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Incidence, Indications, and Risk Factors of Reopening After Cardiac Surgery in Tertiary Cardiac Center, Sudan: Retrospective Observational Study

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Abstract

Background: Chest re-opening after cardiac surgery is a surgical approach that is performed for diagnosis and management of some postoperative complications. The rate of reopening varies from 2% to 6% of patients undergoing cardiac surgery. The most frequent indication for reopening, followed by cardiac tamponade, cardiac arrest and redo surgery. Several risk factors have been associated with reopening such as, age, sex, BMI, NYHA class, diabetes mellitus, cardiopulmonary bypass and aortic cross clamp time. The aim of this study is to determine the incidence, indications, and risk factors of reopening after cardiac surgery.

Methods: In this retrospective observational study, a total of consecutive 638 patients who underwent cardiac surgery in Ahmed Gasim cardiac center in 2017 were included.

Results: The incidence of reopening was found to be 61 per 1000 in all age groups, 90 per 1000 in adults, and 34 per 1000 in paediatrics. Out of 39 reopening cases, Bleeding was found to be the most frequent indication of reopening. multivariate analysis by logistic regression revealed that, having NYHA class II odd ratio OR = 24.767 (95% confidence interval CI = 1.048 – 585.3), past cardiac surgery OR = 13.9(95% CI = 1.013 – 193.3), having diabetes mellitus OR = 4.885 (95% CI = 1.251 –19.056),longer cardiopulmonary bypass time OR = 1.012 (95% CI = 1.00 – 1.024), preoperative aspirin OR = 3.528 (95% CI = 1.062 – 11.720), and warfarin OR = 12.790 (95% CI = 1.594 – 102.3) all are associated with increased risk of reopening after cardiac surgery.

Conclusion : Incidence of reopening in Sudan was relatively higher than the international records. Reopening was mostly performed for postoperative bleeding management. Cardiac failure assessed by NYHA classification, previous cardiac surgery, diabetes mellitus, anti thrombotic therapy and longer bypass time were associated with increased risk of reopening.

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Background

Although open heart surgery have large impact on reducing morbidity and mortality among people with cardiac disease, it have serious complications, in both short and long terms. Most of the short term complications of the open heart surgery are associated with the use of cardiopulmonary bypass machine, type of surgical intervention, and peri-operative medications and these complications include postoperative arrhythmia, hemorrhage, cardiac tamponade, and surgical wound infections [1].

Part of these complications may indicate early reopening of the chest in the first few days following cardiac surgery for diagnosis and therapeutic interventions.

Indications of reopening after cardiac surgery include; post-operative hemorrhage, tamponade, cardiac arrest, sternal osteomyelitis or mediastinitis, sternal dehiscence, and redo surgery [2]. Risk factors of reopening after cardiac surgery include; age, BMI, emergency operation, peri-operative anticoagulant, use of cardiopulmonary bypass machine, and bypass time [3].

Morbidity and mortality are high among patient undergoing reopening compared to the primary operation and the mortality is estimated to be as high as 43% in which half of them occurred during the operation. The most frequent complication of reopening is stork [4]. There is no previous published study has investigated the incidence of reopening after cardiac surgery in Sudan, and its incidence, indications, and risk factors among Sudanese patients are not well described or documented. This study is expected to clarify the situation of reopening in a tertiary hospital and one of the biggest cardiac centers in Sudan.

Methods

Retrospective observational study aim to assess the incidence, indications, and risk factors of reopening after cardiac surgery in Center of Cardiac Surgery and Kidney Transplantation in Ahmed Gasim hospital, a tertiary hospital located in Bahri locality, Khartoum state, Sudan.

All the cohort of consecutive operated patients from January 2017 to January 2018 were included in the study. The data was collected by the first author retrospectively from the hospital record.

Statistical analysis

Data had been analyzed using statistical package for the social sciences SPSS version 20. Tests of normality for numeric data were performed and the data was normally distributed. Categorical data are expressed in frequencies and percents, and numerical data as mean ± standard deviation. Association between reopening and possible risk factors have been tested by univariate analysis using independent t test and for comparing the means of numerical data, and chi square test and fisher's exact test for categorical data.

Multivariate analysis was conducted for further test of test of association; using logistic regression possible risk factors were compared to reopening status. For all previously mentioned statistical tests, a p values at α <0.05 was regarded statistically significant.

Results
Socio-demographic characteristics

Out of the total of consecutive 638 patients, 378 were males representing 59.2% of the patient and 260 were female representing the remaining 40.8% of the patients. All age groups were included the minimum age was 39 day old and the maximum age was 81 year old. Socio-demographic characteristics are listed in table.1.

