of prenatal asphyxia.

The Tanta University Pediatrics ethical committee gave the research permission to proceed. Before individuals were enrolled, parental permission was required. The Declaration of Helsinki and the standards of good clinical practice were followed in the conduct of the research.

A thorough taking of history, and physical assessment were performed on the two research groups.

Laboratory assessment

Samples of blood were taken for standard laboratory tests from all infants having septic shock (N = 40) as well as the healthy control group (N = 80).

Research Methodology:

Electrical Cardiometry (EC) (6):

The ICON® hemodynamic monitor (ICON Cardiotronics, Inc., La Jolla, CA 92307; Osyka Medical GmbH, Berlin and Germany, version C3, Serial number: 1817406) was used to take the measures.

EC was used to compare the hemodynamic condition of the patient to echocardiogram on the first, second, and third days after sepsis signs began and before discharge.

Gender, weight, gestational age (GA), body surface area (BSA), and Apgar ratings have been collected along with other demographic data. The experiment's weight was used to calculate the EC. Aesculon calculated the BSA using the Boyd formula.

The sensor wire was attached to the EC, and the necessary data (age, height, gender, weight, blood pressure, SpO2, HR, and Hb) were provided. index of contractility (ICON), Cardiac index (CI), cardiac output (CO), stroke volume (SV), and systemic vascular resistance were all continually presented on the EC.

Outcomes of the study:

Primary outcomes:

1. Use EC to determine the hemodynamic state of healthy preterm newborns.

2- Use EC to evaluate the hemodynamic state in premature newborns having septic shock.

Secondary outcomes:

Determine the response by assessing the value of EC monitoring in deciding about fluid treatment and the administration of vasopressors or inotropes based on the kind of septic shock.

Statistical Analysis

With the aid of the IBM SPSS statistical software program edition 20.0 (IBM Corp, Armonk, NY), information was introduced into the computer and evaluated. The normality of the distribution was examined using the Kolmogorov-Smirnov test. The mean, standard deviation, range (minimum and maximum), median, and interquartile range (IQR) were used to characterize the quantitative information. At the 5% level, significance of the findings was determined.

Results:

(Table 1) provides the demographic information and anthropometric measures, whereby among the case and control groups did not substantially vary (gestational age,

sex, post-natal age, length, weight, body surface area, and ponderal index). The Apgar score and delivery method are both the same.

Vital signs are illustrated in (table 2).

Table 3 shows: Warm septic shock group SV, CO, SI, and CI were substantially greater at second measurements contrasted to final measures and in contrast to control group.

In the cold septic shock group and in contrast to the control group, SV, CO, SI, and CI were substantially reduced at second readings in contrast to final measurements.

In the combined septic shock group, SV, CO, SI, and CI were substantially reduced at second readings compared to the control group, but no discernible change was existed among second and final readings.

Table 4; In warm septic shock group; no substantial variation was existed as regardIndex of Contractility(ICON) between 2nd evaluations in contrast to last readings and in contrastto control group.

In cold septic shock: ICON was significantly lower at second evaluation in contrast to finalevaluation and in contrast to control group.

In combined septic shock; ICON was significantly lower at second evaluation in contrast to control group but no substantial variation was existed between 2nd and last evaluations.

Table 5 shows: In warm septic shock: SVR and SVRI were significantly lower at second readings in contrast to last evaluations and in contrast to control group.

In cold septic shock: SVR and SVRI have beensubstantially greater at second evaluations in in comparison to control group while no substantial variation was existed between second evaluation and finalevaluations.

In combined septic shock: no substantial variation was existed among secondevaluation in contrast to last evaluations or in contrast to control group.

Table 6 shows:

In warm septic shock:

Stroke Volume Variation (SVV): was significantly higher at second evaluation in contrast to last evaluations and in contrast to control group. Corrected flow time (FTC): was significantly lower at second evaluation in contrast to last evaluations and in contrast to control group. Thoracic Fluid Content (TFC): was substantially greater at second evaluation in comparison to last evaluations while no substantial variation was existed in comparison to control group.

