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Effect of Blood Transfusion on the Outcome of Cardiac Surgery Patients at Benghazi Medical Center (2014-2017)

Nuria Mohammed Ali Eltajuri [1*], Tunis M. Meidan[2]

1 Department of Health Environment, Faculty of Public Health, University of Benghazi

2 Department of Family and Community Medicine, Faculty of Medicine, University of Benghazi

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الملخص:

المقدمة: تعتمد تأثيرات نقل الدم لنتائج مرضي جراحة القلب على عوامل اخري مثل نوع الجراحة ومستوي الهيموجلوبين قبل الجراحة والعوامل الديموغرافية.

الأهداف: تحديد عوامل الخطر التي تؤدي الي نقل الدم أثناء جراحة القلب، معرفة تأثير نقل الدم علي نتائج الوفيات لمرضي جراحة القلب.

منهجية البحث: شملت دراسة مسح مقطعية 240 مريضا خضعوا لعملية جراحية للقلب بين عامي 2014 و2017 في بنغازي. تم جمع البيانات من جميع البالغين من عمر 18 عاما. تم تقييم الارتباط بين نقل الدم في مرضي جراحة القلب والمتغيرات الأخرى قبل الجراحة باستخدام اختبار مربع كاي. تم استخدام الاحصاء الوصفي كمتوسط وانحراف معياري.

نتائج: تضمنت قاعدة البيانات 240 مريضا بمتوسط عمر 57.9±11.5عاما، وكانت نسبة الذكور إلى الإناث 2 :1، 197 (82%) عملية زرع الشرايين، 178 (74.2%) فقر الدم، و74(30.8%) من المرضي الذين تلقوا الدم. نسبة الوفيات 9.2%، كانت نتيجة الجراحة حسب نقل الدم ذات دلالة احصائية.

الخلاصة: نتيجة جراحة القلب المتأثرة بنقل الدم، لا توجد علاقة بين نقل الدم وعوامل أخري (العمر ونوع الجراحة ومستوي الهيموجلوبين للمرضي) في جراحة القلب.

الكلمات المفتاحية: نقل الدم، جراحة القلب، عملية زرع الشرايين.

Abstract

Background: The effect of blood transfusion on cardiac surgery patients is dependent on other factors such as demographics, type of open heart surgery and hemoglobin level before surgery.

Aims: to determine the risk factors that lead to a blood transfusion during cardiac surgery, and to find out the effect of blood transfusion on mortality in cardiac surgery patients.

Methods: A cross-sectional survey study that included 240 patients who underwent cardiac surgery between 2014 and 2017 in Benghazi. All the data was collected from adults (≥ 18 years). The association between blood transfusion in patients of cardiac surgery and other pre-operative variables was assessed using the Chi-square test. Descriptive statistics such as mean, mode, median and standard deviation were used.

Results: The database included 240 patients whose mean age was 57.9 ± 11.5 years and the male-to-female ratio was 2:1. 197 (82%) patients underwent a coronary artery bypass graft, 178 (74.2%) were anemic, and 74 (30.8%) patients received blood. The mortality rate was 9.2%. The outcome of surgery according to blood was statistically significant($p< 0.003$).

Conclusion: The outcome of cardiac surgery is affected by blood transfusion. There is no relation between blood transfusion and other factors (age, sex, type of surgery, hemoglobin level of patients) in cardiac surgery

Keywords: blood transfusion, cardiac surgery patients, cross-sectional survey

1. INTRODUCTION

Cardiovascular disease (CVD) is an important contributor to the total costs of medical care worldwide, where 30% of people die from CVD in the world every year. The most common cause of death in the UK is coronary heart disease and it is the leading cause of death in New York. Cardiac surgery is carried out to treat complications of ischemic heart disease, valve surgery, and congenital heart surgery including heart transplantation. Cardiac surgery includes many types of procedures, but the most common cardiac surgery procedure is coronary artery bypass graft and valve surgery.[1,2,3,4,5]

*Correspondence: Nuria Mohammed Ali Eltajuri.

nora.eltaguri@gmail.com

Blood transfusion is one of the most common medical procedures, and a major part of these are performed during cardiac surgeries. The incidence of perioperative transfusion in cardiac surgeries varies from 40 to 90%, according to the complexity of the procedure and the protocols adopted in each institution.[6]

Blood transfusion plays a role in complications that arise in patients undergoing CABG surgery, where cardiac surgery increases blood transfusion usage more than other surgeries. However, transfusion-related complications in patients are dependent on other factors such as demographics. Types of open heart surgery including coronary artery bypass graft (CABG) surgery, valve surgery, and combined CABG and valve

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procedures are considered intraoperative risk factors, which have effects on the outcomes of cardiac surgery.

