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Correlation between MELD Score and Postoperative Outcomes in Patients Undergoing Coronary Artery Bypass Surgery: A Retrospective Study

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Abstract: 1) Background- Coronary artery bypass grafting (CABG) is a common surgical intervention for patients with severe coronary artery disease. The Model for End-Stage Liver Disease (MELD) score has been widely used to predict mortality risk in patients with end-stage liver disease, but its utility in predicting postoperative outcomes in cardiac surgery patients is less well-established. **2) Methods**-This retrospective study aims to investigate the association between preoperative MELD score and post-operative complications, length of hospital stay, and mortality in patients undergoing coronary artery bypass grafting. This is a single-center, retrospective cohort study conducted at a tertiary care academic medical center. The study includes all adult patients who underwent elective coronary artery bypass grafting between January 2011 and December 2020. Preoperative MELD scores were calculated for each patient, and postoperative outcomes including major adverse cardiac events, length of hospital stay, and 30-day mortality was assessed. To ensure a homogeneous study cohort, we excluded patients who underwent emergent cardiac procedures or had incomplete data necessary for the calculation of MELD scores and assessment of postoperative outcomes. Data was extracted from the electronic medical records, including patient demographics, comorbidities, preoperative laboratory values, operative details, and postoperative outcomes. The study protocol was approved by the Institutional Review Board, and the requirement for informed consent was waived due to the retrospective nature of the study.**3) Results-** This study reveals a statistical association between the MELD score calculated at admission and the length of hospital stay, duration in the ICU, patient age, and the duration of aortic clamping and extracorporeal circulation. Specifically, there is an exponential increase in the MELD score correlating with the rise in these factors, both collectively and individually, highlighting a significant relationship between the duration of extracorporeal circulation and aortic clamping time. **4) Conclusion-**Patients with a high MELD score had an increased risk of postoperative complications and mortality compared to those with a low MELD score. Careful preoperative patient selection and optimization of the patient's clinical condition may improve outcomes in patients with advanced liver disease undergoing cardiac surgery.

Keywords: coronary artery bypass grafting; MELD score; postoperative outcomes; retrospective study doi:10.20944/preprints202407.0516.v1

1. Introduction

Due to the ageing population and recent advances in heart surgery, an increasing number of patients with liver dysfunction have undergone heart surgery [1,2]. The etiology of liver dysfunction in patients undergoing cardiac surgery may be directly related to their degree of heart damage, called cardiac or congestive hepatopathy and heart cirrhosis or to other liver diseases such as fatty degeneration of the liver, amiodarone-induced toxicity, or viral hepatitis [3,4]. Regardless of the etiology of preoperative liver disease, patients with liver dysfunction that require surgery are at higher risk of pre- and postoperative complications than those with a healthy liver [5]. In particular, cardiac surgery in patients with liver dysfunction is associated with increased mortality compared to other surgical procedures [6]. Therefore, a careful assessment of the severity of preoperative liver dysfunction to stratify the risk of patients requiring cardiac surgery would have great clinical value. Indeed, several studies have investigated postoperative mortality in patients with cirrhosis of the liver undergoing cardiac surgery but liver dysfunction as a risk factor has not yet been included in any risk stratification system in cardiovascular surgery [1,2,5,6,7,8]. A number of liver function measurements have been proposed as predictors of operating risk in patients with liver disease. For a period of more than 30 years, the main indicator of liver dysfunction was the Child Turcotte–Pugh Classification (CTP) [9]. However, recent studies suggest that the terminal liver disease model (MELD) is a more robust score and can be a better index than the CTP classification, since it does not include subjective variables [10]. Originally developed to predict mortality in patients undergoing trans-jugular intrahepatic portosystemic shunt procedures [11], MELD has since been used to measure the degree of liver dysfunction and adopted as a tool for prioritizing liver transplant candidates based on the severity of the disease [12]. Many other researchers have tested the ability of the MELD score to predict short-term survival for patients with acute liver failure, acute alcoholic hepatitis overloaded on chronic liver insufficiency and patients with cirrhosis undergoing surgery other than liver transplant [13]. Furthermore, since hepato-renal dysfunction is common in patients with acute heart failure, more recent studies have established that the MELD score and modified MELD versions, such as MELD-XI (which does not include the INR), MELD–Na and the new MELD-albumin score are relatively accurate for estimating the risk of mortality, regardless of cause, in acute cardiac failure patients [14]. Although several studies have shown the postoperative prognostic value of both CTP classification and MELD Scores in patients undergoing cardiac surgery, these observations were limited by the fact that they were derived from small cohorts of less than 100 patients with a clear diagnosis of liver cirrhosis [7,13,15,16]. Therefore, this retrospective study aims to evaluate the predictive capacity of the MELD score on postoperative outcomes in a larger cohort of patients undergoing isolated coronary artery bypass graft (CABG) surgery, regardless of preoperative diagnosis of liver disease [14].