In cold septic shock: SVV was significantly higher at second evaluation in contrast to last evaluations and in contrast to control group. FTC was significantly lower at second evaluation in contrast to last evaluations and in contrast to control group. TFC was substantially greater at second evaluation in contrast to last evaluations while no substantial variation was existed in contrast to control group.

In combined septic shock: SVV was significantly higher at second evaluation in contrast to control group while no substantial variation was existed at second evaluation in contrast to last evaluations. FTC was significantly lower at second evaluation in contrast to control group while no substantial variation was existed at second evaluation in contrast to last evaluations. There was no significant difference in TFC in combined septic shock group at second evaluation in contrast to last evaluations and in contrast to control group.

These table (7) and figure (2) show: Types of CVS support medications required in warm septic shock group were (dopamine 94.7 %, noradrenaline 57.9 % and dobutamine 5.3 %) while types of CVS support medications required in cold septic

shock group were (dobutamine 100.0%, adrenaline 54.5 %, dopamine18.2 % and hydrocortisone 18.2 %). As regard types of CVS support medications required in combined septic shock group were (dopamine 100.0 %, dobutamine 100.0 %, adrenaline 100.0 %, noradrenaline 20.0 % and hydrocortisone 40.0 %).

Discussion:

According to bed-side physical assessment findings in both cold and warm shock physiology, sepsis-related impaired cardiovascular function has previously been characterized. (10)

Peripheral vasoconstriction, chilly peripheries, and tachycardia are the typical symptoms of cold shock; hypotension can frequently be a preterminal occurrence.

Hypotension and peripheral vasodilation brought on by endotoxin release are features of warm shock. Various therapy strategies may be helpful for these clinically distinct presentations. (10)

Early identification of cardiovascular impairment in ill newborns helps medical professionals to make prompt therapeutic choices and objectively track patient response to therapy.(11)

AS regard septic shock cases in this current study, they were 40 cases and they were classified into warm shock (19 cases representing 47.5%), cold shock (11 cases representing 27.5%) and combined shock (10 cases representing 25%).

This classification of septic shock cases in to warm and cold ones came in line with Deep et al. (2013) whom carried out a prospective observational work on 36 cases with septic shock; 21 cases classified as warm septic shock (greater CI and reducedSVRI) and 15 cases classified as cold septic shock (reducedCI and greater SVRI).

Regarding SV, CO and CI at 2nd readings in septic shock group were different according to the type of septic shock:

In warm septic shock group (19 cases) SV, CO and CI were substantially greater at second readings by EC and significantly higher in comparison with controls.

Deshpande et al.'s 2017 study showed that warm shock physiology, characterized by greater cardiac outputs and reduce estimated SVR relative to controls or reported normative values is the primary trait linked with sepsis in newborns. (12)

This may indicate that vaso-regulatory failure is the primary cause of septic shock in preterm newborns.(13)

In cold septic shock (11 cases); CO,SV, and CI at second by EC were significantly lower contrasted to finalevaluations and in contrast to control group.

Kharrat and Jain (2021) reported that Reduced stroke volume and left ventricular systolic malfunction may occur from sudden elevations in afterload in the neonatal heart, particularly in premature newborns. (3)

In combined septic shock (10 cases); CO,SV, and CI at second evaluation by EC were significantly lower in comparison to control group, these results similar to that of cold septic shock as combined type of shock demonstrate the late stage where there is cardiac depression and falling of both systolic and diastolic blood pressure.

In the present study: Index of contractility (ICON) in group of warm septic shock; When comparing second readings to previous readings and to the control group, there had been no discernible change.

To the best of our knowledge, no prior study has examined this item on newborns or pediatric patients with septic shock or sepsis, and there is a dearth of information on it.

Depending solely on the rate of alteration in thoracic impedance, EC only provides theoretical data about the cardiac contractility, which is displayed by the variable ICON. The capability of the ventricles to contract in order to pump is known as myocardial contractility, and in an echocardiogram, this is often indicated by the ejection fraction. (Gillebert et al., 2004). (14)

While ICON was significantly lower at second evaluation in contrast to last evaluations and in contrast to control group in cold septic shock. As regard combined septic shock; ICON was significantly lower at 2nd reading in comparison to control group but no substantial variation was existed among 2nd and last readings.

