Evaluation of differences in fluid and vasopressor use based on presence of left ventricular dysfunction in septic patients at an academic medical center

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INTRODUCTION

- Patients who present with severe sepsis and left ventricular (LV) dysfunction have higher rates of mortality compared to those without LV dysfunction[1,2]
- Mortality is hypothesized to be influenced by hypoperfusion in sepsis and septic shock secondary to loss of systemic vascular resistance is further compounded in patients with low cardiac output (CO) due to ventricular dysfunction[3]
- The management of sepsis involves fluid administration and often vasopressors and in patients with poor CO, fluid overload and coronary vasoconstriction has potential to lead to poor outcomes[4]

PURPOSE

The purpose of this study was to characterize differences in sepsis management in patients with and without LV dysfunction

METHODS

- Two site retrospective chart review of patients from May 2016 - January 2018
- Patients were included if they had diagnosis of sepsis, were treated with vasopressors for greater than 3 hours, and had an echocardiogram within 12 months
- Data collected included patient demographics, vasopressors used, vasopressor max rate and duration, steroid use and milliliters of fluid intake and output on ICU days 1 through 7
- Categorical variables were analyzed using the Chi Squared test and were reported as proportions. Continuous variables were compared using the Mann Whitney U tests and were reported as medians with interquartile range (IQR)
- Primary outcome was the need for mechanical ventilation (MV) and secondary outcomes included ICU fluid balance, vasopressor requirements, corticosteroid use, MV-free days, length of stay, and mortality
- This project is part of the health system medication use evaluation (MUE) and improvement program, which has been reviewed by the Augusta University Institutional Review Board and determined not to be human subjects research

DISCLOSURES

The authors have no conflicts of interest to disclose

RESULTS

Table 1. Demographics

Ejection Fraction (EF(Groups	<40% (n=37)	≥40% (n=42)	P-value
Age (years)	69 (57-79)	62 (53-68)	0.009
Height (cm)	173 (165-180)	170 (164-178)	0.236
Admission weight (kg)	80 (62-103)	86 (71-107)	0.218
Male	26 (70%)	21 (50%)	0.067
Average EF	30 (23-34)	58 (54-65)	<0.001

Data presented as number (%) or median (Q1 – Q3)

Table 3. Patient Outcomes

Ejection Fraction (EF) Groups	<40%	≥40%	P-value
Mechanical Ventilation (MV)	32 (86%)	24 (57%)	0.004
MV-free days	20 (0-25)	24 (0-28)	0.064
Hospital Mortality	14 (38%)	11 (26%)	0.267
ICU Length of Stay (days)	6 (4-9)	5 (2-7)	0.144

Data presented as number (%) or median (Q1 – Q3)

Table 4. Patient Outcomes

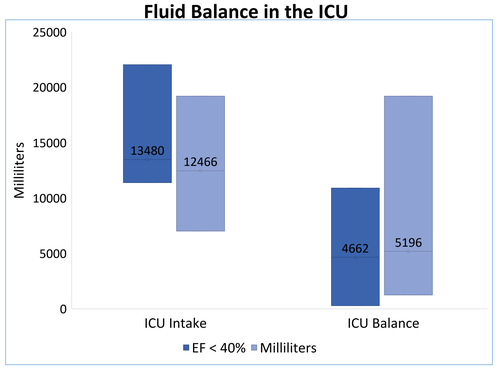
Variable	Odds Ratio	95% CI
Reduced EF	9.483	2.435 – 36.929
Age	0.962	0.918 – 1.009
Female Gender	1.243	0.381 – 4.055
AUMC	2.835	0.860 – 9.346
Weight	1.009	0.989 – 1.030
ICU Fluid Balance	1.000	1.000 – 1.000