1.1. Definition

Coronary artery disease is currently the leading cause of death worldwide. Although its mortality has declined in the last 4 decades in developed countries, it continues to cause about one-third of all deaths in people aged ≥35 years. The major blood vessels that feed the heart (coronary arteries) struggle to send enough blood, oxygen and nutrients to the heart muscle. Deposits of cholesterol (plaques) deposited in the arteries of the heart and inflammation are usually the cause of coronary artery disease. Coronary artery atherosclerotic disease is the leading cause of mortality and morbidity due to major cardiovascular events in the United States and abroad. Although improved awareness and the development of new drugs have led to a decrease in mortality, the burden of the disease remains very high [17,18]. Identifying patients who can benefit from surgery early, before symptoms appear, has been shown to reduce mortality and morbidity [19]. Cardiac bypass surgery, also known as coronary artery bypass graft (CABG) surgery, is a surgical procedure used to improve blood flow to the heart in patients with coronary heart disease.

1.2. Epidemiology

For people over the age of 40, the lifetime risk of developing coronary artery disease is 49% for men and 32% for women [19, 20]. The risk increases with age in both men and women; however, the incidence in women remains lower compared to that observed in men in approximately 10 years. The incidence in premenopausal women is relatively low, while the incidence is significantly increased in postmenopausal women [20]. Coronary artery bypass graft (CABG) surgery has evolved over the past decades, with a decrease in mortality and complication rates. In the United States, more than 200,000 CABG procedures are performed annually [30]. The majority of patients undergoing CABG have comorbidities that may increase the risk of perioperative complications and mortality, such as advanced age, reduced renal function, heart failure, or stroke.

1.3. Methods of treatment

Conservative treatment of coronary artery disease is aimed at stopping the progression of atherosclerosis, reducing symptoms and preventing atherothrombotic events [22]. This involves combining lifestyle modification measures, such as exercise and diet, with drug therapy. Drug therapy is the cornerstone of the treatment of coronary artery disease [23]. It usually includes a combination of anti-ischemic drugs – primarily beta-blockers or calcium channel inhibitors, as well as nitrates – and those that prevent atherothrombotic events and control cardiovascular risk factors. The latter primarily include anti-aggregation therapy using, for example, acetylsalicylic acid (ASA) or clopidogrel, statin therapy, hypolipemic agents and administration of renin-angiotensin-aldosterone system inhibitors (RAAS). The final choice of medicines must be tailored to each individual patient. Drug therapy functions as a complement to surgical treatment and is considered the central pillar in the management of patients with aorto-coronary bypass. The first coronary bypass operation (CABG) was performed on May 2, 1960. The first percutaneous coronary surgery (PCI) was performed almost 20 years later. Since then, the invasive treatment of coronary artery disease has moved in the light of the reflectors of cardiac medical care [20]. The guidelines recommend that PCI be individualized for patients with chronic CAD to take into account the clinical condition, the severity of stenosis and the various methods used to confirm ischemia [23]. PCI is the most suitable therapy for the treatment of acute myocardial infarction, mainly due to its speed of application. It is associated with both the relief of symptoms and the extension of life expectancy [24]. Recently, techniques such as lithotripsy, percutaneous desobstruction methods for chronic total occlusion (CTO), intracoronary imaging using intravascular ultrasound (IVUS), optical coherence tomography (OCT), robotic PCI assisted and wireless software-based FFR measurements have been included. Ultra-thin stents for elucidating medicines are also used. Bioresorbable stents are also being further investigated for special applications, despite their initially unconvincing results [21, 22].