This impairment of cardiac contractility had been in line with Habimana et al. (2020) whe stated that the primary feature of cardiac problems in sepsis, particularly in the

hypodynamic phase of shock marked by elevated SVR, inadequate perfusion of tissues, chilly skin, and failure of organs, is contractile dysfunction. (15)

According to de Waal and Evans (2010), neonates may develop cold shock or already have it when they are born. Cold shock is a condition that happens in cases of serious infections when the circulatory system vasoconstricts in an attempt to re-distribute the blood to the vital central circulation in anticipation of impending circulatory failure. These newborns have a low LV myocardial function and a significant SVR. (16)

One element that affects afterload is vascular resistance, and SVR by EC is computed using the formula: 80 x (MAP - CVP)/CO, assuming that CVP (central venous pressure) is 3 mm Hg. (Hsu et al., 2016).(6)

In the current study SVR and SVRI are important items measured by EC and of a great clinical importance; we compared them in different types of septic shock groups with controls. As regard in warm septic shock group; SVR and SVRI were significantly lower at second evaluation in contrast to previous evaluationsand in contrast to control group. This low SVR and SVRI with high SV and CO in sepsis group indicating the predominant type of warm sepsis in the studied cases, this was in agreement with Wu and Noori (2021), de Waal and Evans (2010), Deshpande et al. (2017), and Saini et al. (2014) whomstated that warm shock physiology is more common in neonates characterized by reduced estimated SVR, and greater COcontrasted to controls or standards that have been published. (12)(16)(13)(17)

SVR and SVRI in cold septic shock group were substantially greater at the secondevaluation in comparison to control group.

The classification of cases into warm and cold septic shock according to SVRI and CI in our study came in line with Rao et al. (2021) who performed a pilot prospective

observational work of 30 pediatrics patients with septic shock revealed that 19 (63.3%) child were having cold shock and 11(36.7%) had warm shock, this classification was according to CI and SVRI as regard EC, those with reduced CI and greater SVRI had been classified as vasoconstrictive shock, while those with greater CI and reducedSVRI had been classified as vasodilated shock. (18)

One of the important clinical applications of EC is assessment of fluid status in neonates and giving an idea about preload through measurement of corrected flow time (FTC),stroke volume variation (SVV), and thoracic fluid content (TFC).

In this current study; In septic shock groups SVV was substantially greater at second readings in contrastto controls While FTC was significantly lower at 2nd evaluation in contrast to control group. As regard TFC was substantially greaterat second evaluationin contrastto control group. These evaluationsmean most septic shock cases had lower blood volume, decreased preload and need for fluid boluses.

This came in agreement with Gupta and Donn (2020) who postulated that,utilizing EC, preload was recently shown to be indirectly assessed. In paediatric groups, arise in thoracic fluid content (TFC) and stroke volume variation (SVV) have been used as a preload marker, although there is a dearth of information in the neonatal population. (19)

In the research done by Rao et al. (2021), it was determined how useful EC was for classifying hemodynamic conditions and determining fluid responsiveness in paediatric septic shock. They discovered that fluid responders had a substantially greater SVV prior to to the fluid bolus and a larger decline in SVV following the fluid bolus in contrast to the non-responders.(18)

According to different parameters measured by EC (SV, SI, CO, CI, SVR, SVRI, ICON, FTC and SVV) were useful for assessment of cardiac performance and hemodynamic status of the studied population and were considered as tools for the need of fluid boluses and further cardiac medications and their types.

This present study showed 100% of septic shock group cases required fluid boluses.

As regard types of CVS support medications required in different types of septic shock group. In warm type (low SVR) the medications needed were mainly with vasopressor effect (dopamine 94.7 %, noradrenaline 57.9% and dobutamine 5.3%).