Table 2. Medication Use

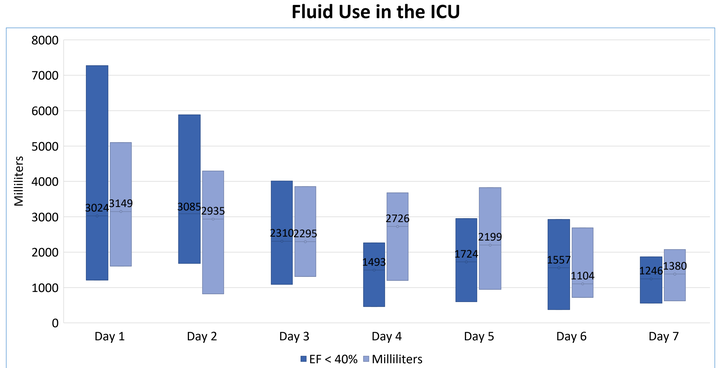
Vasopressor/Steroid Use	EF <40%	EF ≥40%	P-value
Norepinephrine	35 (95%)	35 (83%)	0.116
NE Duration (hours)	55 (16-85)	38 (21-78)	0.527
NE max rate, mcg/min	30 (19 – 40)	26 (9 – 40)	0.423
Cumulative NE dose, mg	42 (20 – 78)	18 (7 – 51)	0.037
Vasopressin	16 (43%)	14 (33%)	0.365
AVP Duration (hours)	15 (5 – 30)	12 (5 – 38)	0.951
AVP Max Rate (units/min)	0.04 (0.03 – 0.04)	0.03 (0.03 – 0.04)	0.257
Dopamine	3 (8%)	5 (12%)	0.577
DA duration, hours	27 (7 – unavailable)	2 (1 – 10)	0.071
DA max rate, mcg/min	20 (18 – unavailable)	6 (5 – 20)	0.393
Epinephrine	5 (14%)	1 (2%)	0.062
EPI Duration (hours)	19 (4 – 34)	7 (7 – 7)	0.667
EPI Max Rate (mcg/min)	10 (7 – 13)	1 (1 – 1)	0.333
Phenylephrine	11 (30%)	19 (45%)	0.156
Duration (hours)	16 (12 – 58)	13 (5 – 36)	0.250
Max Rate (mcg/min)	200 (100 – 300)	108 (40 – 200)	0.026
Steroids	13 (35%)	20 (48%)	0.262
Duration (days)*	2 (1 – 4)	4 (2 – 7)	0.087
Cumulative dose, mg	225 (100 – 1108)	848 (398 – 1750)	0.110

Data presented as number (%) or median (Q1 – Q3). Cumulative steroid dose is reported as hydrocortisone equivalents.

Fluid Balance in the ICU



Fluid Use in the ICU



DISCUSSION

- Patients with low ejection fractions were more likely to be mechanically ventilated (86% vs 57%, p=0.004) despite similarities in fluid and vasopressor use.
- The concern for fluid overload is peaked the significant increase in MV in patients with reduced LV ejection fraction.
- Patients received more cumulative NE if they had reduced EF (42 vs 18 mg, p=0.037) which may indicate a tendency to use higher doses for longer periods of time in patients with preexisting cardiac dysfunction
- Mortality and ICU length of stay were similar between the patient groups, but the study is likely underpowered to detect a difference.

CLINICAL IMPLICATIONS

- Limited evidence supports alternative management strategies for patients with depressed left ventricular function
- Fluids used to resuscitate septic patient may contribute to respiratory complications such as pulmonary edema resulting in need for mechanical ventilation
- Patients presenting with diminished cardiac function can be treated as having a poorer prognosis for MV and it may be appropriate to start 2nd line therapies such as steroids early and to treat more conservatively with fluids, using markers of fluid response such as passive leg raise and central venous pressure
- Obtaining echocardiograms on patients presenting with septic shock or who may develop septic shock may be a useful prognosticator and director for therapies

NEXT STEPS

- Further analyses of patient outcomes across multiple centers with larger study population should be done to assess correlation between left ventricular function, fluids, and vasopressors
- A large prospective randomized controlled trial that stratifies patients according to cardiac function for the treatment of sepsis and septic shock is needed to assess clinical implications of fluid and vasopressor use in these patient populations

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