Anemia is defined as hemoglobin level (Hb<12.0 grams per deciliter) for non-pregnant adult women, and anemia for men (Hb< 13.0 grams per deciliter).[7,8,9,10,11,12]

Due to the lack of information on this subject, this study has undertaken the following aims:-

1. To determine the risk factors that lead to blood transfusion during cardiac surgery.

2. To find out the effect of blood transfusion on mortality in cardiac surgery patients.

The risk factors associated with patients who underwent cardiac surgery included the patient's characteristics (age, gender), pre-operative hemoglobin level and type of surgery.

The outcome of cardiac surgery is measured by mortality rate, and postoperative risk factor blood transfusion is associated with the outcome of cardiac surgery.

Moreover, because there is a link between blood transfusion and outcomes of cardiac surgery, this work will include variables related to blood transfusion (type of cardiac procedure, age of patients, sex of patients, and preoperative hemoglobin level).

In 2017, Carlos Arias-Morales et al published a study concerning the relationship between blood transfusion and outcomes of cardiac surgery. They found that the relationship between these two factors is still poorly understood, where it differs among patients in characteristics, demographics, type of procedure, and preoperative status of patients.[9]

In the United Kingdom, a study was conducted concerning the incidence and significance of anemia in patients undergoing cardiac surgery. The aim was to look at the significance of pre-operative anemia, which explains the strong association between pre-operative anemia and morbidity and mortality.[12]

Many risk factors are associated with preoperative anemia in cardiac surgery; preoperative anemia is considered one of the highly effective risk factors and is a highly prevalent condition that is independently associated with adverse outcomes. Anemic patients had more complications of adverse outcomes (death, stroke, or acute kidney injury) than non-anemic patients. Another found that many risk factors and preoperative patient characteristics (such as age, sex, diabetes, hypertension and smoking) were associated with cardiac surgical mortality.[14,15]

In 2002, Zindrou et al published a study concerning preoperative hemoglobin concentration and mortality rate after coronary artery bypass surgery. They found that the patients with preoperative lower hemoglobin concentration had higher in-hospital mortality rates after surgery than those with a higher hemoglobin concentration.[16]

Most previous studies agreed that blood transfusion has an effect on the outcome of cardiac surgery, with a higher mortality rate in patients who received blood transfusion than other patients, in addition to other factors (age, sex, type of procedure, and preoperative hemoglobin concentration).

2. METHODOLOGY

Place: Benghazi Medical Center (BMC), Benghazi-Libya.

Study design: A descriptive (cross-sectional study) retrospective study.

Population: All patients who underwent cardiac surgery in BMC from the 1st of October 2014 to the 31st of December 2017 were included in the study.

Data were collected from the medical records database in the Cardiovascular Surgery Department at BMC.

Information was extracted from the database of BMC, Cardio-Vascular-Thoracic Surgery Department (CVT). All records of adult cardiac surgery in Benghazi from the 1st of October 2014 to the 31st of December 2017, were included in the sample which included 240 surgical procedures.

The dataset consisted of demographic characteristics, details on the intervention, in-hospital mortality and risk factors for mortality after cardiac surgery.

All the data was collected from adult (≥ 18 years) cardiac surgery patients. Data elements collected included patients' characteristics (age, gender), pre-operative blood tests (Hb) and details (diagnosis, type of surgery), postoperative risk factors, blood transfusion and the outcome of surgery.

Data were analyzed by using SPSS version 23.

Descriptive statistics such as mean, mode, median and standard deviation were used.

Inferential statistics: Chi-square was used to find if there is a statistical difference between variables and data was considered significant when the P value is ≤ 0.05.

The association between the outcome of cardiac surgery and other pre-operative variables was assessed using the Chi-square test.

The association between the outcome of cardiac surgery and the post-operative variable blood transfusion was assessed using the Chi-square.

Data is presented in form of tables and figures. the figures were created by Microsoft Excel 2010.

3. RESULTS

The risk factors of cardiac surgery in this study included demographic factors such as age, sex, weight and family history. The distribution of patients according to age in this study is illustrated in Table 1 and Figure 1.

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Table 1: Distribution of patients according to age

Age /year	No.	%
21 - 30	7	2.9
31 - 40	14	5.8
41-50	29	12
51-60	70	29.2
61-70	99	41.3
>70	21	8.8
Total	**240**	**100**

Mean=57.9 years. Std. Deviation=11.49 years. median=60.5years. minimum=21 years. maximum=85years.

