Assiut Scientific Nursing Journal
http://asnj.journals.ekb.eg http://www.arabimpactfactor.com
DOI:10.21608/asnj.2025.401492.2119 http://olddrji.lbp.world/indexedJournals.aspx
https://vlibrary.emro.who.int/journals/assiut-scientific-nursing-journal

Acute kidney Injury: Incidence and Risk Factors among Patients Undergoing Open Heart Surgery

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Abstract

Background: Acute kidney injury frequently occurs as a complication in 20–30% following open heart surgery patients; is associated with higher mortality and prolonged hospital stay. It is typically diagnosed by elevated serum creatinine or reduced urine output **Aim:** To explore the incidence and risk factors of acute kidney injury in patients undergoing open heart surgery. **Research design:** A correlational and prospective research design were patients. **Setting:** The study was conducted in the cardiothoracic surgical intensive care unit at Assiut University Hospital. **Sample:** A total of 120 adult patients undergoing open heart surgery were selected using a convenience sampling **Tools, Tool (I):** Open heart surgery assessment tool, **Tool (II):** Occurrence of acute kidney injury assessment tool, **Tool (III):** Patient's outcomes assessment tool of kidney injury in patients undergoing open-heart surgery **Results:** Among the studied patients, 40% of them that developed Acute kidney injury was observed. Astrongly positive correlation between acute kidney injury incidence and the was observed occurrence of complications with P value (at $p<0.05$). **Conclusion:** the Study shows that One of the major complications of open-heart surgery is acute kidney injury, which tends to affect men more commonly **Recommendation:** Strict hemodynamic monitoring and important of renal function test and renal output should be emphasized in patients undergoing open heart surgery.

***Keywords**: Acute kidney Injury, Incidence, Risk Factors & Open Heart Surgery*

Introduction

Acute kidney injury (AKI) frequently occurs as a complication among patients undergoing open heart surgery, with its incidence ranging from 20% to 30%. The onset of AKI is linked to increase short- and long-term mortality rates, as well as prolonged hospitalization. Although the underlying mechanisms of open heart surgery–related AKI are not fully understood, they likely result from a combination of preexisting health conditions and perioperative physiological stressors.

Diagnosis of AKI typically relies on elevated serum creatinine levels or reduced urine output and is classified using standardized criteria, such as those established by the Kidney Disease: Improving Global Outcomes (KDIGO) guidelines. **(Kolbrink, et al., 2023)**

Open heart surgery–associated acute kidney injury (AKI) is defined by a rapid decline in renal function occurring within hours to days after the surgical procedure. Clinical manifestations often include oliguria or anuria, accompanied by elevated levels of blood urea and serum creatinine, as well as disturbances in fluid and electrolyte balance. It stands as one of the most significant postoperative complications following cardiovascular surgery. **(Pickkers, et al., 2021)**

The incidence of acute kidney injury (AKI) following Open heart surgery varies significantly, largely due to the use of differing diagnostic criteria. Currently, the two most commonly applied systems in clinical settings are the Acute Kidney Injury Network (AKIN) criteria and the Kidney Disease: Improving Global Outcomes (KDIGO) guidelines.

Accordingly, the present study was designed to assess the incidence of AKI in postoperative cardiac surgery patients using both classification systems, taking into consideration changes in serum creatinine levels and urine output within the first 72 hours after surgery. **Machado, et al., 2020).**

Acute kidney injury (AKI) poses a substantial barrier to recovery after Open heart surgery and is often linked to secondary dysfunction in other vital organs, including the brain, lungs, and gastrointestinal tract. Moreover, it significantly elevates the risk of mortality during hospitalization. Multiple pathophysiological mechanisms are implicated in the development and progression of AKI, such as renal ischemia, reperfusion damage, systemic inflammation, hemolysis, oxidative stress, cholesterol emboli, and nephrotoxic exposures. While preventive options are still limited, current evidence emphasizes the value of maintaining sufficient renal perfusion and intravascular volume, avoiding venous

congestion, preferring balanced crystalloid solutions over high-chloride fluids, and minimizing exposure to cardiopulmonary bypass whenever feasible. **(Howitt, et al.., 2020)**

