Effect of hyperdynamic LVEF on ICU outcomes

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Abstract

Objective To study the effect of hyperdynamic left ventricular function on ICU outcomes.

Keywords: Intensive Care Unit, Hyperdynamic

1. Background

In a recent meta-analysis review by Huang et al. (2013) [1] the authors attemped to answer the question whether ventricular depression or dilation is associated with lower mortality rates. A total of 62 studies were reviewed and 14 included in the analysis. The meta-analysis failed to find any evidence to support the view that the survivors from severe sepsis or septic shock had lower ejection fractions. This study aims to further explore this research question using the MIMIC-II clinical database from the Beth Israel Deaconness Medical Center in Boston, MA [2].

2. Materials and Methods

The cohort used in this study is shown in Figure 1. The consisted of all adults admitted to the ICU with echo reports. A subset anlysis considers the patients who satisfy for the Angus crietria [3]. All statistical analysis was performed using R. Baseline comparisons were performed using Fisher tests for categorical variables with results reported as numbers and percentages. Continuously normally distributed variables were compared using t-tests and reported as median, while non-normally distributed data were compared using Mann-Whitney tests and reported as medians and interquartile range (IQR).

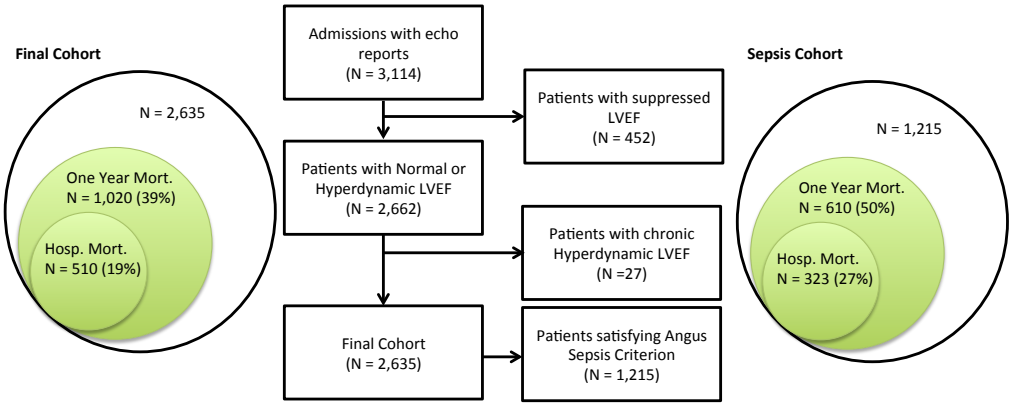

Figure 1: Patient record selection. Using the MIMIC II database we identified 2,632 patients that had a echo report.

3. Results

Table 2 highlights the results of the univariate analysis for all patients with hyperdynamic EF. Table **??** highlights the results of the univariate analysis for all patients with acute hyperdynamic EF. Significant values ($P < 0.05$) are shown in bold. Hyperdynamic patients are more likely to be female, be admitted to MICU, SICU and ventilated. Hyperdynamic patients also have higher risk of mortality, SOFA and SAPSI scores and stay longer in ICU. Table **??** looks at potential confounders for the cohort: hyperdynamic patients are more liekly to have congestive heart failure, hypertension and cancer.

Table **??** highlights the results of the univariate analysis for all septic patients. Significant values ($P < 0.05$) are shown in bold. Hyperdynamic septic patients have a higher 28-day and ICU/hospital mortality are more likely to be administered more fluids. The confounder analysis in Table **??** is inconclusive.

References

[1] S. J. Huang, M. Nalos, A. S. McLean, Is early ventricular dysfunction or dilatation associated with lower mortality rate in adult severe sepsis and septic shock? a meta-analysis, Critical Care 17 (2013) R96.

[2] M. Saeed, M. Villarroel, A. T. Reisner, G. Clifford, L. Lehman, G. M. ody, T. Heldt, T. H. Kyaw, B. Moody, R. G. Mark, Multiparameter intelligent monitoring in intensive care II (MIMIC-II): A public-access intensive care unit database, Crit Care Med 39 (2011) 952–960.