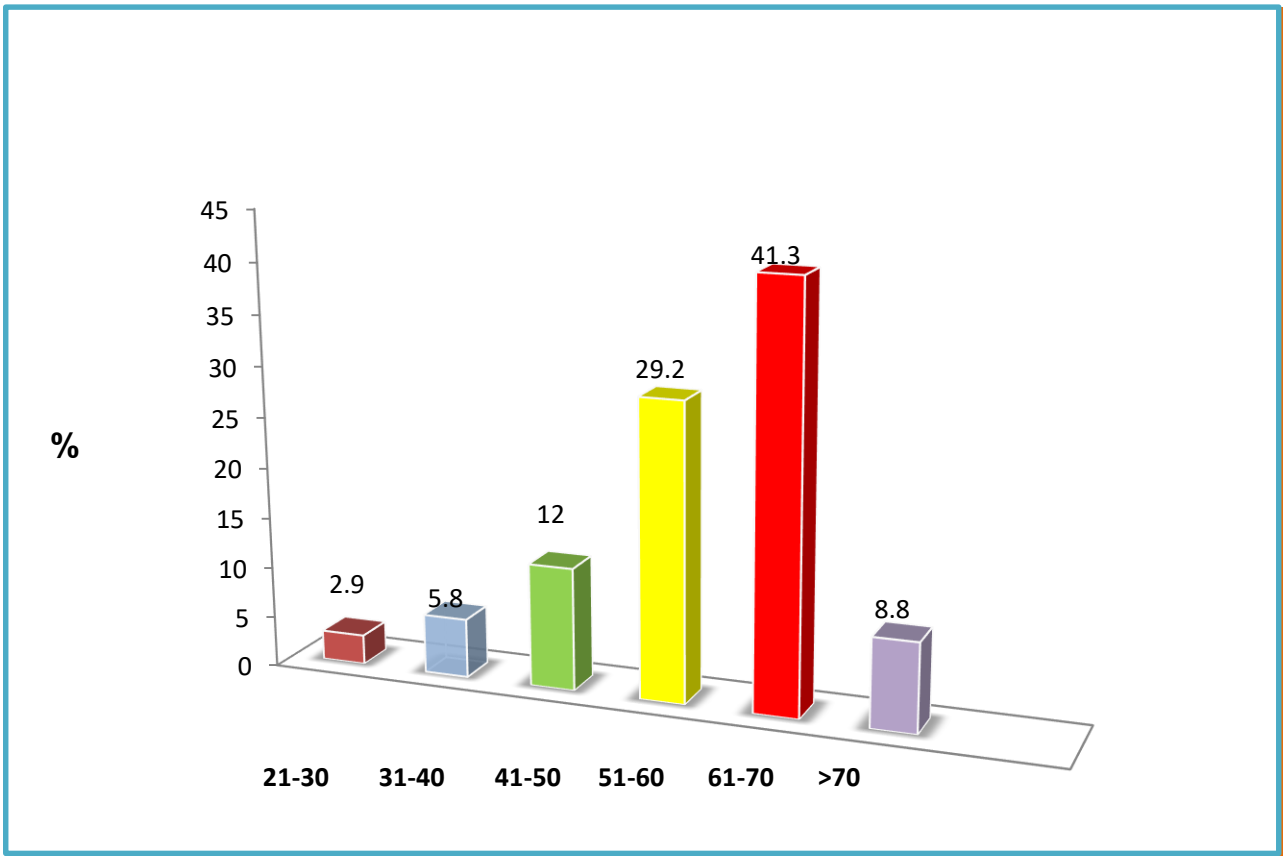


Fig. 1: Distribution of patients according to age

The distribution of patients according to sex in the current study is illustrated in Table 2 and Figure 2.

Table 2: Distribution of patients according to sex

Sex	NO.	%
Male	159	66.2
Female	81	33.8
Total	**240**	**100**

Male: Female = 2:1

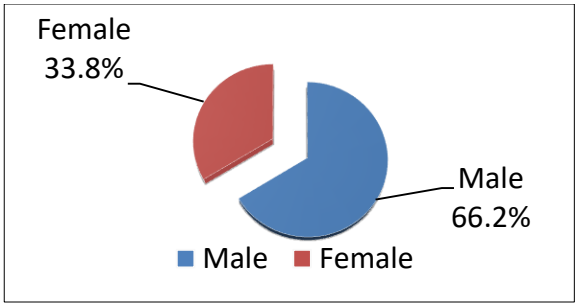


Fig 2: Distribution of patients according to sex

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The distribution of patients according to procedure in this study is illustrated in table 3 and figure 3.

