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

We conducted a retrospective cohort study using the Multiparameter Intelligent Monitoring in Intensive Care II (MIMIC II) database. MIMIC II is a large open-access database, which includes data from electronic medical records of patients admitted to the ICUs at Beth Israel Deaconess Medical Center since 2001. The creation and use of the MIMIC database was approved by the institutional review boards of both Beth Israel Deaconess Medical Center and Massachusetts Institute of Technology (IRB protocol 2001-P-001699/3).

All adult patient records who underwent an echocardiograph in the database were screened for purposes of inclusion. Patients were excluded if their left-ventricular function was suppresed The cohort characteristics used in this

study is shown in Figure 1. The study outcome was 28-day mortality among the entire patient cohort.

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).
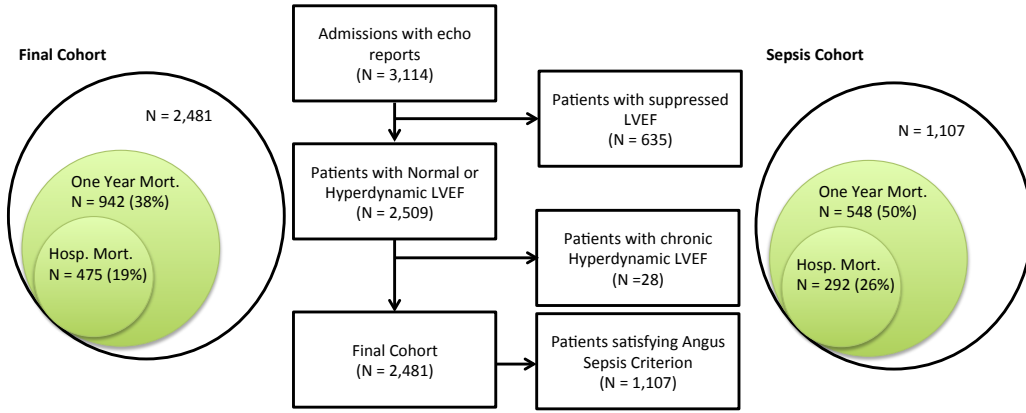

Figure 1: Patient record selection. Using the MIMIC II database we identified 2,481 patients that had a echo report.

3. Results

Table **??** 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

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	NLVEF (N=2237)	**HDLVEF** (N=244)
	N (%) or median (IQR)	
Age	68.54 (23.48)	65.78 (25.32)
Gender (Male)	143 (58.61)	1127 (50.38)*
SAPS-I	17.00 (7.00)	15.00 (7.00)*
Care Unit		
MICU	119 (48.77)	1170 (52.30)
CCU	33 (13.52)	351 (15.69)
CSRU	25 (10.25)	175 (7.82)
SICU	67 (27.46)	541 (24.18)
Labs		
Max wbc	15.30 (9.35)	13.60 (8.80)*
Wbc	11.80 (7.65)	11.05 (6.60)*
Max lactate	2.60 (2.92)	2.20 (2.30)*
Lactate	1.90 (1.36)	1.70 (1.25)*
Max createnine	1.20 (1.20)	1.10 (1.10)
Createnine	1.00 (0.92)	1.00 (0.90)
Co-morbidities		
Diabetes	177 (72.54)	1670 (74.65)
Alcohol abuse	232 (95.08)	2114 (94.50)
Arrhythmias	180 (73.77)	1597 (71.39)
Valvular disease	207 (84.84)	1943 (86.86)
Hypertension	136 (55.74)	1466 (65.53)*
Renal failure	222 (90.98)	2006 (89.67)
Chronic pulmonary	189 (77.46)	1721 (76.93)
Liver disease	26 (10.66)	159 (7.11)
Cancer	229 (93.85)	2144 (95.84)
Psychosis	235 (96.31)	2158 (96.47)
Depression	230 (94.26)	2121 (94.81)
Chf	143 (58.61)	1498 (66.96)*
Treatments		
Rrt	199 (81.56)	1918 (85.74)
Vasopressor	109 (44.67)	1242 (55.52)*
Ventilated	71 (29.10)	872 (38.98)*
Fluids in 3-days (ml)	9088.46 (10902.17)	7675.80 (8998.60)*
Echo time (days)	1.06 (2.95)	0.98 (2.15)