This came in agreement with studies showed that Norepinephrine administration is additionally known to improve blood pressure, CO, and regional blood flow. Dopamine is the most popular vasopressor utilised in the NICU and it's been proven to be effective as well as safe in raising blood pressure throughout transitional hypotension. In a 2010 meta-analysis by Higgins et al.(20)

While CVS support medications required in cold septic shock group (low CO and high SVR) were (dobutamine 100.0%, adrenaline 54.5%, dopamine18.2% and hydrocortisone 18.2%). As regard types of CVS support medications required in combined septic shock group were (dopamine100.0%, dobutamine 100.0%, adrenaline 100.0%, noradrenaline 20.0% and hydrocortisone 40.0%).

Robel-Tillig et al. (2007) stated that, Due to its vasodilator properties, dobutamine was preferred over dopamine. (affecting both beta- and alpha-adrenergic receptors) moreover, the variation in inotropics intensity (Dobutamine is more potent than dopamine).(21)

In the current study; hydrocortisone was found to be useful in some cases with refractory septic shock.

The comparatively small dosage of hydrocortisone would likely prove preferred to the excessive dosage of dexamethasone in the management of refractory hypotension in life-threatening circumstances and emergency, despite the fact that routine and prophylactic usage of systemic corticosteroids shouldn't be advised due to their potential side effects. According to Higgins et al.'s (2010) meta-analysis research, hydrocortisone treatment substantially raises blood pressure in preterm babies who are hypotensive and lowers the need for vasopressors in hypotensive and vasopressor-dependent shock patients.(20)

Limitations of the study:

Small sample size, short duration of the study, unblinded design because it was impossible to compare electrical cardiometry and echocardiography in the same NICU, and no invasive hemodynamic methods of measurement were used for some variables, such as blood pressure, in this single-center study. Larger samples are required to confirm our findings.

Conclusion:

In late preterm neonates suffering septic shock, electrical cardiometry might be suggested as a helpful method for assessing hemodynamicsand can differentiate between different types of septic shock based on the results of cardiac output and systemic vascular resistance.

Consent

As per international standard, parental written consent has been collected and preserved by the author(s).

Ethical Approval:

As per international standard or university standard guideline participant consent and ethical approval has been collected and preserved by the authors.

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Tables:

(Table 1) Demographic data:

	Septic shock cases (n = 40)	Control (n = 80)	P
Sex			
Male	20 (50.0%)	33 (41.3%)	0.363
Female	20 (50.0%)	47 (58.8%)	
Weight (kg)	2.48 ± 0.23	2.58 ± 0.32	0.063
Length (cm)	46.5 ± 1.47	47.0 ± 2.14	0.087
GA (weeks)	35.2 ± 0.83	35.3 ± 0.87	0.821
BSA (kg/M^2)	0.18 ± 0.01	0.18 ± 0.02	0.062

Ponderal index	2.45 ± 0.12	2.46 ± 0.15	0.804
Postnatal age days	6.45 ± 4.04	6.54 ± 4.30	0.895
Delivery			
C.S	26 (65.0%)	49 (61.3%)	0.689
NVD	14 (35.0%)	31 (38.8%)	
Apgar score 5 min	9.53 ± 0.51	9.58 ± 0.50	0.607

GA: gestational age, BSA: body surface area, CS: cesarian section, NVD: normal vaginal delivery. Data presented as mean + SD (Standard deviation)

(Table 2) vital signs:

Vital signs	Septic shock (n = 40)	Control (n = 80)	F	P
Temperature °C Min. – Max. Mean ± SD.	35.0 – 37.0 36.31 ± 0.71	36.60 – 37.20 36.94 ± 0.13	34.051*	<0.001*
Respiratory rate (C/min) Min. – Max. Mean ± SD.	55.0 – 70.0 59.38 ± 3.24	34.0 – 54.0 42.96 ± 4.83	226.726*	<0.001*
Heart Rate (B/min) Min. – Max.	100.0 – 190.0	132.0 – 158.0	13.588*	<0.001*

Mean ± SD.	156.2 ± 21.97	144.6 ± 7.04		
Systolic BP(mmHg) Min. – Max. Mean ± SD.	 43.0 – 70.0 56.95 ± 9.23	 55.0 – 80.0 65.79 ± 5.74	 22.453*	 <0.001*
Diastolic BP (mmHg) Min. – Max. Mean ± SD.	 16.0 – 46.0 28.72 ± 8.66	 34.0 – 53.0 42.35 ± 4.41	 77.906*	 <0.001*
MBP(mmHg) Min. – Max. Mean ± SD.	 27.60 – 51.0 38.19 ± 5.25	 41.0 – 60.0 50.04 ± 4.50	 86.864*	 <0.001*

Data presented as mean + SD (Standard deviation).