Table 3: Distribution of patients according to procedure

Procedure	No.	%
Coronary artery bypass graft	197	82
Valve surgery	33	13.8
Coronary artery bypass graft & valve surgery	10	4.2
Total	**240**	**100**

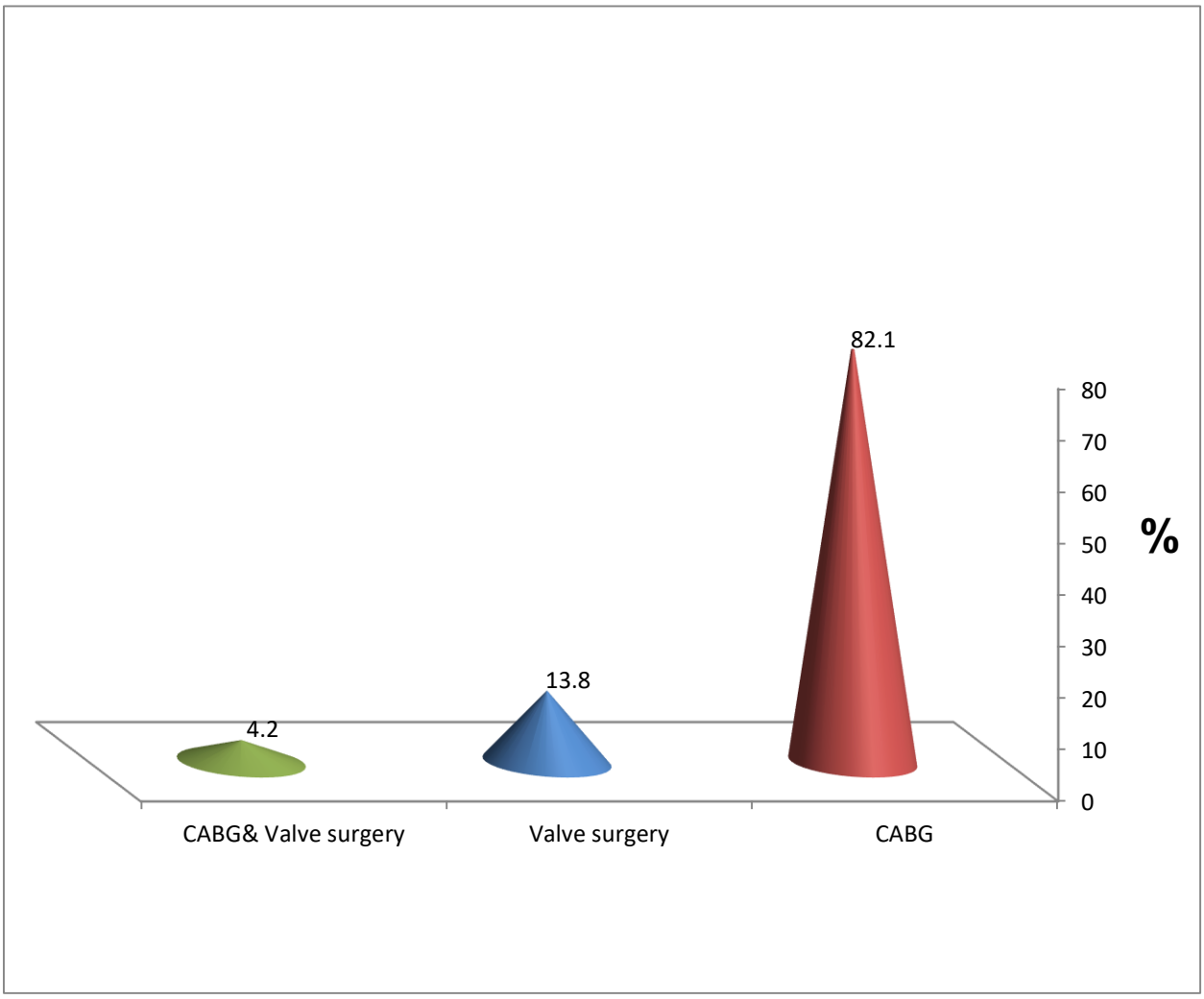


Fig. 3: Distribution of patients according to procedure

The distribution of patients according to preoperative hemoglobin level in this study is illustrated in table 4 and figure 4.