Acute kidney injury (AKI) is a serious postoperative complication that frequently necessitates prolonged hospitalization and intensive monitoring. To reduce the negative outcomes linked to AKI, there is a pressing need for more rapid and precise diagnostic approaches. In the future, the discovery and clinical validation of specific renal injury biomarkers are anticipated to supersede conventional creatinine-based methods as the standard for AKI diagnosis. **(Wiersema, et al. 2020).**

The unique aspects of cardiac surgery—including cardiopulmonary bypass (CPB), aortic cross-clamping, substantial transfusion of blood products, and the use of high-dose vasopressors—are major contributors to the increased risk of acute kidney injury (AKI) in these patients, compared to those undergoing non-cardiac surgeries. **(Makris, 2020).**

Significance of the study:

Acute kidney injury (AKI) occurring during Open heart surgery results in increased creatinine levels in 10% to 20% of adult patients and is linked to postoperative complications and mortality. **(Gameiro,etal., 2021; Dragan** & **Seghrouchni, et al., 2024).** Correcting deviations in key indicators of kidney function, including creatinine levels and GFR is crucial. Studies in Morocco reported AKI incidence between 11.4% and 18% during cardiac surgery. **(Matteucci et al., 2020).** The occurrence rate of acute kidney injury (AKI) among patients undergoing open-heart surgery at Assiut University Heart Hospital is hard to quantify due to poor documentation. Despite its critical nature, AKI remains under-researched in nursing studies at the university. This study aims to assess the incidence and risk factors of AKI in these patients.

Aim of the study:

This study aimed to Explore the incidence and risk factors of acute kidney injury among patients undergoing open heart surgery

Research question:

1. What is the frequency of acute kidney injury in individuals undergoing open-heart surgical procedures?
2. What are the contributing risk factors for acute kidney injury in individuals undergoing open-heart surgical procedures?

Methods

Research design:

A prospective and correlation research design was utilized. The study was conducted based on a selected research design which focuses on exploring and interpreting the meanings that individuals or groups assign to a social or human issue **(Hegazy & Etal 2022)**

Setting of study: This study conducted in cardio-thoracic intensive care unit (12 bed) at Assiut University heart Hospital the cardiothoracic surgical intensive care unit

Patients: A convenience sample of 120 patients who had undergone open-heart surgeries in the Cardiothoracic Surgery Department at Assiut University Heart Hospital over a six-month period was included. The sample consisted adult male and female patients, aged between 18 and 65 years. The data collection period extended from September 2024 to February 2025.

Tools used for data collection

Tool (I): Open Heart Surgery Assessment Tool:

This tool was developed by the researcher after reviewing of the related literatures by **(Govender, et al., 2020 & Matteucci et al., et al. 2020**) and used to evaluate the studied patients based on their demographic and clinical characteristics ,homodynamic state, and hematological assessment &radiological studies to establish baseline data for comparison, this tool was composed of three main parts

Part (I): Demographic and clinical data of open-heart surgery: Demographic information encompassed the patient's code, age, gender, occupation, and educational level. Clinical data was included current medical diagnosis, type of surgical operation, past medical history, patient weight, height, body mass index and smoking status.

Part (II): Assessment of hemodynamic status: This part covered vital signs such as pulse, systolic and diastolic blood pressure, mean blood pressure, and respiratory rate oxygen saturation. In addition to patient temperature.

Part (III): Hematological assessment & radiological studies: This part refers to data related to the results of laboratory investigations
and radiological studies

Tool (II): Occurrence of Acute Kidney Injury Assessment Tool: The tool was constructed by the researcher based on a review of relevant literature **(Gameiro, 2021).**

Part (I): Risk factors assessment tool among patients undergoing open heart surgery: (Preoperative, intraoperative, and postoperative). Pre operation severity of acute illness, chronic comorbidities and emergency surgery Intraoperative complexity of surgery, hemodynamic instability and hypo-\hypervolemia post operation:- c omplexity of surgery, hemodynamic instability and Hypo-\hypervolemia

Part (II): Acute kidney injury assessment this part used by the researcher to assess the frequency of acute kidney injury by using RIFLE criteria.

Which developed by **(Yaqub, et al., 2022**) the RIFLE classification (Risk, Injury, Failure, Loss of kidney function, and End-stage kidney disease) was introduced to define and categorize the severity of acute kidney injury (AKI). This system primarily depends on variations in serum creatinine, glomerular filtration rate (GFR), and/or urine output, and it has been widely adopted in clinical practice**.** demonstrated that the RIFLE criteria. (Risk of renal dysfunction, Injury to kidney, Failure or Loss of kidney function, and End-stage kidney disease).