2. Material and method

2.1. Selection of patients

The study includes a number of 589 patients with coronary artery disease who had undergone coronary bypass surgery. All patient's data were extracted from the electronic file paraclinical data on admission, discharge, the results of imaging investigations, as well as information from intraoperative protocols. The study batch contains 589 patients diagnosed with ischemic coronary disease who have undergone a Coronary Bypass intervention at the Institute of Cardiovascular Diseases "Prof. Dr. George I.M. Georgescu" Iasi in a period of 10 years, January 2011 - December 2020. The medical records of the patients included in the study were studied. Paraclinical investigations (biological and imaging) as well as information from intraoperative protocols were followed. All patients included in the study were registered under a code number to keep them anonymous, and the results were used according to a protocol approved by the Ethics Committee.

The study aims to evaluate the evolution of patients who underwent coronary bypass surgery, as well as to analyze the impact of the MELD score on postoperative outcomes.

The inclusion criteria were: patients with coronary artery disease are listed for aorta-coronary bypass surgery and patients presenting complete medical records. The exclusion criteria were:

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patients with coronary disease who have undergone percutaneous angioplasty and patients presenting incomplete records of the medical record.

2.2. Stages of implementation

Data extracted from the observation sheets of the patients included paraclinical values, imaging data, the surgical protocol. The data collected was introduced and processed using Microsoft Excel and SPSS 16.00. The data obtained at the hospital will be analyzed and correlated with the intraoperative and postoperative evolution of patients with CABG.

2.3. Studied factors

- Demographic parameters (age, sex, average);
- Paraclinical balance at admission: CBC: (Hemoglobin, hematocrit, leucocytes, polymorphonuclear, lymphocytes, monocytes, eosinophils, thrombocytes), erythrocyte sedimentation speed, time of partially activated thromboplastin, prothrombin Quick time, prothrombin index, international normalized ratio, fibrinogen, natrium, potassium, blood glucose, urea, creatinine, bilirubin, aspartate aminotransferase, alanine aminotransferase, triglyceride, cholesterol, blood type, antigen on the surface of red blood cells;
- Electrocardiogram: RS segment, PR segment, QRS complex, QT segment, TS segment, atrial fibrillation, QRS axis, T wave;
- Radiological examination-cardio-thoracic index;
- Preoperative echocardiography: end-diastolic diameter of the left ventricle(mm), end-systolic diameter of the left ventricle (mm), fractional shortening(%), ejection fraction (%), volumetric ejection fraction(%), right atrium(mm), end-diastolic diameter of right ventricle(mm), surface of the mitral orifice(cm2), maximum gradient of the tricuspid valve, movement of the tricuspid ring during systole, mitral valve insufficiency, aortic valve insufficiency, pulmonary valve insufficiency, tricuspid valve insufficiency;
- Paraclinical balance at discharge: CBC: (Hemoglobin, hematocrit, leucocytes, polymorphonuclear leukocytes , lymphocytes, monocytes, eosinophils, thrombocytes), erythrocyte sedimentation speed, time of partially activated thromboplastin, prothrombin Quick time, prothrombin index, international normalized ratio, fibrinogen, natrium, potassium, blood glucose, urea, creatinine, bilirubin, aspartate aminotransferase, alanine aminotransferase, triglyceride, cholesterol, blood type, antigen on the surface of red blood cells;
- Postoperative echocardiography: end-diastolic diameter of the left ventricle(mm), end-systolic diameter of the left ventricle (mm), fractional shortening(%), ejection fraction (%), volumetric ejection fraction(%), right atrium(mm), end-diastolic diameter of right ventricle(mm), surface of the mitral orifice(cm2), maximum gradient of the tricuspid valve, movement of the tricuspid ring during systole, mitral valve insufficiency, aortic valve insufficiency, pulmonary valve insufficiency, tricuspid valve insufficiency;
- Data from the intraoperative protocol: aorta clamping time (min), total extracorporeal circulation time (min), height (cm), weight (kg), extracorporeal circulation temperature (degrees Celsius), blood/cardioplegia, extracorporeal circulation balance sheet (ml);
- Total days in the intensive care unit (ICU) were divided into 4 periods to see the evolution of patients during the stationing there, ICU's balance sheet 1(INITIAL), 2, 3 and 4 (FINAL), containing: urea, creatinine, creatine kinase-MB, hemoglobin, hematocrit, leucocytes, thrombocytes, red blood cells, prothrombin Quick time, total bilirubin, aspartate aminotransferase, alanine aminotransferase, prothrombin activity(sec), the activity of the international normalized ratio (%) prothrombin activity (%), fibrinogen, time of partially activated thromboplastin.