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Table 4: Distribution of patients according to preoperative hemoglobin level

Hemoglobin (g/dl)	No.	%
<12.5	178	74.2
≥12.5	62	25.8
Total	**240**	**100**

Mean= 11.1. Median= 10.95. Std. Deviation= 1.75. Minimum=7.40. Maximum=15.00

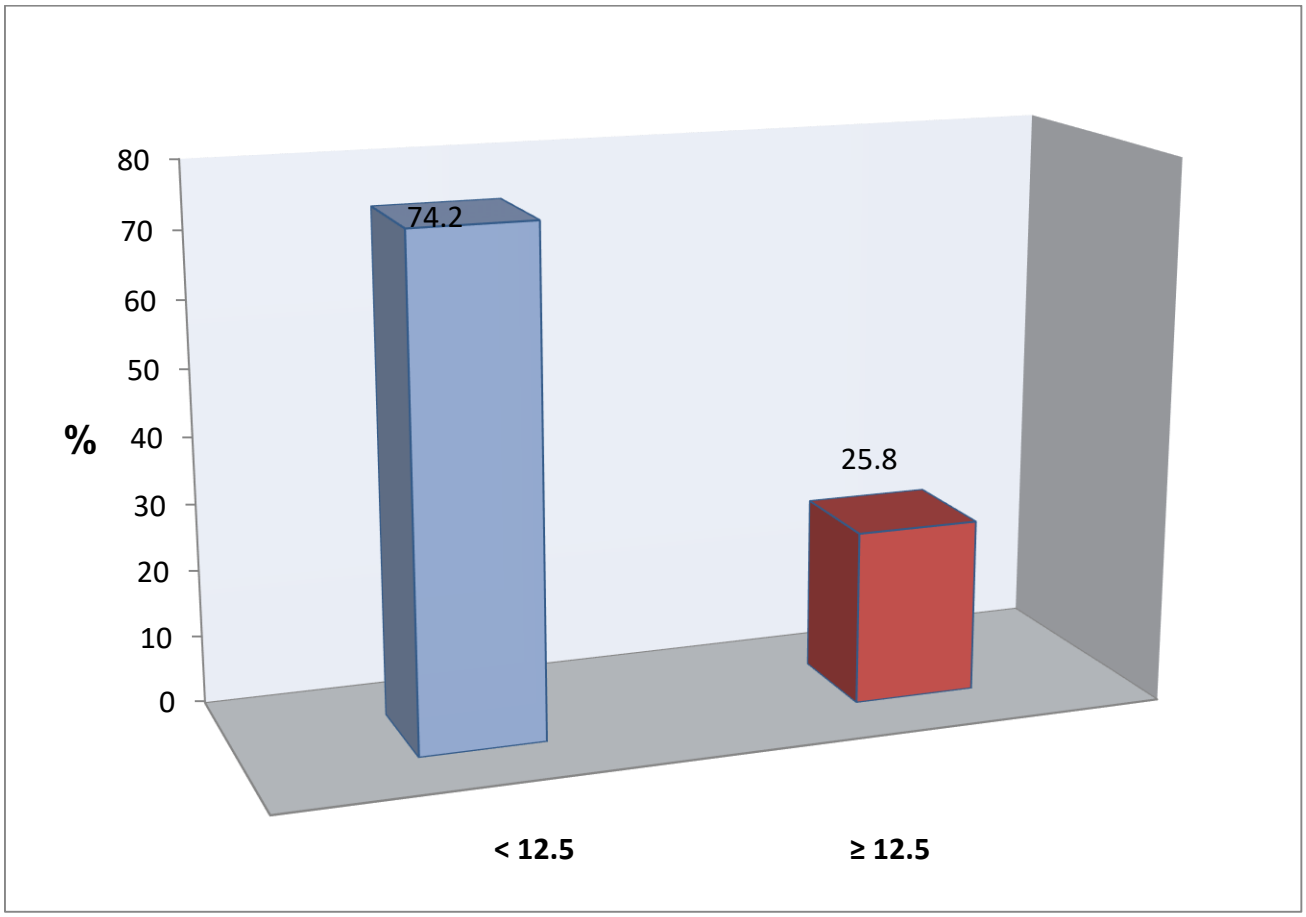


Fig. 4: Distribution of patients according to preoperative hemoglobin level

Blood transfusion is a treatment for anemic patients, where bloodtransfusions play a role in complicated patients. The distribution of patients according to their history of blood transfusion is illustrated in table 5 and figure 5.