Tool (III): Open heart surgery patients clinical outcomes: The tool was constructed by the researcher based on a review of relevant literature **(Agarwal et al., 2019), (Andonovic et al ., 2023) & (Yaqub et al., 2022)**

It included the assessment of the duration of mechanical ventilation (MV), the success or failure of weaning trials, and the incidence of complications such as cardiogenic shock and acute kidney injury (AKI). Additionally, it involved the evaluation of the length of hospitalization in the Intensive Care Unit (ICU) and the mortality rate.

Procedures: To accomplish the aim for the study, it passed through the following phases

Preparatory phase:

- Official "Consent was acquired to proceed with the proposed study, enabling the researcher to initiate data collection**.**
- Tools used for data collection were designed based on an extensive analysis of related literature across multiple dimensions, incorporating local and international sources including books, journals, articles, and magazines.

A pilot study: Was conducted and necessary modifications will be done on 12 adult patients of the sample used to assess the clarity and applicability of the developed instruments.

The reliability: The tools were developed after reviewing the literature and were tested for reliability using Cronbach's alpha coefficient.

Content validity: The research tools were evaluated for content validity by a committee of five experts (3) in the field of critical care nursing and (2) cardio-thoracic surgeons in the related domain, and required adjustments were made accordingly. Additionally, the tools were assessed for internal consistency to ensure reliability

Ethical consideration:

Research proposal was approved from Ethical Committee in the Faculty of Nursing, Assiut University on (24\8\2024), with ID approval (1120240857). There was no risk to the study subjects during the implementation of the study. The investigator ensured the confidentiality and privacy of all participants. The purpose and nature of the study were clearly explained to the patients, and their right to refuse participation was emphasized. Verbal informed consent was obtained from all patients who agreed to participate in the study

Implementation phase:

- The data collection period extended from September 2024 to February 2025.
- Data was obtained in cardio-thoracic surgery intensive care unit from each patient underwent open heart study during morning shifts.
- The investigator attended the mentioned setting from 9 am to 8pm in the scheduled days of open heart which is 5 days per week to collect relevant data from studied patients.
- The researcher introduced herself, described the study's goals, and received the patient's verbal consent to take part in the study on a voluntary basis.
- Data collection related to the demographic characteristics of the studied patients were conducted using Tool I, Part (1).
- The clinical data collection for the studied patients was carried out using Tool I, Part (2).
- The investigator monitored the patients before, during, and after the open-heart surgery. The monitoring continued throughout the patient's stay until discharge from the Intensive Care Unit (ICU).
- Complications were assessed both intraoperative and postoperatively using Tool III, which was specifically designed to collect data on potential complications such as arrhythmias, cardiogenic shock, bleeding, infections, and acute kidney injury (AKI). This tool enabled systematic tracking and documentation of any adverse events during the perioperative period.

Statistical design:

Upon completion of data collection, the gathered data were systematically organized, tabulated, and subjected to statistical analysis using an IBM personal computer with the Statistical Package for the Social Sciences (SPSS), version 25. Continuous variables are reported as mean ± standard deviation, and some variables are expressed as median and range. Categorical or integer variables are presented as frequencies and percentages. To compare values between two groups, the Wilcoxon rank-sum test or the Mann–Whitney U test was applied for non-normally distributed variables. One-way ANOVA was employed to compare means across more than two groups. Categorical or integer parameters were compared using the Chi-square test. Correlations between study variables were assessed using correlation coefficients (r).A statistically significant difference was considered at a p-value ≤ 0.05, while a highly statistically A statistically significant difference was defined as a p-value ≤ 0.001.