3. Results

The study includes 589 patients diagnosed with ischemic coronary disease who had undergone a coronary bypass surgery at the Institute of Cardiovascular Diseases "Prof. Dr. George I.M. Georgescu" Iasi in the period 2011 – 2020. In order to be able to assess the degree of liver dysfunction

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in all these patients, the intern Meld Score was calculated according to the formula: MELD Score (Model for End-Stage Liver Disease) = 3.78 × ln [Bilirubin (mg/dL)] + 11.2 × lN [INR] + 9.57 × Ln [Creatinine (mg / dL))] + 6.43. After the Meld score was calculated it was interpreted according to the model below (Table 1). A class was associated with each mortality range to streamline the statistical process, as follows (Table 1).

Table 1. Interpretation of the MELD Score and Class.

MELD Score	3-Month Mortality (%)	Meld Class
< 9	1.9%- 3.7%	1
10 to 19	6%- 20%	2
20 to 29	19.6%- 45.5%	3
30 to 39	52.6%- 74.5%	4
>40	71%- 100%	5

We extracted the following data from the database: time of clamping of the aorta (calculated in minutes), time of extracorporeal circulation (minutes), total time of hospitalization, period of hospitalization in the ICU's, the age and sex of the patients to see whether these factors are influenced and in what way, by the MELD score calculated at the hospital, respectively how liver dysfunction affects the short-term progress of patients starting with their intraoperative period. The data were statistically processed and for this purpose the software program SPSS 16.00 for WINDOWS was used to determine the frequency, the arithmetic average, error of the arithmetic mean (±s) the standard deviation (s), the coefficient of multiple regression method ENTER, the right of regression, the Pearson correlation, Chi-Square Tests, ANOVA Test, the meaning test p. and confidence interval (C.I.).

As for the sex of patients, it is noted that the majority is represented by men in the proportion of 78.2% compared to women representing 21.8 %. In the batch of patients examined (Table 2) it can be observed how the MELD score falls between 0.08 the minimum value and 30.78- the maximum value with an average value of 6.25 and a standard deviation of 3.96.

Table 2. Statistical description of the analyzed batch.

Descriptive statistics	N	Min	Max	Mean	Std. Error	Std. Dev.	Variance	Skewness	Std. Error
MELD score	589	*0.08*	*30.78*	*6.25*	1.63	*3.96*	15.75	1.97	0.101
Hopitalization days	589	*1*	*137*	*19.35*	3.69	*8.96*	80.39	5.15	0.101
Clamping time of the aorta	589	*15*	*653*	*86.92*	1.52	*37.11*	1377.51	6.51	0.101
Extracorporeal circulation time	589	*22*	*582*	*118.28*	1.70	*41.47*	1720.10	3.36	0.101
Days in ICU's	588	*3*	*57*	*7.25*	1.73	*4.21*	17.72	5.12	0.101
Age	589	*31*	*83*	*63.11*	3.69	*8.96*	80.33	-0.51	0.101
Valid N (listwise)	588								

The variance value of 15.75 indicates the extent of the spread of values around the center of the MELD indicator, Skewness (asymmetry coefficient) of 1.97 which denotes the presence of an asymmetrical distribution on the left. Hospitalization days fall between 1 and 137 with an average value of 6.25, a standard deviation= 8.96. In the case of hospitalization days, the value deviates from the average by 19.35 days. The variance value of 80.39 indicates the degree of spread of values around the center of the Hospitalization Days indicator. Asymmetry coefficient of 5.15 indicates the presence of an asymmetric distribution on the left. The clamping time of the aorta has a minimum value of 15 minutes and a maximum value of 653 minutes, with an average value of 86.92 minutes. Standard deviation was 37.11, so the value deviates from the average by 37.11, the variance value is 1377.51 and the coefficient of asymmetry was 6.51 which indicates the presence of an asymmetric distribution to the left. The time of extracorporeal movement is between 22 and 582 minutes with the average value of 118.28 minutes, its value deviates from the average of 41.47 minutes. The variance value of 1720.10 indicates the degree of spread of the values around the center of the indicator and the coefficient of asymmetry was 3.36, respectively a positive value, which indicates a presence of an asymmetric distribution to the left. The stationary days in ICU vary between 3 and 57 with an average value of 7.25, the standard deviation was 4.21 and the variance value of 17.72 indicate the extent of the spread of values around the center of the Total days indicator in ICU's, and the asymmetry coefficient of 5.12 indicates the presence of an asymmetric distribution to the left. The age ranges from 31 to 83 with an average of 63.11 years. In the case of this indicator, the value deviates from the average by 8.96 years. The variance value of 80.33 indicates the degree of spread of the values around the center of the indicator and the coefficient of asymmetry of -0.51, respectively a negative value, indicate the presence of an asymmetric distribution to the right.

