Effect of hyperdynamic LVEF on ICU outcomes

Thomas Brennan

Cambridge MA, United States

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 consisted of adults admitted to the ICU with echo reports. All statistical analysis was performed using Matlab version 2013a (Mathworks). Baseline comparisons were performed using chi^2 tests for equal proportion with results reported as numbers, percentages, and 95% confidence intervals. Continuously normally distributed variables were compared using t-tests and reported as means with 95% confidence intervals, while non-normally distributed data were compared using Wilcoxon rank sum tests and reported as medians and interquartile range (IQR).

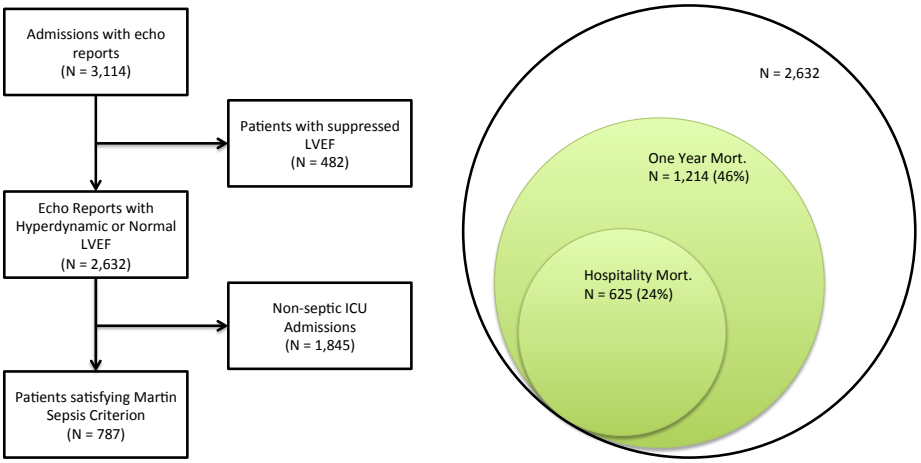

Figure 1: Patient record selection. Using the MIMIC II database we identified 2,632 patients that had a echo report.

3. Results

Table 1 highlights the results of the univariate analysis for all patients with echo reports. Significant values ($P < 0.01$) are shown in bold. Hyperdynamic patients are more likely to be female, stay in ICU & hospital longer, have a higher risk of mortality and are more likely to be ventilated and administered more fluid. Table 2 looks at potential confounders for the cohort: hyperdynamic patients are more liekly to have congestive heart failure, hypertension and cancer.

Table 3 highlights the results of the univariate analysis for all septic patients. Significant values ($P < 0.01$) 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 4 is

inconclusive.

Table 1: Characteristics of study patients (n = 2542).

	No. (%) [95% CI] of Patients				
	Normal (n=2285 , 90%)		Hyperdynamic (n=257, 10%)		P value
Male sex	1115	(49) [47-51]	99	(39) [33-45]	**0.002**
Service type:					
MICU	1209	(53) [51-55]	136	(53) [47-59]	0.998
CCU	350	(15) [14-17]	28	(11) [8-15]	0.059
SICU	544	(24) [22-26]	69	(27) [22-33]	0.280
CSRU	182	(8) [7-9]	24	(9) [6-14]	0.444
Primary outcome:					
Mort. 28 days	433	(19) [17-21]	76	(30) [24-35]	< **0.001**
Mort. 1 year	862	(38) [36-40]	126	(49) [43-55]	< **0.001**
Mort. ICU	277	(12) [11-14]	54	(21) [16-26]	< **0.001**
Mort. Hospital	427	(19) [17-20]	79	(31) [25-37]	< **0.001**
Sepsis	685	(30) [28-32]	96	(37) [32-43]	0.015
RRT	177	(8) [7-9]	27	(11) [7-15]	0.123
Ventilation	1425	(62) [60-64]	187	(73) [67-78]	**0.001**
	Median (Interquartile range)				
Age	65.5	(26.6-91.6)	69.0	(31.0-92.3)	0.037
SOFA score	6.0	(0.0-16.0)	8.0	(1.0-18.0)	< **0.001**
Secondary outcome:					
ICU length of stay	5.1	(1.0-43.5)	6.7	(1.1-40.0)	< **0.001**
Hosp. length of stay	12.0	(2.0-63.4)	15.0	(3.0-81.0)	**0.010**
Echo delta	1.0	(0.1-19.1)	1.0	(0.0-16.7)	0.879
Ventilation duration	6.7	(0.2-54.3)	8.6	(0.2-59.0)	0.061
Fluids intake	10069.8	(450.0-57673.5)	12516.3	(985.0-81127.7)	< **0.001**
Fluids output	6369.0	(427.3-31018.2)	7197.0	(489.2-33197.3)	0.021

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.

Table 2: ICD9 Group and Elixhauser comorbidities of study patients (n = 2542).