Results

Table(1): Distribution of Demographic data of the studied patients(n=120)

Item	No.	%
Age (years)		
20<40 years	29	24.2
40-60 years	91	**75.8**
Gender:		
Male	66	**55.0**
Female	54	45.0
Occupation:		
Yes	44	36.7
No	76	**63.3**
Educational level:		
Illiterate	20	16.7
Read and write	7	5.8
Primary	14	11.7
Preparatory	1	.8
Secondary	15	12.5
High education	63	**52.5**
Current medical diagnosis:		
IHD	11	9.2
Valvular disorder	7	5.8
CABG	73	**60.8**
MVR	23	19.2
DVR	5	4.2
AVR	1	.8
Past History: (multi-select)		
Hypertension	85	**70.8**
DM	55	45.8
IHD	17	14.2
Rheumatic heart disease	7	5.8
BMI		
Under weight (18.5)	3	2.5
Normal range (18.5- 24.9)	48	**40.0**
Overweight (25-29.9)	43	35.8
Obese (>30)	26	21.7
Smoking status		
Smoker	21	17.5
Heavy-Smoker	41	34.2
Non-Smoker	58	**48.3**

IHD: Ischemic Heart Disease CABG: Coronary Artery Bypass Graft MVR: Mitral Valve Replacement
DVR: Double Valve Replacement AVR: Aortic Valve Replacement DM: Diabetes Mellitus

Table (2): Distribution of studied patients according to risk factors occurrence (n=120):

Items	Total patients (n=120)		AKI (n=48)	
	No.	%	No.	%
Preparative risk factors:				
Severity of acute illness	29	**24.2**	29	40.3
Chronic comorbidities	30	**25.0**	22	45.8
Emergency surgery	8	6.7	8	16.7
Intraoperative risk factors:				
Pump use (on-pump)	70	**58.3**	37	77.1
Off-pump	50	41.7	11	22.9
Complexity of surgery	21	17.5	20	41.7
Hemodynamic instability	62	**51.7**	35	72.9
Hypovolemia	71	**59.2**	47	97.9
Anemia	34	28.3	34	70.8
Hemorrhage	69	**57.5**	43	89.6
Inflammation	2	1.7	2	4.2
Post-operative risk factors:				
Complexity of surgery	17	14.2	17	35.4
Hemodynamic instability	47	**39.2**	40	83.3
Hypovolemia	93	**77.5**	47	97.9
Inflammation(surgery)	30	**25.0**	22	45.8

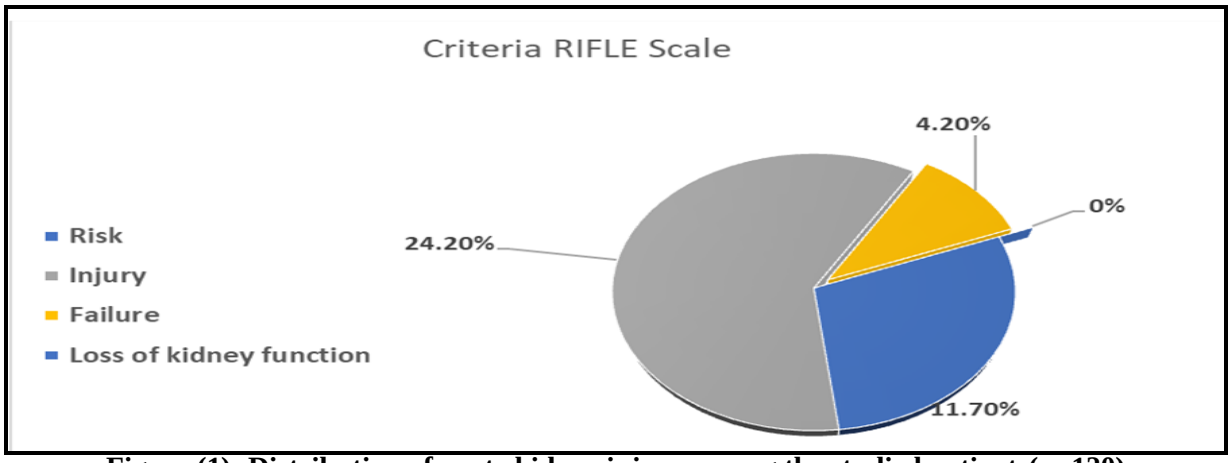

Figure (1): Distribution of acute kidney injury among the studied patients(n=120)

Table (3): Distribution of studied patients according to patient's outcomes assessment (n=120)