(Table 3)EC data at 2nd and last readings in different types of septic shock group and in comparison to control group:

EC	Septic shock (n = 40)						Control (n = 80)
	Warm (n = 19)		Cold (n = 11)		Combined (n = 10)		
	2nd reading	last reading	2nd reading	last reading	2nd reading	last reading	
SV (ml) Min. – Max. Mean ± SD.	 1.67 – 4.33 3.85 ± 0.62	 2.51 – 3.65 3.21 ± 0.44	 1.56 – 2.31 1.84 ± 0.31	 1.32 – 3.41 2.67 ± 0.74	 1.53 – 2.43 2.04 ± 0.40	 1.97 – 3.52 2.51 ± 0.58	 2.15 – 3.82 3.15 ± 0.44
p_1	<0.001*		0.001*		0.125		
p_2	<0.001*		<0.001*		<0.001*		
CO (L/min) Min. – Max. Mean ± SD.	 0.24 – 0.72 0.63 ± 0.11	 0.35 – 0.50 0.44 ± 0.06	 0.21 – 0.36 0.26 ± 0.07	 0.14 – 0.45 0.36 ± 0.12	 0.22 – 0.37 0.29 ± 0.05	 0.19 – 0.52 0.32 ± 0.12	 0.31 – 0.54 0.45 ± 0.05
p_1	<0.001*		0.005*		0.542		

p_2	<0.001*		<0.001*		<0.001*		
CI (L/min/m^2) Min. – Max. Mean ± SD.	1.60 – 4.40 3.75 ± 0.61	2.31 – 3.33 2.64 ± 0.31	1.37 – 2.0 1.57 ± 0.24	0.93 – 2.66 2.15 ± 0.62	1.46 – 2.05 1.71 ± 0.21	1.11 – 2.73 1.92 ± 0.75	2.05 – 3.37 2.51 ± 0.25
p_1	<0.001*		0.008*		0.485		
p_2	<0.001*		<0.001*		<0.001*		

Table (4): ICON (index of contractility) by EC at 2nd and last readings in different types of septic shock group and in comparison to control group:

ICON	Septic shock (n = 40)						Control (n = 80)
	Warm (n = 19)		Cold (n = 11)		Combined (n = 10)		
	2nd day	last reading	2nd day	last reading	2nd day	last reading	
Min. – Max.	62.30 – 90.30	65.0 – 93.3	56.70 – 63.80	65.90 – 91.20	55.30 – 65.0	53.80 – 63.0	64.20 – 93.0
Mean ± SD.	81.77 ± 8.63	78.92 ± 8.25	60.04 ± 2.64	79.64 ± 10.34	60.69 ± 3.93	60.11 ± 2.91	79.80 ± 6.84
p_1	0.364		<0.001*		0.589		
p_2	0.287		<0.001*		<0.001*		

SD: Standard deviation

p_1: p value for Paired t-test for comparing between 2nd day and Last reading in each Septic shock

p_2: p value for Student t-test for comparing between 2nd day in each septic shock and control

*: Statistically significant at $p \leq 0.05$

Table (5): SVR and SVRI by EC at 2nd and last readings in different types of septic shock and in comparison to control group:

	Septic shock (n = 40)						Control (n = 80)
	Warm (n = 19)		Cold (n = 11)		Combined (n = 10)		
	2nd reading	last reading	2nd reading	last reading	2nd reading	last reading	
SVR (dyn-s/cm5)							
Min. – Max.	3255 – 12200	7136 – 11428	10577 – 15018	9120 – 16533	6560 – 11636	7136 – 11043	6074 – 10871
Mean ± SD.	4678.7±1898.5	9164.6±1340.3	12764 ± 1824	10908.8 ± 2810	8799.1±2019.5	9157.8±1578.1	8487.1±990.0
p_1	<0.001*		0.056		0.273		
p_2	<0.001*		<0.001*		0.641		