R Square represents the determination coefficient and expressed as a percentage, as the proportion of the variation of the dependent variable explained by the variance of the independent variables 60.7% of Y's variation is explained with the variables X. This indicator takes values within the range [0,1] and shows the proportion in which the variation of the dependent variable is explained by the variance of the independent variables. Thus, the determination coefficient becomes an indicator of the magnitude of the effect for regression analysis. According to the Model Summary (Tabel 3), the most accurate model explaining the variation of the MELD score variable is the sixth model where the R Square value is 21.7% (the value of 0.217 is included in the range [0.1]), which means that approximately 22% of the Variation in the MELD score is given by the predictive variables, respectively: days of hospitalization, days of stationary stay in ICU's, aortic clamping time, time of extracorporeal circulation, age and sex of the patients. R Square is the determination coefficient and expressed as a percentage, as the proportion of the variation of the dependent variable explained by the variance of the independent variables. Since the data were collected over time, the Durbin-Watson statistical test was used to see whether there is a self-correlation or a serial correlation between the variables included in the study and the Meld score in this batch of patients. The test checks the independence of the errors, the result being between 0 and 4. In order to be able to consider that the assumption of error independence is satisfied, it is necessary that the test value is between 1.5 and 2.5. It is noted that in the analysis performed the value is 1,89, close enough to 2 to state that the residual variable and the independent variables are not correlated. In this case, the application of the multiple linear regression model is a viable form of analysis for the study of relationships between variables.

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Table 3. Model Summary[g].

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	**0.223**[a]	**0.115**	0.113	3.94158	0.015	8.908	1	584	**0.003**	
2	**0.226**[b]	**0.116**	0.113	3.94310	0.001	0.549	1	583	**0.049**	
3	**0.227**[c]	**0.116**	0.111	3.94601	0.000	0.142	1	582	**0.046**	
4	**0.272**[d]	**0.168**	0.162	3.84303	0.052	32.608	1	581	**0.000**	
5	**0.283**[e]	**0.169**	0.161	3.84457	0.001	0.534	1	580	**0.045**	
6	**0.342**[f]	**0.217**	0.207	3.74882	0.047	31.008	1	579	**0.000**	1.896

a. Predictors: (Constant), hospitalization days b. Predictors: (Constant), hospitalization days, clamping time of the aorta c. Predictors: (Constant), hospitalization days, clamping time of the aorta, extracorporeal circulation time d. Predictors: (Constant), hospitalization days, clamping time of the aorta, extracorporeal circulation time, days in ICU's e. Predictors: (Constant), hospitalization days, clamping time of the aorta, extracorporeal circulation time, days in ICU's, age f. Predictors: (Constant), hospitalization days, clamping time of the aorta, extracorporeal circulation time, days in ICU's, age, sex g. Dependent Variable: MELD score.

The ANOVA test releases statistical differences between the variables followed, respectively: aortic clamping time, extracorporeal circulation time, total hospitalization period, hospital stay period in ICU's, age and sex in terms of MELD score, since $p < 0.05$ in all these groups (Tabel 4).