	Frequency	Percent
Age: (n=638)		
≥18	327	51.3
19- 36	28	4.4
37- 54	65	10.2
55- 72	197	30.9
≤ 73	21	3.3
Sex: (n=638) male Female	387	59.2
	260	40.8
Occupation: adults (n=310)		
unemployed	172	55.5
self- employed	98	31.6
employed	40	13
Marital status: adults (n=301)		
Single	35	14.4
Married	245	78.8

Divorced	3	0.8
Widowed	18	6.0
Residency: (n=582)		
Blue Nile	106	18.2
Darfur	22	3.8
Kassala	61	10.5
Khartoum	254	43.6
Kurdofan	45	7.7
Northern	94	16.2

Table 1: Socio-demographic characteristics of cardiac surgery patients in Ahmed Gasim hospital in 2017.

Incidence of Reopening

Age group	Total number of patients	Frequency of reopening	Percent of reopening	Incidence per 1000
All age groups	638	39	6.1	61
All age groups	638	39	6.1	61
All age groups	638	39	6.1	61

Table 2: Incidence of reopening in cardiac surgery patients in Ahmed Gasim hospital in 2017.

Indications of Reopening

Showed in figure 2. Bleeding was found to be the most frequent indication of reopening occurred in 30 out of 49 underwent reopening accounting for 61% of reopening indication, followed by cardiac tamponade and cardiac arrest both occurring at the same frequency of 9 (18,%), and redo surgery was the least frequent indication in only 2 patients (4%).

Indication	Frequency (n=49)	Percent
Bleeding	30	79
Tamponade	4	10
Cardiac arrest	4	10
Redo surgery	1	2.5

Table 3: Indication of reopening after cardiac surgery in Ahmed Gasim hospital in 2017.

Risk factors or reopening

Association between and reopening and multiple factors was established using analysis chi square test for categorical variable and independent t test(table.3) for comparing the mean of continues variables, a statistically significant p value of < 0.05 was estimated for analysis of age, NYHA classification, previous open heart surgery, type of cardiac surgery performed, diabetes mellitus, tuberculosis, previous myocardial infarction, preoperative exposure to aspirin and warfarin

	Reopening Mean ± Standard deviation		P value
	Yes	No	
Age(y)	45.2 ± 24.55	25.1 ± 25.85	<0.001*
EF**	56.96 ± 11.33	59.19 ± 9.58	0.230
LVEDD**	48.6 ± 8.50	47.01 ± 10.77	0.472
CPB time	100.5 ± 38.03	99.6 ± 50.2	0.936
Aortic cross clamp time	74.2 ± 38.16	66.8 ± 43.03	0.396

Table 4: Baseline characteristics of cardiac uergery patients in Ahmed Gasim hospital 2017 by independent t test. *indicate statistically significant p value using in *indicate statistically significant p value using independent t test at α <0.05 level, ** variables measured for adults patients only. CPB: cardiopulmonary bypass, LF: ejection fraction, LVEDD: left ventricle end diastolic dimensions,

Risk factor		Reopening		Parsons chi square ??fidvalue /fisher's exact value	P value
		Yes (n=39)	No (n=599)		
Sex	Male	26	352	0.947	0.330
	Female	13	247		
NYHA classification	NYHA I	6	198	16.922	0.001*
	NYHA II	13	241		
	NYHA III	10	62		
	NYHA IV	2	3		
Priority of surgery	Elective	38	591	2.103	0.435
	Urgent	1	6		
	Emergency	0	2		
Past sternotomies	Yes	2	6	5.011	0.025*
	No	37	591		
Diabetes mellitus	Yes	13	118	4.579	0.039*
	No	25	480		
Hypertension	Yes	9	113	0.528	0.523
	No	29	485		
Renal insufficiency	Yes	1	2	4.016	0.169
	No	37	598		
Tuberculosis	Yes	2	2	13.888	0.019*
	No	36	596		
Previous MI	Yes	5	27	5.586	0.036*
	No	33	571		
Previous stroke	Yes	0	4	0.256	0.781
	No	38	594	8.809	0.006*
Aspirin	Yes	12	83		
	No	26	515		
Heparin	Yes	0	3	0.192	0.831
	No	38	595		
Warfarin	Yes	4	12	10.575	0.012*
	No	34	586		

Table 5: Baseline characteristics of cardiac surgery patients in Ahmed Gasim hospital in 2017 by chi square test/ fisher's exact tests.

*indicate statistically significant p value using x^2 or fisher exact test at α <0.05 level, MI: myocardial infarction, NYHA: New York Heart Association.