[3] D. C. Angus, W. T. Linde-Zwirble, J. Lidicker, G. Clermont, J. Carcillo, M. R. Pinsky, Epidemiology of severe sepsis in the united states: analysis of incidence, outcome, and associated costs of care, Critical care medicine 29 (2001) 1303–1310.

	Normal EF (N=2387)	**Hyperdynamic EF** (N=244)
	N (%) or median (IQR)	
Gender (Male)	1174 (49.18)	101 (41.39)*
Care Unit		
CCU	370 (14.06)	33 (1.25)
CSRU	187 (7.11)	25 (0.95)
MICU	1262 (47.97)	119 (4.52)
SICU	568 (21.59)	67 (2.55)
Septic	1092 (45.75)	123 (50.41)
Labs		
Max WBC	13.60 (8.90)	15.30 (9.35)*
WBC	11.00 (6.70)	11.80 (7.65)*
Max lactate	2.20 (2.40)	2.60 (2.92)*
Lactate	1.70 (1.30)	1.90 (1.36)*
Max createnine	1.10 (1.20)	1.20 (1.20)
Createnine	1.00 (1.00)	1.00 (0.92)
Co-morbidities		
Diabetes	632 (26.48)	67 (27.46)
Alcohol abuse	127 (5.32)	12 (4.92)
Arrhythmias	701 (29.37)	64 (26.23)
Valvular disease	332 (13.91)	37 (15.16)
Hypertension	833 (34.90)	108 (44.26)*
Renal failure	282 (11.81)	22 (9.02)
Chronic pulmonary	567 (23.75)	55 (22.54)
Liver disease	177 (7.42)	26 (10.66)
Cancer	102 (4.27)	15 (6.15)
Psychosis	82 (3.44)	9 (3.69)
Depression	127 (5.32)	14 (5.74)
CHF	822 (34.44)	101 (41.39)*
Treatments		
RRT	366 (15.33)	45 (18.44)
Vasopressor	1071 (44.87)	135 (55.33)*
Mech. Ventilation	1462 (61.25)	173 (70.90)*
Fluids in 3-days (ml)	7683.25 (8935.38)	9088.46 (10902.17)*

Table 1: Characteristics of normal versus all hyperdynamic EF patients

	Normal EF (N=2562)	**Acute Hyperdynamic EF** (N=69)
	N (%) or median (IQR)	
Gender (Male)	1248 (48.71)	27 (39.13)
Care Unit*		
CCU	390 (14.82)	13 (0.49)
CSRU	200 (7.60)	12 (0.46)
MICU	1350 (51.31)	31 (1.18)
SICU	622 (23.64)	13 (0.49)
Septic	1170 (45.67)	45 (65.22)*
Labs		
Max WBC	13.70 (8.88)	15.50 (9.00)
WBC	11.10 (6.65)	11.40 (8.80)
Max lactate	2.20 (2.40)	2.60 (1.98)
Lactate	1.70 (1.30)	1.90 (1.19)
Max createnine	1.10 (1.20)	1.30 (1.30)
Createnine	1.00 (1.00)	1.05 (1.20)
Co-morbidities		
Diabetes	679 (26.50)	20 (28.99)
Alcohol abuse	138 (5.39)	1 (1.45)
Arrhythmias	736 (28.73)	29 (42.03)*
Valvular disease	353 (13.78)	16 (23.19)*
Hypertension	906 (35.36)	35 (50.72)*
Renal failure	300 (11.71)	4 (5.80)
Chronic pulmonary	602 (23.50)	20 (28.99)
Liver disease	195 (7.61)	8 (11.59)
Cancer	112 (4.37)	5 (7.25)
Psychosis	89 (3.47)	2 (2.90)
Depression	137 (5.35)	4 (5.80)
CHF	888 (34.66)	35 (50.72)*
Treatments		
RRT	397 (15.50)	14 (20.29)
Vasopressor	1164 (45.43)	42 (60.87)*
Mech. Ventilation	1589 (62.02)	46 (66.67)
Fluids in 3-days (ml)	7740.15 (9045.22)	8889.06 (14182.76)*