Table 4. ANOVA[g] test.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	138.40	1	138.40	8.90	**0.003**[a]
	Residual	9073.04	584	15.53		
	Total	9211.44	585			
2	Regression	146.93	2	73.46	4.72	**0.009**[b]
	Residual	9064.51	583	15.54		
	Total	9211.44	585			
3	Regression	149.14	3	49.71	3.19	**0.023**[c]
	Residual	9062.30	582	15.57		
	Total	9211.44	585			
4	Regression	630.72	4	157.68	10.67	**0.000**[d]
	Residual	8580.71	581	14.76		
	Total	9211.44	585			
5	Regression	638.62	5	127.72	8.64	**0.000**[e]
	Residual	8572.82	580	14.78		
	Total	9211.44	585			
6	Regression	1074.39	6	179.06	12.74	**0.000**[f]
	Residual	8137.05	579	14.05		
	Total	9211.44	585			

a. Predictors: (Constant), hospitalization days b. Predictors: (Constant), hospitalization days, clamping time of the aorta c. Predictors: (Constant), hospitalization days, clamping time of the aorta, extracorporeal circulation time d. Predictors: (Constant), hospitalization days, clamping time of the aorta, extracorporeal circulation time, days in ICU's e. Predictors: (Constant), hospitalization days, clamping time of the aorta, extracorporeal circulation time, days in ICU's, age f. Predictors: (Constant), hospitalization days, clamping time of the aorta, extracorporeal circulation time, days in ICU's, age, sex g. Dependent Variable: MELD score.

In the distribution hypotheses of the multiple linear model, the calculated values of coefficients come from normal distribution, thus being possible statistical verification of coefficients. The coefficient values are displayed in column B, and the T and Sig columns are the values of the t test for coefficients (Tabel 5). The T test indicates whether one of the coefficients is significantly different from 0. If one of the regression coefficients is not different from 0, it means that the respective dependent variable has virtually no effect on the independent variable. In the case of the multiple regression model analyzed in the work, both the constant and the rest of the coefficients, present reduced values of the threshold of significance sig $\alpha 0 = 0 <$ sig $\alpha = 0.05$; sig $\alpha 1 = 0.041 <$ sig $\alpha=0.05$; sig $\alpha 2 =0.049 <$ Sig $\alpha= 0.55$; sig $\alpha 3 = 0.08 <$ sig $\alpha= 0.05$, sig $\alpha 4 = 0<$ sig $\alpha = 0.05$, sig $\alpha 5 = 0.012 <$ sig A= 0.05, sig a $\alpha 6 =0 <$ sig A=0.05, thus all coefficients are statistically significant. In other words, we can generalize the results of this regression analysis to the entire population of patients from which the study sample comes. According to the same test, it is observed that every one-day increase in hospitalization days will increase the MELD score by 0.027, respectively, every 1 minute increase in the clamping time of the aorta will produce a MELD score increase by 0.004, each increase in a day of stationary stay in ICU's will increase MELD score of 0.221 points, each year added to age will produce an increase of 0.024 of the score while each minute in minus of extracorporeal circulation time will decrease MELD score with 0.005.

Table 5. Multiple regression coefficient test. .

Model		Unstandardized Coefficients		Std. Coefficients	t	Sig.	95% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	5.213	0.387		13.45	0	4.45	5.97		
	Hospitalization days	0.054	0.018	0.22	2.98	0.003	0.01	0,09	1.000	1.00
2	(Constant)	4.967	0.510		9.73	0.000	3.96	5.96		
	Hospitalization days	0.052	0.018	0.021	2.83	0.005	0.016	0.08	0.977	1.02
	Clamping time of the aorta	0.003	0.004	0.23	0.74	0.049	-0.005	0.01	0.977	1.02
3	(Constant)	5.058	0.564		8.96	0	3.94	6.16		
	Hospitalization days	0.053	0.019	0.22	2.85	0.004	0.017	0.09	0.944	1.06
	Clamping time of the aorta	0.007	0.011	0.267	0.63	0.024	-0.015	0.02	0.152	6.59
	Extracorporeal circulation time	-0.004	0.010	-0.140	-0.37	0.046	-0.024	0.01	0.148	6.74
4	(Constant)	4.394	0.562		7.82	0	3.29	5.49		
	Hospitalization days	0.017	0.019	0.238	0.859	0.039	-0.021	0.055	0.839	1.192
	Clamping time of the aorta	0.008	0.011	0.272	0.700	0.044	-0.014	0.029	0.152	6.598