Discussion

In this study, that incidence of reopening after cardiac surgery was estimated to be 61 /1000 or 6.1% for all age groups approximating the incidence of 5.6% estimated in a similar Nigerian study that was also including all age groups from 1 month to 52 year [8]. Among adults patients we found an incidence of 90/1000 or 9% which is much higher than what had been mentioned in almost all of reviewed literatures, in which incidence rate was varying from 2% to 6% [5-7]. Variation in incidence may be due to several factors like patient's age, co-morbidities, pre-surgery and intra-surgery anticoagulation therapy, surgical techniques and individual surgical skills of surgeon.

Although that paediatrics cardiac surgery are associated with more postoperative morbidity and mortality than adults, our finding of incidence of reopening in paediatrics of 3.4% are lower than incidence in adults but are consistence with the of finding of many similar paediatrics studies, it is approximate the incidence of 3.9% reported from similar Indonesian study A higher reopening incidence of 5.1% was estimated among paediatric patients underwent cardiac surgery with cardiopulmonary bypass and 7.4% among patients without cardiopulmonary bypass [18, 19].

In this study, the most frequent indication of reopening was postoperative bleeding in 79%, followed by cardiac tamponade and cardiac arrest both of similar percent (10%), and followed by redo surgery in 2.5%. These findings are consistent with the similar reviewed literatures, as bleeding was the indication of reopening in about 70.4% of reopening cases

	B	S.E.	Wald	df	Sig.			95% CI for Exp(B)
						Exp(B)	Lower	Upper
Bypass time	.012	.006	3.653	1	.056	1.012	1.000	1.024
NYHA			8.987	3	.029			
NYHA I	2.042	1.485	1.890	1	.169	7.704	.419	141.572
NYHA II	3.209	1.614	3.956	1	.047*	24.767	1.048	585.336
NYHA III	.953	1.529	.388	1	.533	2.592	.129	51.902
Age	-.010	.016	.396	1	.529	.990	.961	1.021
Previous surgery	2.639	1.340	3.879	1	.049*	13.993	1.013	193.339
Diabetes mellitus	1.586	.695	5.211	1	.022*	4.885	1.251	19.065
Hyperten-sion	.665	.738	.811	1	.368	1.944	.457	8.268
Renal Insuf-ficiency	24.489	40192.933	.000	1	1.000	43205041629.000	.000	
Tubercu-losis	23.981	26311.147	.000	1	.999	26000595672.779	.000	.
Previous acute MI	.036	.896	.002	1	.968	1.037	.179	6.002
Aspirin	1.261	.613	4.235	1	.040*	3.528	1.062	11.720
Warfarin	2.549	1.062	5.754	1	.016*	12.790	1.594	102.630

Table 6: Binary logistic regression of reopening and potential risk factors in Ahmed Gasim hospital in 2017. *indicate statistically significant p value using binary logistic regression at α <0.05 level. MI: myocardial infarction, NYHA: New York Heart Association.

in a similar study followed by cardiac tamponade in 23% of case and both bleeding and tamponade in 5.9% of cases [6]. A different higher finding was reported in another study in which bleeding was the indication in 92.8% of cases [5].

Regarding reopening risk factors, our findings were consistence with the findings reported by many similar studies, as longer cardiopulmonary bypass was found to be significantly associated with increased risk of reopening in many literatures [5, 6, 12, 17]. This finding may be explained by the fact that cardiopulmonary bypass affect the platelets and haemostasis, which increase the risk of bleeding the main indicator of reopening [14].

Past history of cardiac surgery lead to mediastinal fibrosis that my advanced around the great vessels, increasing the risk blood vessels injury in subsequent cardiac surgery. Our findings of association between previous cardiac and reopening is also reported in many different studies [5, 9].

As NYHA classification is used for clinical categorization of heart failure, it is usually higher in patients with high surgical risk [5]. In this study, the multivariate analysis finding of significant association between NYHA classes and increased risk of reopening after cardiac surgery was consistent with a result of similar study aimed to identify the risk factor of massive bleeding and subsequent reopening risk [11]. Contradicted to other study finding of no significant association between NYHA class II-IV and risk of reopening after cardiac surgery [5, 10, 13].

Preoperative administration of anti-thrombotic agents, specifically aspirin and warfarin significantly increase the risk of reopening after cardiac surgery as they both increase bleeding risk and subsequent need of re-exploration. This association was also founds in multiple other studies [15, 16]. Diabetic mellitus was also found to increase the risk of reopening after cardiac surgery in similar study and that is consistence with our findings [7].

Limitations

Because our findings reflect routine clinical practice at only a single institution, this study carries the possibility of biases in patient, surgeon, or center selection, as well as in reopening decision. The use of multiple statistical tests increased the probability that associations might have been due to chance alone.