Table 2: Characteristics of normal versus acute hyperdynamic EF patients

	Odds-ratio (95% Confidence Interval)	**P-value**
Age	0.9992 (0.9934,1.0049)	0.7969
Gender (Male)	0.9626 (0.7807,1.1864)	0.7206
Elixhauser Points (28-day)	1.0736 (1.0554,1.0923)	**<0.01***
SAPS-I	1.0756 (1.0531,1.0988)	**<0.01***
Vasopressor	1.8418 (1.4734,2.3061)	**<0.01***
Hyperdynamic EF	1.4836 (1.0714,2.0361)	**0.0159***

Table 3: Multivariate model predicting 28-day mortality for all patients

	Hazard ratio (95% Confidence Interval)	**P-value**
Age	0.9997 (0.9981,1.0025)	0.7799
Gender (Male)	0.9895 (0.9331,1.0944)	0.7961
Elixhauser Points (28-day)	1.0226 (0.9714,0.9844)	**<0.01***
SAPS-I	1.0244 (0.9682,0.9842)	**<0.01***
Vasopressor	1.2052 (0.7612,0.9044)	**<0.01***
Hyperdynamic EF	1.1256 (0.7744,1.0193)	0.0915

Table 4: Multivariate Cox Hazard model predicting 28-day mortality for all patients

	Non-Septic (N=1416) N (%)	**Septic** (N=1215)	**P-value**
Normal EF	1295 (91.45)	1092 (89.88)	0.1776
Hyperdynamic EF (all)	121 (8.55)	123 (10.12)	0.1776
Acute Hyperdynamic EF	24 (1.69)	45 (3.70)	**<0.01***

Table 5: Ejaction fraction characteristics of septic patients

	Odds-ratio (95% Confidence Interval)	**P-value**
Age	1.0029 (0.9946,1.0110)	0.4892
Gender (Male)	1.0550 (0.7982,1.3950)	0.7067
Elixhauser Points (28-day)	1.0596 (1.0354,1.0848)	**<0.01***
SAPS-I	1.0615 (1.0320,1.0923)	**<0.01***
Vasopressor	2.1157 (1.5533,2.9025)	**<0.01***
Hyperdynamic EF	1.4864 (0.9662,2.2614)	0.0671