Outcomes	Total patients (n=120)		AKI (n=48)		Non-AKI (n=72)		X2	P value
Length of stay (day) Mean ± S. D	5.21 ± 2.27		5.24 ± 2.47		5.17 ± 1.95		(U)1693	850
Mortality	No	%						
Survival	115	**95.8%**	45	93.8%	70	97.2%	.870	351
Died	5	4.2%	3	6.3%	2	2.8%		
Frist weaning trial No (%)								
Success	96	**80.0%**	43	89.6%	53	73.6%	4.592	**032***
Failure	24	20.0%	5	10.4%	19	26.4%		
Number of weaning trial No (%)								
First trial	95	**79.2%**	42	87.5%	53	73.6%	4.250	236
Second trial	11	9.2%	3	6.3%	8	11.1%		
Third trial	12	10.0%	2	4.2%	10	13.9%		
More than three	2	1.7%	1	2.1%	1	1.1		
Occurrence of complication No (72) Patients. (60%)								
Hemodialysis	5	4.2%	5	10.4%	0	0	25.687	**.001****
ARDS	5	4.2%	2	4.2%	3	4.2%		
Arrhythmia	66	**55.0%**	14	29.2%	52	72.2%		
Cardiogenic shock	2	1.7%	1	2.1%	1	1.4		
Duration of mechanical ventilation (day) Mean ± S. D	2.12 ± 1.29		2.18±1.71		2.09± 0.92.		(U)1530	351

(*) Statistically significant at p<0.05. *(**) highly statistically significant at p<0.01.*
U= Mann-Whitney U test. *Mean ± standard deviation*

Table (4): Relationship between hemodynamic state assessment and AKI Incidence pre and post operation (n=120)

Items	Preoperative		X2	P value	Post-operative		X2	P value
	Non-AKI N=72	AKI N=48			Non-AKI N=72	AKI N=48		
Temperature								
Normal (36.0-37.0 C)	72	48	--	--	72	41	11.15	**004****
Hypothermia (35.9 C)	0	0			0	1		
Hyperthermia (37.1 C)	0	0			0	6		
BP								
Normal(100-140) Mmhg	72	45	4.615	**.032***	56	19	18.11	**001****
Hypotension(90\60) mmhg	0	3			15	28		
Hypertension(>140\90) mmhg	0	0			1	1		
MBP								
Normal (70-100)mmhg	72	45	4.615	**.032***	53	21	10.864	**001****
Hypotension(<60) mmhg	0	3			19	27		
Hypertensio >70)mmhg	0	0			0	0		

Items	Preoperative		X2	P value	Post-operative		X2	P value
	Non-AKI N=72	AKI N=48			Non-AKI N=72	AKI N=48		
Respiration								
Normal(12-20)b\m	72	47	1.513	.219	28	9	5.477	**019***
Tachypnea (>20)b\m	0	1			44	39		
Bradypnea(<12)b\m	0	0			0	0		
Pulse								
Normal(60-100)bp\m	71	47	.085	.771	8	8	.769	380
Tachycardia(>100)bp\m	1	1			64	40		
Bradycardia(<60)bp\m	0	0			0	0		
Spo2								
Normal (95-100)%	72	48	--	--	72	48	--	--
Hypoxia <85%	0	0			0	0		

(*) Statistically significant at p<0.05. *(**) highly statistically significant at p<0.01.*
(--) test cannot applied. *MBP:- mean blood pressure*

Table (5): Relationship between risk factor occurrence and AKI Incidence (n=120)

Risk factors	Total no.	Non-AKI	AKI			X2	P value
			Risk	Injury	Failure		
	N=120	N=72	N=14	N=29	N=5		
Preparative risk factors:							
Severity of acute illness	29	0	7	19	3	58.604	**.000****
Chronic comorbidities	**30**	8	6	15	1	29.9	**.000****
Emergency surgery	**8**	0	4	2	2	24.87	**.000****
Intraoperative risk factors:							
Pump use (on-pump)	**70**	33	11	23	3	12.24	**007****
Off-pump	**50**	39	3	6	2		
Complexity of surgery	**21**	1	7	10	3	35.23	**.000****
Hemodynamic instability	**62**	27	11	21	3	14,98	**002**
Hypovolemia	**71**	24	13	29	5	49.93	**.000****
Anemia	**34**	0	6	25	3	80.223	**.000****
Hemorrhage	**69**	26	12	26	5	34.01	**.000****
Inflammation	**2**	0	1	1	0	4.42	219
Post-operative risk factors:							
Complexity of surgery	**17**	0	4	11	2	30.48	**.000****
Hemodynamic instability	**47**	7	13	22	5	67.292	**.000****
Hypovolemia	**93**	46	13	29	5	19.414	**.000****
Inflammation(surgery)	**30**	8	6	13	3	19.135	**.000****