Conclusions

In this study, the incidence of reopening estimating from single institutional experience was found to be within the higher limits of what had been reported previously by others. Bleeding was found to be the most frequent indication of reopening. This study reemphasizes the known pre- and intra-operative risk factors or reopening after cardiac surgery. Cardiac failure assessed by NYHA classification, previous cardiac surgery and longer bypass time were significantly associated with increased risk of reopening.

References

1. Williams NS, Bulstrode CJK, O'Connell PR (2008) Bailey & Love's short practice of surgery.
2. Cheng DCH, David TE (2006) Perioperative care in cardiac anesthesia and surgery.
3. Karthik S, Grayson AD, McCarron EE, Pullan DM, Desmond MJ et al. (2004) Reexploration for bleeding after coronary artery bypass surgery: risk factors, outcomes, and the effect of time delay. The Annals of thoracic surgery 78: 527-534.
4. Unsworth-White MJ, Herriot A, Valencia O, Poloniecki J, Smith EEJ, et al. (1995) Resternotomy for bleeding after cardiac operation: a marker for increased morbidity and mortality. The Annals of thoracic surgery 59: 664-667.
5. Ruel M, Chan V, Boodhwani M, McDonald B, Ni X, et al. (2017) How detrimental is reexploration for bleeding after cardiac surgery? The Journal of thoracic and cardiovascular surgery 154: 927-935.
6. Júlia Čanádyová, Dušan Zmeko, Aleš Mokráček (2012) Re-exploration for bleeding or tamponade after cardiac operation. Interactive cardiovascular and thoracic surgery 14: 704-707.
7. Ranucci M, Bozzetti G, Ditta A, Cotza M, Carboni G, et al. (2008) Surgical reexploration after cardiac operations: why a worse outcome? The Annals of thoracic surgery 86: 1557-1562.
8. Falase B, Sanusi M, Majekodunmi A, Ajose I, Idowu A et al. (2013) The cost of open heart surgery in Nigeria. Pan African Medical Journal 14.
9. Okonta KE, Rajan S (2011) Re-exploration after open heart surgery at the Madras Medical Mission, Chennai, India. Journal of the West African College of Surgeons 1: 1-17.
10. Haneya A, Diez C, Kolat P, von Suesskind-Schwendi M, Ried M, et al. (2015) Re-exploration for bleeding or tamponade after cardiac surgery: impact of timing and indication on outcome. The Thoracic and cardiovascular surgeon 63: 51-57.
11. Long SS, Pickering LK, Prober CG (2003) Principles and practice of pediatric infectious diseases. Shock 20: 98.
12. Dacey LJ, Munoz JJ, Baribeau YR, Johnson ER, Lahey SJ, et al. (1998) Reexploration for hemorrhage following coronary artery bypass grafting: incidence and risk factors. Archives of surgery133: 442-447.
13. Biancari F, Mikkola R, Heikkinen J, Lahtinen J, Kettunen U, et al. (2012) Individual surgeon's impact on the risk of re-exploration for excessive bleeding after coronary artery bypass surgery. Journal of cardiothoracic and vascular anesthesia 26: 550-556.
14. Mikkola R (2017) Determinants and Clinical Implications of Bleeding Related To Coronary Artery Bypass Surgery.
15. Deja MA, Kargul T, Domaradzki W, StÄ…cel T, Mazur W, et al. (2012) Effects of preoperative aspirin in coronary artery bypass grafting: a double-blind, placebo-controlled, randomized trial. The Journal of thoracic and cardiovascular surgery 144: 204-209.
16. Kincaid EH, Monroe ML, Saliba DL, Kon ND, Byerly WG, et al. (2003) Effects of preoperative enoxaparin versus unfractionated heparin on bleeding indices in patients undergoing coronary artery bypass grafting. The

Annals of thoracic surgery 76: 124-128.

17. Miana LA, Atik FA, Moreira LF, Hueb AC, Jatene FB, et al. (2004) Risk factors for postoperative bleeding after adult cardiac surgery. Brazilian Journal of Cardiovascular Surgery 19: 280-286.

18. Murni IK, Djer MM, Yanuarso PB, Putra ST, Advani N, et al. (2019) Outcome of pediatric cardiac surgery and predictors of major complication in a developing country. Annals of pediatric cardiology 12: 38-44

19. Agarwal HS, Wolfram KB, Saville BR, Donahue BS, Bichell DP et al. (2014) Postoperative complications and association with outcomes in pediatric cardiac surgery. The Journal of thoracic and cardiovascular surgery.148: 609-616.