SD: Standard deviation

p_1: p value for Paired t-test for comparing between 2nd day and Last reading in each Septic shock

p_2: p value for Student t-test for comparing between 2nd day in each septic shock and control

*: Statistically significant at $p \leq 0.05$

Table (6): Fluid status at 2nd and last readings in different types of septic shock group and in comparison to control group:

Fluid Status	Septic shock (n = 40)						Control (n = 80)
	Warm (n = 19)		Cold (n = 11)		Combined (n = 10)		
	2nd day	last reading	2nd day	last reading	2nd day	last reading	
SVV%							
Min. – Max.	15.0 – 39.0	7.0 – 13.0	16.0 – 39.0	8.0 – 29.0	13.0 – 26.0	10.0 – 33.0	5.0 – 15.0

Mean ± SD.	21.37 ± 5.79	9.84 ± 1.71	22.09 ± 6.82	13.36 ± 7.86	20.50 ± 5.23	20.10 ± 9.43	11.19 ± 2.80
p_1	<0.001*		0.023*		0.919		
p_2	<0.001*		<0.001*		<0.001*		
FTC (ms) Min. – Max. Mean ± SD.	165.0 – 212.0 187.4 ±14.35	230.0 – 334.0 256.4 ± 30.24	167.0 – 200.0 182.1 ± 10.20	110.0 – 267.0 230.1 ± 60.65	175.0 – 218.0 189.6 ± 16.85	132.0 – 282.0 194.2 ± 67.01	160.0 – 300.0 250.4 ± 27.32
p_1	<0.001*		0.023*		0.858		
p_2	<0.001*		<0.001*		<0.001*		

SD: Standard deviation

p_1: p value for Paired t-test for comparing between 2nd day and Last reading in each Septic shock

p_2: p value for Student t-test for comparing between 2nd day in each septic shock and control

*: Statistically significant at $p \leq 0.05$

SVV: Stroke Volume Variation, FTC: Corrected Flow Time, TFC: Thoracic Fluid Content

Table (7): CVS support (fluid boluses and medications) in different types of septic shock group (n = 40):

CVS medication	Septic shock (n = 40)					
	Warm (n = 19)		Cold (n = 11)		Combined (n = 10)	
	No.	%	No.	%	No.	%
Bolus fluids	19	100.0	11	100.0	10	100.0
Dopamine	18	94.7	2	18.2	10	100.0

Noradrenaline	11	57.9	0	0.0	2	20.0
Dobutamine	1	5.3	11	100.0	10	100.0
Adrenaline	0	0.0	6	54.5	10	100.0
Hydrocortisone	0	0.0	2	18.2	4	40.0

Figures:

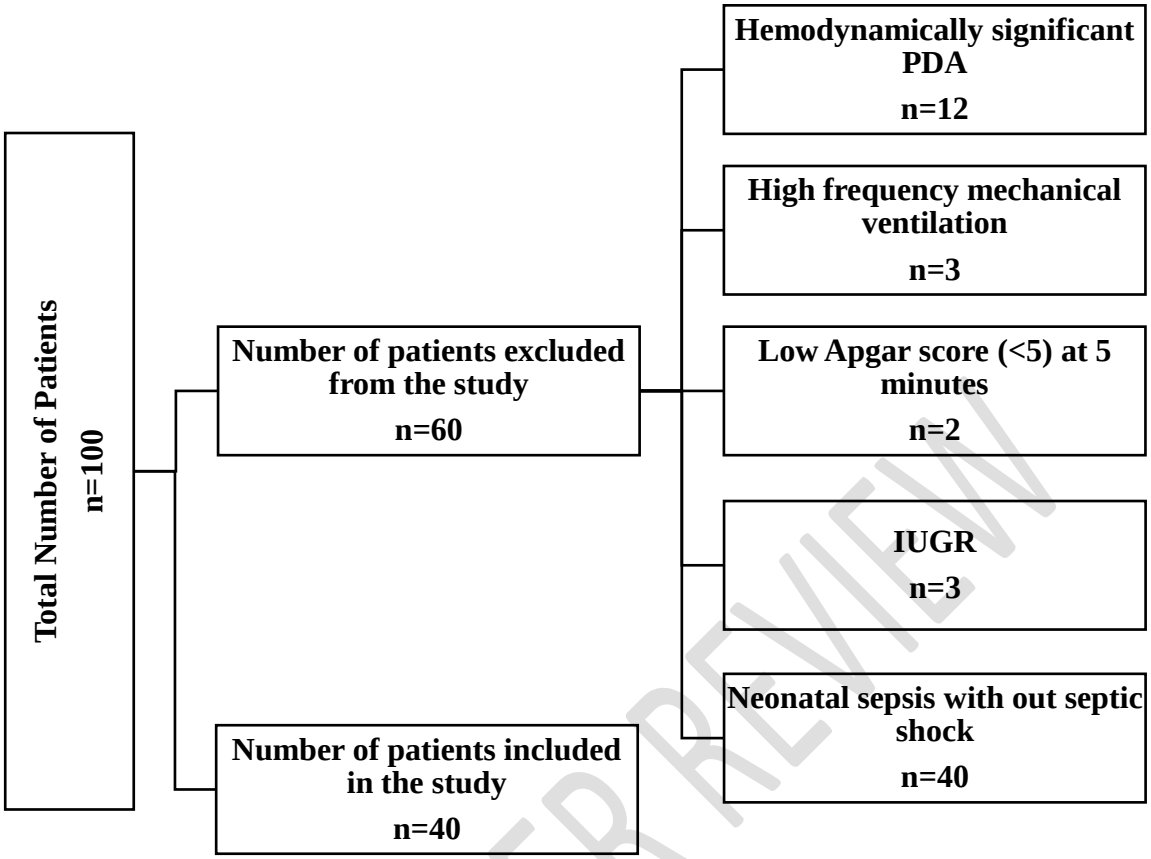

Figure 1: Illustration of the study design

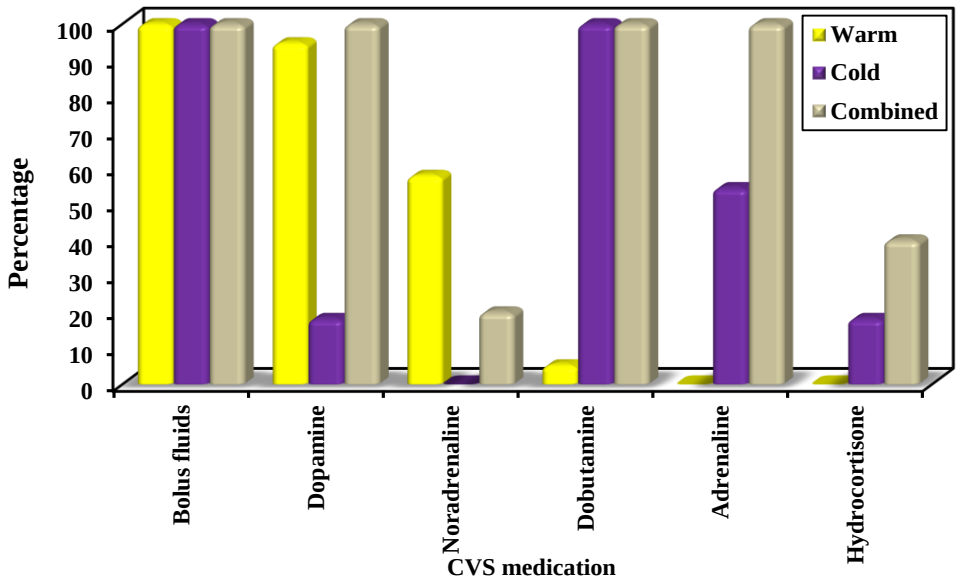

Figure (2): CVS support (fluid boluses and medications) in different types of septic shock group (n = 40)