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	Extracorporeal circulation time	-0.007	0.010	-0.171	-0.686	0.049	-0.026	0.013	0.148	6.765
	ICU's days	0.232	0.041	0.247	5.710	0.000	0.152	0.312	0.858	1.165
5	(Constant)	3.604	1.219		2.955	0.003	1.209	5.998		
	Hospitalization days	0.016	0.019	0.236	0.825	0.041	-0.022	0.054	0.837	1.195
	Clamping time of the aorta	0.007	0.011	0.263	0.610	0.042	-0.015	0.028	0.150	6.688
	Extracorporeal circulation time	-0.006	0.010	-0.165	-0.619	0.036	-0.026	0.013	0.147	6.817
	ICU's days	0.229	0.041	0.243	5.573	0.000	0.148	0.309	0.845	1.183
	Age	0.013	0.018	0.230	0.731	0.046	-0.022	0.049	0.959	1.042
6	(Constant)	5.360	1.230		4.357	0.000	2.944	7.776		
	Hospitalization days	0.027	0.019	0.260	1.403	0.041	-0.011	0.064	0.828	1.207
	Clamping time of the aorta	0.004	0.011	**0.240**	0.397	**0.049**	-0.017	0.025	0.149	6.700
	Extracorporeal circulation time	-0.005	0.010	**-0.048**	-0.471	**0.038**	-0.024	0.015	0.147	6.823
	ICU's days	0.221	0.040	**0.235**	5.518	**0.000**	0.142	0.299	0.844	1.185
	Age	0.024	0.018	**0.055**	1.368	**0.012**	-0.011	0.059	0.947	1.056
	Gender	-2.120	0.381	**-0.220**	-5.568	**0.000**	-2.868	-1.372	0.975	1.026

Coefficients[a] Dependent Variable: MELD Score.

The Pearson correlation test that measures the degree of association of the variables followed with the MELD score unleashes a positive association between the MELD score and hospitalization days, ICU's staying days, age, as well as the clamping time of the aorta and the extracorporeal circulation which denotes an exponential increase in the Meld Score in relation to the increase in each of them (Tabel 6).

The right regression between the MELD score and stationary days in ICU's decreases R Square=0,067 which means that the stationary period in the ICU's explains approximately 7% of the variation in the MELD grades, while total hospitalization correlates with about 2% of the Variation in MELD score in these patients. Regarding the correlation between hospital days in ICU's and total hospitalization days, it is observed that the first explains 13% of the variation in total hospitalization days, while the stationary days in the ICU's explaining 5% of the Variation in Meld classes and the extracorporeal circulation time is determined in a very large proportion, respectively about 85%, by the clamping time of the aorta. The results obtained provide valuable insights into the evolution of patients with coronary artery bypass surgery, highlighting the importance of time factors, age and sex in the development of the Meld score in this group of patients.

Table 6. Pearson Correlation Test.

Correlations		**Meld score**	**Hospitalisation days**	Clamping time of the aorta	Extracorporeal circulation time	**ICU days**	**age**	**Gender**
Meld score	Pearson Correlation	1	**0.226****	0.151	0.150	**0.259****	**0.177***	**-0.208****

	Sig. (2-tailed)		0.002	0.220	0.227	0.000	0.042	0.000
	N	589	589	589	589	588	589	587
Hospitalization days	Pearson Correlation	0.226**	1	0.152**	0.212**	0.362**	0.196*	0.103*
	Sig. (2-tailed)	0.002		0.000	0.000	0.000	0.020	0.013
	N	589	589	589	589	588	589	587
Clamping time of the aorta	Pearson Correlation	0.151	0.152**	1	0.920**	0.148**	0.118**	-0.014
	Sig. (2-tailed)	0.220	0.000		0.000	0.000	0.004	0.728
	N	589	589	589	589	588	589	587
Extracorporeal circulation time	Pearson Correlation	0.150	0.212**	0.920**	1	0.180**	0.185*	0.000
	Sig. (2-tailed)	0.227	0.000	0.000		0.000	0.040	0.993
	N	589	589	589	589	588	589	587
ICU's days	Pearson Correlation	0.259**	0.362**	0.148**	0.180**	1	0.154**	0.017
	Sig. (2-tailed)	0.000	0.000	0.000	0.000		0.000	0.674
	N	588	588	588	588	588	588	586
Age	Pearson Correlation	0.177*	0.196*	0.118**	0.185*	0.154**	1	0.106**
	Sig. (2-tailed)	0.042	0.020	0.004	0.040	0.000		0.010
	N	589	589	589	589	588	589	587
Gender	Pearson Correlation	-0.208**	0.103*	-0.014	0.000	0.017	0.106**	1
	Sig. (2-tailed)	0.000	0.013	0.728	0.993	0.674	0.010	
	N	587	587	587	587	586	587	587