Table 5: Distribution of patients according to their history of blood transfusion

Blood transfusion	No.	%
No	166	69.2
Yes	74	30.8
Total	**240**	**100**

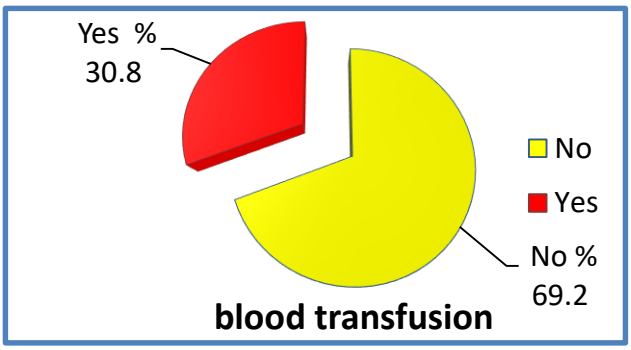


Fig. 5: Distribution of patients according to their history of blood transfusion

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The distribution of patients according to the outcome of surgery is illustrated in table 6 and figure 6.

Table 6: Distribution of patients according to the outcome of surgery

Outcome of surgery	No.	%
survived	218	90.8
Died	22	9.2
Total	**240**	**100**

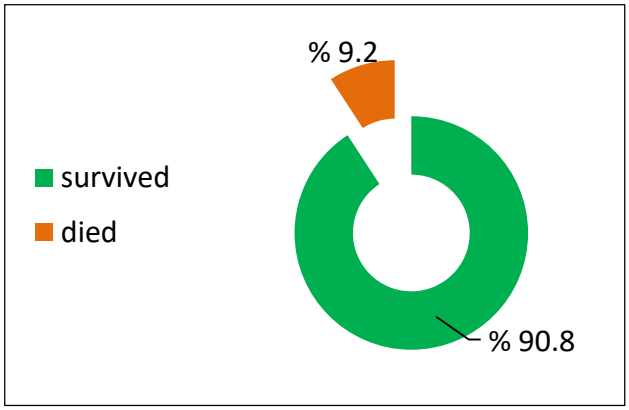


Fig. 6: Distribution of patients according to the outcome of surgery

Table 7: Distribution of patients according to blood transfusion and age

Blood transfusion	Age of patients				Total	
	≤ 60		> 60			
	No.	%	No.	%	No.	%
No	91	54.8	75	45.2	166	100
Yes	29	39.2	45	60.8	74	100
Total	**120**	**50**	**120**	**50**	**240**	**100**

X2= 5.002 df.= 1 p= 0.025 (Not significant).

Table 8: Distribution of patients according to blood transfusion and sex

Blood transfusion	Sex				Total	
	Male		Female			
	No.	%	No.	%	No.	%
No	110	36.3	56	33.7	166	100
Yes	49	66.2	25	33.8	74	100
Total	**159**	**66.3**	**81**	**33.8**	**240**	**100**

X2= .00 df.= 1 p=0.994 (Not significant).

Table 9: Distribution of patients according to blood transfusion and type of surgery

Blood transfusion	Type of surgery						Total	
	Coronary artery bypass graft		Valve surgery		CABG + valve surgery			
	No.	%	No.	%	No.	%	No.	%
No	134	80.7	28	16.9	4	2.4	166	100
Yes	63	85.1	5	6.8	6	8.1	74	100
Total	**197**	**82.1**	**33**	**13.8**	**10**	**4.2**	**240**	**100**

X2= 7.91 df.= 2 p=0.019 (Not significant).

Table 10: Distribution of patients according to blood transfusion and hemoglobin level of patients

Blood transfusion	Hemoglobin level (g/dl)				Total	
	<12.5		≥ 12.5			
	No.	%	No.	%	No.	%
No	124	74.7	42	25.3	166	100
Yes	54	73	20	27	74	100
Total	**178**	**74.2**	**62**	**25.8**	**240**	**100**

X2=0.080 df.=1 p=0.77 (Not significant).

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Table 11: Distribution of patients according to blood transfusion and outcome of surgery

Blood transfusion	Outcome of surgery				Total	
	survived		died			
	No.	%	No.	%	No.	%
No	157	94.6	9	5.4	166	100
Yes	61	82.4	13	17.6	74	100
Total	**218**	**90.8**	**22**	**9.2**	**240**	**100**

X2= 9.068 df.= 1 p=0.003 (Significant).