Table 6: Multivariate model predicting 28-day mortality for septic patients

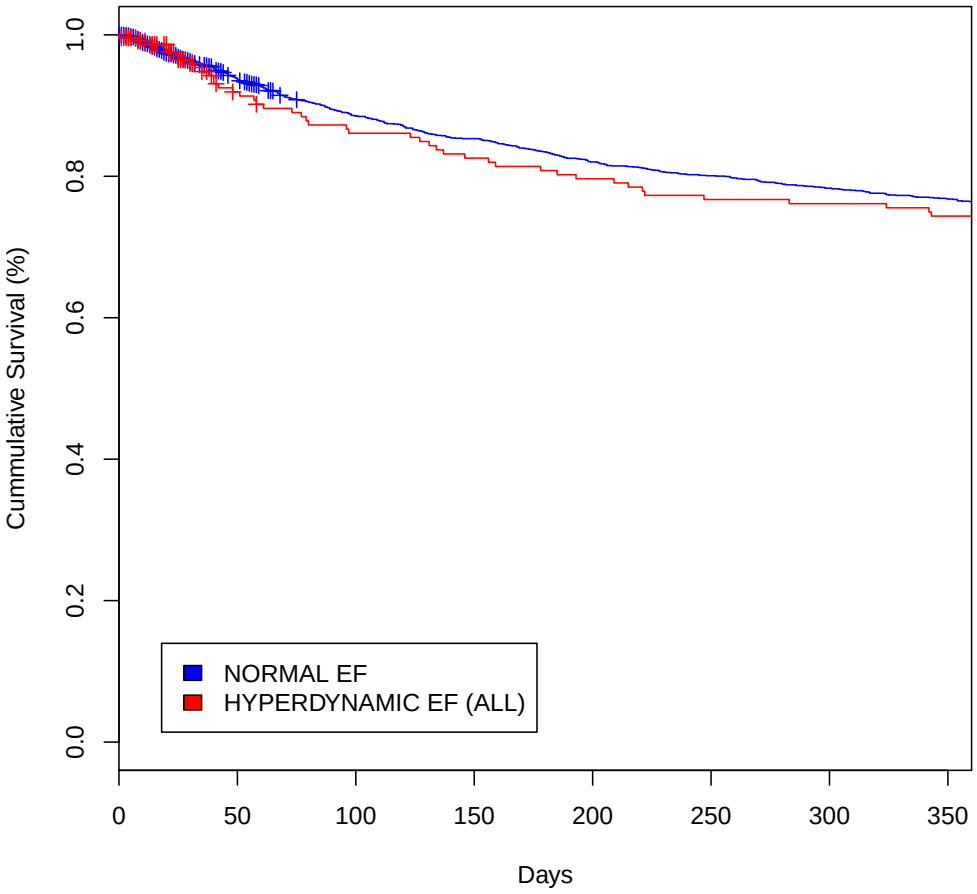

Figure 2: Survival curves for hospital survivors of normal and hyperdynamic EF cohorts

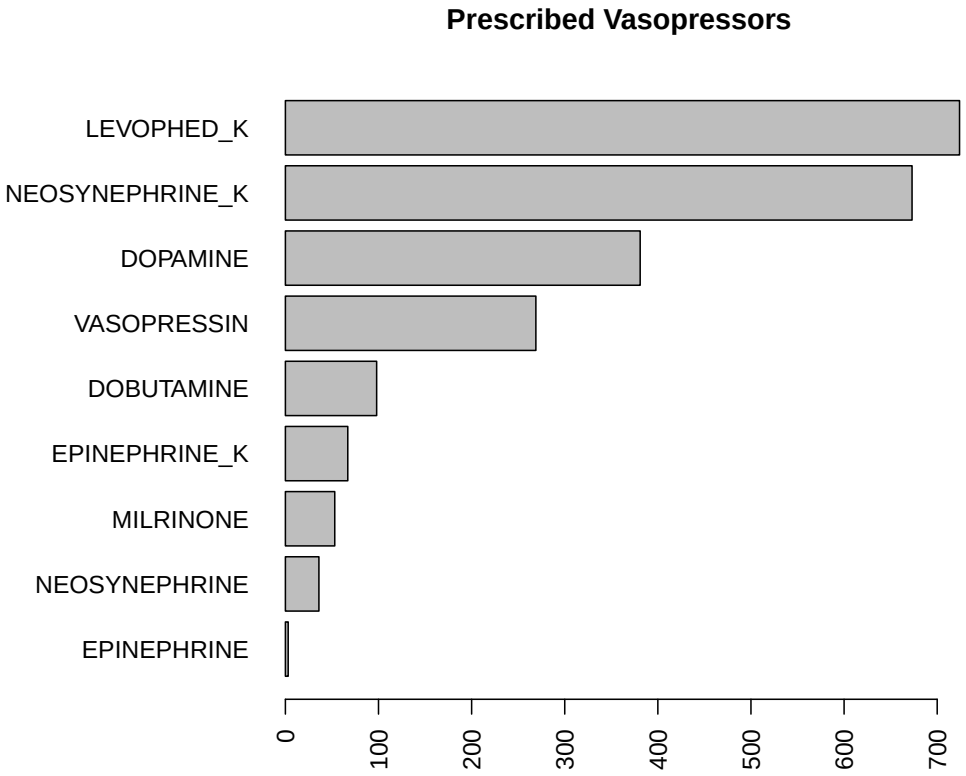

Figure 3: Histogram of vasopressors