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

4. Discussion

According to the same test, it is observed that every one-day increase in hospitalization days will increase the MELD score by 0.027, respectively, every 1 minute increase in the clamping time of the aorta will produce a MELD score increase by 0.004, each increase in a day of stationary stay in ICU's will increase MELD score of 0.221 points, each year added to age will produce an increase of

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0.024 of the score while each minute in minus of extracorporeal circulation time will decrease MELD score with 0.005.

The Pearson correlation test that measures the degree of association of the variables followed with the MELD score unleashes a positive association between the MELD Score and hospitalization days, ICU's staying days, age, as well as the clamping time of the aorta and the extracorporeal circulation which denotes an exponential increase in the MELD score in relation to the increase in each of them (Tabel 6). The right regression between the MELD score and stationary days in ICU's decreases R Square=0,067 which means that the stationary period in the ICU's explains approximately 7% of the variation in the MELD grades, while total hospitalization correlates with about 2% of the Variation in MELD score in these patients. Regarding the correlation between hospital days in ICU's and total hospitalization days, it is observed that the first explains 13% of the variation in total hospitalization days, while the stationary days in the ICU's explaining 5% of the Variation in MELD classes and the extracorporeal circulation time is determined in a very large proportion, respectively about 85%, by the clamping time of the aorta. The results obtained provide valuable insights into the evolution of patients with coronary artery bypass surgery, highlighting the importance of time factors, age and sex in the development of the MELD score in this group of patients.

Liver dysfunction is a major factor for poor postoperative prognosis in patients undergoing cardiac surgery [25,26]. The CTP classification has been widely used for the evaluation of preoperative liver function, but the use of MELD scores has recently evolved as a promising indicator for prognosis because it is considered to be simpler and more objective than the classification of CTP [25, 27]. The Araujo et al. [28] study which followed 1197 patients undergoing elective cardiac surgery on U.S. territory targeted a significantly higher mortality rate of patients with cirrhosis, respectively 5.19% for those with coronary bypass and 7.49% for valve surgery and significantly greater percentage of complications: bleeding, respiratory, renal and infectious complications, adding an average duration of hospitalization by 2.2 days longer for these patients. Chou et al. [29] with 1040 patients undergoing elective cardiac surgery in Taiwan decrease a significantly higher mortality during hospitalization in patients with cirrhosis (15.3 versus 7.8%) with the same increase in the rate of complications and the prolongation of 4.6 days of the hospital stay. The present study unleashes a statistical association between the Meld score calculated at admission and days of hospitalization, days of stationary in ICU, age, as well as the clamping time of the aorta and the extracorporeal circulation, more precisely an exponential increase in the Meld scoring in correlation with the increase of all of them but also with the growth of each in particular and an important relationship between the time of extracorporeal circulation and the clamping time of aorta. These findings correspond to those in the literature, noting the increased risk of mortality and morbidity in patients with cirrhosis undergoing cardiac surgery, including longer hospital stays, greater need for transfusion and increased rates of renal, respiratory and infectious complications.

5. Conclusions

In conclusion, the Meld score is an important and accurate predictor of postoperative outcome in patients undergoing cardiac surgery. The Meld score has a positive correlation with hospitalization days, ICU stay, age, clamping time of the aorta and extracorporeal circulation time. It appears to be a simple and objective tool for preoperative risk assessment and may help guide the management of high-risk patients undergoing cardiac surgery. The results obtained provide valuable insights into the evolution of patients with coronary artery bypass surgery, highlighting the importance of time factors, age and sex in the development of the MELD score in this group of patients. Liver dysfunction is a major factor for poor postoperative prognosis in patients undergoing cardiac surgery. The MELD score could be a useful tool for preoperative risk stratification and prediction of postoperative outcomes in this high-risk patient population.

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