	No. (%) [95% CI] of Patients				
	Normal (n=2285 , 90%)		Hyperdynamic (n=257, 10%)		P value
ICD9 Group:					
Cardiovascular	706	(31) [29-33]	75	(29) [24-35]	0.572
Respiratory	357	(16) [14-17]	39	(15) [11-20]	0.851
Cancer	424	(19) [17-20]	56	(22) [17-27]	0.209
Endocrine metabolic	41	(2) [1-2]	2	(1) [0-3]	0.231
Other	130	(6) [5-7]	8	(3) [2-6]	0.084
GI	209	(9) [8-10]	33	(13) [9-18]	0.056
GU	63	(3) [2-4]	7	(3) [1-6]	0.975
Trauma	355	(16) [14-17]	37	(14) [11-19]	0.632
Treatment	0	(0) [0-0]	0	(0) [0-0]	NA
Elixhauser Comorbidity:					
Diabetes	527	(23) [21-25]	65	(25) [20-31]	0.423
CHF	675	(30) [28-31]	97	(38) [32-44]	**0.007**
Alcohol abuse	114	(5) [4-6]	11	(4) [2-8]	0.618
Arrhythmias	595	(26) [24-28]	53	(21) [16-26]	0.059
Valvular disease	239	(10) [9-12]	34	(13) [10-18]	0.174
Hypertension	655	(29) [27-31]	98	(38) [32-44]	**0.002**
Renal failure	214	(9) [8-11]	26	(10) [7-14]	0.696
Chronic pulmonary	481	(21) [19-23]	52	(20) [16-26]	0.760
Liver disease	146	(6) [5-7]	19	(7) [5-11]	0.536
Cancer	83	(4) [3-4]	22	(9) [6-13]	$<$ **0.001**
Psychosis	64	(3) [2-4]	9	(4) [2-7]	0.523
Depression	80	(4) [3-4]	12	(5) [3-8]	0.342

Table 3: Characteristics of study septic patients (n = 781).

	No. (%) [95% CI] of Patients				
	Normal (n=685 , 88%)		Hyperdynamic (n=96, 12%)		P value
Male sex	354	(52) [48-55]	47	(49) [39-59]	0.617
Service type:					
MICU	510	(74) [71-78]	64	(67) [57-75]	0.106
CCU	41	(6) [4-8]	3	(3) [1-9]	0.255
SICU	112	(16) [14-19]	22	(23) [16-32]	0.110
CSRU	22	(3) [2-5]	7	(7) [3-15]	0.048
Primary outcome:					
Mort. 28 days	193	(28) [25-32]	40	(42) [32-52]	**0.007**
Mort. 1 year	351	(51) [48-55]	58	(60) [50-70]	0.092
Mort. ICU	135	(20) [17-23]	33	(34) [26-44]	**0.001**
Mort. Hospital	217	(32) [28-35]	44	(46) [36-56]	**0.006**
Sepsis	685	(100) [99-100]	96	(100) [95-100]	NaN
RRT	86	(13) [10-15]	19	(20) [13-29]	0.052
Ventilation	522	(76) [73-79]	78	(81) [72-88]	0.273
	Median (Interquartile range)				
Age	63.8	(30.4-91.7)	64.1	(28.9-89.6)	0.734
SOFA score	9.0	(1.0-18.0)	9.0	(3.0-19.3)	0.056
Secondary outcome:					
ICU length of stay	9.6	(1.4-58.8)	10.9	(1.8-43.1)	0.223
Hosp. length of stay	19.0	(3.0-76.0)	20.5	(3.9-146.8)	0.174
Echo delta	1.4	(0.1-23.1)	1.2	(0.1-17.0)	0.193
Ventilation duration	10.6	(0.4-69.1)	13.3	(0.9-76.3)	0.245
Fluids intake	14205.5	(2019.4-70192.1)	18745.5	(3489.6-101428.4)	**0.005**
Fluids output	7163.5	(703.5-36512.2)	7521.0	(863.1-44718.1)	0.605

Table 4: ICD9 Group and Elixhauser comorbidities of study patients (n = 781).

	No. (%) [95% CI] of Patients				
	Normal (n=685 , 88%)		Hyperdynamic (n=96, 12%)		P value
ICD9 Group:					
Cardiovascular	73	(11) [9-13]	12	(13) [7-21]	0.587
Respiratory	105	(15) [13-18]	12	(13) [7-21]	0.467
Cancer	278	(41) [37-44]	41	(43) [33-53]	0.692
Endocrine metabolic	10	(1) [1-3]	1	(1) [0-6]	0.745
Other	27	(4) [3-6]	3	(3) [1-9]	0.697
GI	64	(9) [7-12]	15	(16) [10-24]	0.056
GU	18	(3) [2-4]	1	(1) [0-6]	0.345
Trauma	110	(16) [14-19]	11	(11) [6-20]	0.243
Treatment	0	(0) [0-0]	0	(0) [0-0]	NA
Elixhauser Comorbidity:					
Diabetes	169	(25) [22-28]	27	(28) [20-38]	0.465
CHF	258	(38) [34-41]	44	(46) [36-56]	0.124
Alcohol abuse	50	(7) [6-10]	4	(4) [1-11]	0.257
Arrhythmias	190	(28) [25-31]	31	(32) [24-42]	0.354
Valvular disease	77	(11) [9-14]	8	(8) [4-16]	0.392
Hypertension	165	(24) [21-27]	31	(32) [24-42]	0.083
Renal failure	95	(14) [11-17]	11	(11) [6-20]	0.518
Chronic pulmonary	122	(18) [15-21]	19	(20) [13-29]	0.636
Liver disease	78	(11) [9-14]	12	(13) [7-21]	0.749
Cancer	26	(4) [3-6]	8	(8) [4-16]	0.041
Psychosis	22	(3) [2-5]	2	(2) [0-8]	0.549
Depression	15	(2) [1-4]	4	(4) [1-11]	0.239