4. DISCUSSION

These findings show (Table 1) that the age of patients ranged between 21 years and 85 years and the mean age was 57.9 ± 11.5 years, compared to a previous study published in 1999 where the mean age was 62.5 ± 10.7 (range= 17- 94 years).[11]

These findings show that males constitute 66.3%, while females were 33.85%; male to female ratio was 2:1 (see Figure 2). These data are opposite to Fortes's study in Brazil where 54 (36.5%) were male and 94 (63.5%) were female.[14]

These findings show that 197 (82%) underwent coronary artery bypass graft, 33 (13.8%) had valve surgery, and 10 (4.2%) had CABG & valve. The highest percentage of patients receiving blood underwent CABG procedures because these procedures are the most common (Table 3). Different figures were recorded by Mazzeffi in Georgia; 22% CABG, 12 % valve, 5.6% CABG & valve, and 60.3% other.[8]

The findings show that hemoglobin levels were between 7.40 g/dl and 15.00 g/dl, and the mean Hb was 11.1 ± 1.75 g/dl. 178 were (74.2%) anemic, and 62 (25.85%) non-anemic (see Figure 4). In a study conducted on UK patients by Klein, 31% were anemic, and 69% were non-anemic.[12]

The findings show that a history of blood transfusion was recorded in 74 (30.8%) of the patients receiving blood, and 166 (69.2%) had not received blood (see Table 5). These findings were similar to the findings of a study conducted in the United States, in which 34 % of cardiac surgery patients had received blood.[12]

The findings show that the mortality rate of patients who underwent surgery was 22 (9.2%) of the patients died, and 218 (90.8%) survived (see Figure 6). These findings were similar to the findings of a study conducted in the UK, in which (6.1 %) of the patients died after cardiac surgery.[16]

The distribution of patients according to blood transfusion and age in this study is illustrated in Table 7. These findings show that blood transfusion was 39.2% in the age group of ≤ 60 and 60.8% in the age group of > 60, which was not statistically significant (p-value 0.025).

The distribution of patients according to blood transfusion and sex in this study is illustrated in Table 8. These findings show that 66.2% of males and 33.8% of females were statistically not significant at p-value = (0.994).

The distribution of patients according to blood transfusion and type of surgery in this study is illustrated in Table 9. These findings show that blood was received in 85.1% of coronary artery bypass graft procedures, in 6.8% of valve surgery procedures, and in 8.1% of CABG & valve surgery procedures, which was not statistically significant at *p*-value =0.019.

The distribution of patients according to blood transfusion and hemoglobin level in this study is illustrated in Table 10. These findings show that of patients who received blood, 73% had pre-operation hemoglobin levels of < 2.5 g/dl, and 27% had pre-operation hemoglobin levels of ≥ 12.5 g/dl, with a statistically not significant (*p* value=0.77).

The distribution of patients according to blood transfusion and outcome of surgery is illustrated in Table 11. The death rate was 17.6 % of patients receiving blood and 5.4 % of patients not receiving blood, with a high significance statistically (*p* value=0.003).

Previous studies found that many risk factors and preoperative patient characteristics (such as age, sex, diabetes, hypertension and smoking) were associated with cardiac surgical mortality.[14,15]

A previous study in the United States found that the relationship between these two factors is still poorly understood, where it differs among patients in characteristics, demographics, type of procedure, and preoperative status of patients.[9]

Another study concerning the preoperative hemoglobin concentration and mortality rate after coronary artery bypass surgery found that patients with preoperative lower hemoglobin concentration had higher in-hospital mortality rates after surgery than those with a higher hemoglobin concentration.[16]

5. CONCLUSION

- When reviewing the results of this study, it is concluded that a high percentage of patients receiving blood are advanced in age (> 60 years), male (sex), and anemic (> 12.5 g/dl).
- The outcome of cardiac surgery is affected by blood transfusion.
- There is no relation between blood transfusion and other factors (age, sex, type of surgery, hemoglobin level of patients) in cardiac surgery.

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6. RECOMMENDATIONS

- An analytical cohort study is needed to explain if there is a relationship between cardiac surgery and blood transfusion.
- Patients admitted to undergoing cardiac surgery are asked to monitor blood analysis before operations.
- Use of cell saver machines to avoid blood transfusions.
- Use hemofiltration during cardiopulmonary bypass in on-pump surgery.

7. REFERENCES

1. Jianxing Yu, Yonghui Ma, Sen Yang, Kai Pang, Yaqin Yu, Yuchun Tao and Lina Jin. Risk Factors for Cardiovascular Disease and Their Clustering among Adults in Jilin (China). International Journal of Environmental Research and Public Health. 2015; 1-10.