Table 1: Characteristics of normal versus all HDEF patients

	NLVEF (N=2412)	**HDEF** (N=69)	
	N (%) or median (IQR)		*P*-value
Age	67.51 (22.60)	66.10 (25.23)	0.9628*
Gender (Male)	42 (60.87)	1228 (50.91)	0.113
SAPS-I	17.00 (8.00)	15.00 (7.00)	**0.0061***
Care Unit			**0.033***
MICU	31 (1.25)	1258 (50.71)	
CCU	13 (0.52)	371 (14.95)	
CSRU	12 (0.48)	188 (7.58)	
SICU	13 (0.52)	595 (23.98)	
Labs			
Max wbc	15.50 (9.00)	13.70 (8.90)	0.1899*
Wbc	11.40 (8.80)	11.10 (6.55)	0.2434*
Max lactate	2.60 (1.98)	2.20 (2.40)	0.2036*
Lactate	1.90 (1.19)	1.70 (1.30)	0.1693*
Max createnine	1.30 (1.30)	1.10 (1.10)	0.2286*
Createnine	1.05 (1.20)	1.00 (0.90)	0.4185*
Co-morbidities			
Diabetes	49 (71.01)	1798 (74.54)	0.487
Alcohol abuse	68 (98.55)	2278 (94.44)	0.179
Arrhythmias	40 (57.97)	1737 (72.01)	**0.014***
Valvular disease	53 (76.81)	2097 (86.94)	**0.020***
Hypertension	34 (49.28)	1568 (65.01)	**0.010***
Renal failure	65 (94.20)	2163 (89.68)	0.311
Chronic pulmonary	49 (71.01)	1861 (77.16)	0.246
Liver disease	8 (11.59)	177 (7.34)	0.168
Cancer	64 (92.75)	2309 (95.73)	0.223
Psychosis	67 (97.10)	2326 (96.43)	1.000
Depression	65 (94.20)	2286 (94.78)	0.782
Chf	34 (49.28)	1607 (66.63)	**0.004***
Treatments			
Rrt	55 (79.71)	2062 (85.49)	0.171
Vasopressor	27 (39.13)	1324 (54.89)	**0.010***
Ventilated	23 (33.33)	920 (38.14)	0.453
Fluids in 3-days (ml)	8889.06 (14182.76)	7731.82 (9121.47)	**0.0143***
Echo time (days)	1.36 (3.01)	0.99 (2.17)	0.0629*

Table 2: Characteristics of normal versus acute HDEF patients

	NLVEF (N=2237)	**HDLVEF** (N=244)
	N (%)	N (%)
Dobutamine	145 (96.67)	1226 (97.85)
Dopamine	133 (88.67)	1124 (89.70)
Epinephrine	145 (96.67)	1245 (99.36)*
Vasopressin	144 (96.00)	1211 (96.65)
Levophed	116 (77.33)	1033 (82.44)
Milrinone	146 (97.33)	1246 (99.44)*
Neosynephrine	124 (82.67)	1066 (85.08)

Table 3: Characteristics of vasopressors treatment up to 24 hours before echocardiogram

	Odds-ratio (95% Confidence Interval)	**P-value**
Age	1.0008 (0.9951,1.0067)	0.7910
Gender (Male)	0.9672 (0.7810,1.1974)	0.7596
Elixhauser Score	0.9321 (0.9158,0.9486)	**<0.01***
SAPS-I	0.9313 (0.9113,0.9516)	**<0.01***
Vasopressor	1.8616 (1.4831,2.3408)	**<0.01***
HPEF	1.4743 (1.0642,2.0240)	**0.0178***

Table 4: Multivariate logistic regression model predicting 28-day mortality for all patients

	Odds-ratio (95% Confidence Interval)	**P-value**
Age	1.0052 (0.9970,1.0139)	0.2281
Gender (Male)	0.7589 (0.5509,1.0439)	0.0904
Elixhauser Score	0.9013 (0.8744,0.9283)	**<0.01***
SAPS-I	0.9159 (0.8871,0.9450)	**<0.01***
Vasopressor	2.0219 (1.4214,2.8901)	**<0.01***
HPEF	1.4356 (0.8220,2.4511)	0.1930

Table 5: Multivariate logistic regression model, excluding patients with CHF and hypertension co-moborbidities, predicting 28-day mortality (N=1093)

	Non-Septic (N=1374)	**Septic** (N=1107)
	N (%)	N (%)
NLVEF	124 (11.20)	120 (8.73)*
HDLVEF	983 (88.80)	1254 (91.27)*
Acute HDLVEF	1062 (95.93)	1350 (98.25)*

Table 6: Left Ventricular Ejection Fraction Characteristics for septic patients

	Hazard ratio (95% Confidence Interval)	**P-value**
Age	1.0065 (0.9908,0.9962)	**<0.01***
Gender (Male)	1.0006 (0.9127,1.0943)	0.9902
Elixhauser Score	1.0146 (0.9762,0.9950)	**<0.01***
SAPS-I	0.9611 (0.9427,1.1485)	0.4304
Vasopressor	0.9664 (0.8810,1.2154)	0.6771
HPEF	1.0373 (0.9547,0.9736)	**<0.01***

Table 7: Multivariate Cox Hazard model predicting one-year mortality for all 28-day survivors

	Hazard ratio (95% Confidence Interval)	**P-value**
Age	1.0069 (0.9894,0.9969)	**<0.01***
Gender (Male)	0.9670 (0.9011,1.1869)	0.6327
Elixhauser Score	1.0168 (0.9695,0.9976)	**0.0216***
SAPS-I	1.0023 (0.8560,1.1629)	0.9766
Vasopressor	1.0046 (0.7576,1.3079)	0.9736
HPEF	1.0417 (0.9435,0.9768)	**<0.01***

Table 8: Multivariate Cox Hazard model predicting one-year mortality for 28-day survivors who did not have comorbidities of CHF or Hypertension