2. Spencer King, Gary Walford, M. Hashmat Ashraf, Peter B. Berger, Frederick Bierman, Joanna Chikwe, Jeptha Curtis, etc. adult cardiac surgery. 2018; 7-12.

3. Jan Bucerius, Jan F. Gummert, Michael A. Borger, Thomas Walther, Nicolas Doll, Jo¨ rg F. Onnasch, Sebastian Metz, and etc. Stroke After Cardiac Surgery. The society of Thoracic Surgery. 2003; 472.

4. Paul S. Myles. Meaningful Outcome Measures in Cardiac Surgery. The Journal of ExtraCorporeal Technology. 2013; 23.

5. Ferket, B.S.; Colkesen, E.B.; Visser, J.J.; Spronk, S.; Kraaijenhagen, R.A.; Steyerberg, E.W.; Hunink, M.G.M. Systematic review of guidelines on cardiovascular risk assessment which recommendations should clinicians follow for a cardiovascular health check? Arch. Intern. Med. 2010, 170, 27–40.

6. Fernanda Azevedo-Silva. Adverse Events and Risk Factors of Blood Transfusion in Cardiovascular Surgery: A Prospective Cohort Study. International Journal of Cardiovascular Sciences. 2019;32(6):573-575.

7. Charuhas V. Thakar, Sarah Worley, Susana Arrigain, Jean Pierre Yared, and Emil P. Paganini. Influence of renal dysfunction on mortality after cardiac surgery: Modifying effect of preoperative renal function. International Society of Nephrology. 2004; 1112-1117.

8. Michael Mazzeffi, Joel Zivot, Timothy Buchman, and Michael Halkos. In-Hospital Mortality After Cardiac Surgery: Patient Characteristics, Timing, and Association With Postoperative Length of Intensive Care Unit and Hospital Stay. The Society of Thoracic Surgeons. 2014; 1220-1225.

9. Carlos Arias-Morales , Nicoleta Stoicea , Alicia A Gonzalez-Zacarias , Diana Slawski , Sujatha P. Bhandary , Theodosios Saranteas , Eva Kaminiotis and etc. Revisiting blood transfusion and predictors of outcome in cardiac surgery patients. F1000Research . 2017; 1-7.

10. Geissler RG, Rotering H, Buddendick H, et al.: Utilisation of blood components in cardiac surgery: a single-center retrospective analysis with regard to diagnosis-related procedures. Transfus Med Hemother. 2015; 42(2): 75–82.

11. Daniel T. Engelman, David H. Adams, John G. Byrne, Sary F. Aranki, John J. Collins, Jr, Gregory S. Couper, Elizabeth N. Allred, Lawrence H. Cohn, and Robert J. Rizzo. Impact Of Body Mass Index and Albumin On Morbidity And Mortality After Cardiac Surgery. The Journal of Thoracic and Cardiovascular Surgery Volume 118. 1999; 866-871.

12. A. A. Klein, T. J. Collier, M. S. Brar, C. Evans, G. Hallward, S. N. Fletcher and T. Richards. The incidence and importance of anaemia in patients undergoing cardiac surgery in the UK – the first Association of Cardiothoracic Anesthetists national audit. The Association of Anaesthetists of Great Britain and Ireland. 2016; 627-635.

13. Antonio Miceli, Lrancesco Romeo, Mattia Glauber, Paolo M de Siena, Massimo Caputo, and Gianni D Angelini. Preoperative anemia increases mortality and postoperative morbidity after cardiac surgery. Journal of Cardiothoracic Surgery. 2014; 1-6.

14. Joao Vyctor Silva Fortes, Mayara Gabrielle Barbosa e Silva, Thiago Eduardo Pereira Baldez, Marina de Albuquerque Gonçalves Costa1, Luan Nascimento da Silva, Renata Silva Pinheiro, Zullma Sampaio Fecks, and Daniel Lago Borges. Mortality Risk After Cardiac Surgery: Application Of Inscor in a University Hospital in Brazil Northeast. Brazilian Journal of Cardiovascular Surgery. 2016; 396-370.

15. Keyvan Karkouti, Duminda N. Wijeysundera, and W. Scott Beattie. Risk Associated With Preoperative Anemia in Cardiac Surgery. American Heart Association. 2007; 478-484.

16. Zindrou D, Taylor KM, Bagger JP. Preoperative haemoglobin concentration and mortality rate after coronary artery bypass surgery. Lancet 2002; 359: 1747–8.

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