(**) highly statistically significant at p<0.01

Table (6): Correlation between AKI incidence and outcomes of the studied patients (n=120):

		length of stay (day)	Mortality	Duration of mechanical ventilation (day	First Weaning Trial	Number of Weaning Trial	Occurrence of complication
Acute Kidney incidence	**r**	.015	.085	.034	-.196	.167	463
	p	.870	.355	.710	**.032***	.069	**.001****
	test	Point biserial correlation	Phi	Point biserial correlation	Phi	Spearman	Cramer's V

(*) Statistically significant at p<0.05. (**) highly statistically significant at p<0.01.

As shown in Table (1): Illustrates that regarding, 61.7% among the patients under study have age ranged 40- 60 years, 55% are male, 63.3% have no occupation and 52.5% have a high education level. Regarding current medical diagnosis 60.8% of the studied patients are CABG and 70.8% of them have past medical history of hypertension. Also, the current study illustrated that 40% of them have 18.5-24.9 regarding BMI and 48.3% of them are non-smoker.

Table (2): Clarifies that regarding preoperative risk factor occurrence, 24,2% of total studied patient have severity of acute illness and 25% of total patients have chronic comorbidities. As regard to intraoperative risk factors 58.3% of the total studied patients have on-pump use, 51.7% of them have hemodynamic instability, 59.2% have hypovolemia and 57.5% of total patients have hemorrhage. Regarding post-operative risk factors 39.2% of total studied patients have hemodynamic instability, 77.5% of them have hypovolemia and 25% of them have inflammation.

Figure (1): Shows that: the patients were categorized into two groups according to the RIFLE classification: the AKI group included 48 patients (40%) diagnosed with acute kidney injury, while the non-AKI group comprised 72 patients (60%) without evidence of AKI. Furthermore, the AKI group was sub-classified based on the RIFLE criteria as follows: Risk (n = 14, 11.6%), Injury (n = 29, 24.2%), Failure (n = 5, 4.2%), and Loss of kidney function (n = 0, 0%)

Table (3): Indicates that, the mean ± standard deviation of their length of hospital stay is 5.21 ± 2.27 day and the mean ± S.D of their duration on mechanical ventilation is 2.12 ± 1.29 day. Regarding mortality, 95.8% of the studied patients are survival and 80% of them success first weaning trial. As regard of number of weaning trials 79.2% of total patients have first trial of weaning. Furthermore, 55% of them have arrhythmia as regard to occurrence of complication

Table (4): Shows the findings indicate a statistically significant association between the incidence of AKI and the patients' blood pressure (BP) and mean blood pressure (MBP) during the preoperative phase. Additionally, a highly statistically significant relationship was observed between AKI and the patients' temperature, BP, and MBP in the postoperative period. Furthermore, a statistically significant correlation was found between the incidence of AKI and the patients' respiratory rate after surgery .

Table (5): Clarifies that there is a highly statistically significant relationship between the occurrence of preoperative risk factors and AKI incidence, and between intraoperative risk factors occurrence except inflammation and AKI incidence as well as between postoperative risk factors and AKI incidence ($p< 0.001$**).

Table (6): Clarifies high level of statistical significance positive correlation between AKI and occurrence of complication ($r=.463$, $p<.001$). Also, A statistically significant negative correlation was found between AKI and success of first weaning trial ($r= -.196$, $p=.032$).

Discussion

Acute Kidney Injury (AKI) represents a common and serious clinical complication that can arise following open heart surgery, significantly impacting patient outcomes, prolonged hospital stays and increased overall mortality. The incidence of AKI in this surgical population varies widely, with studies reporting rates ranging from 15% to over 30%,depending on the diagnostic criteria and individual patient characteristics, the incidence of AKI varies. The onset of AKI during the perioperative period not only elevates the risk of progression to chronic kidney disease (CKD), but also imposes a significant strain on healthcare systems due to increased requirements for intensive care management and renal replacement therapy, and prolonged recovery **(Francescato, 2024).**

Regarding demographic data:

The present study illustrates that regarding AKI group, more than two thirds of AKI group have age ranged 40- 59 years, more than half are male, less than two thirds have occupation and less than half have a high education level. Regarding current medical diagnosis more than half of AKI group are CABG and more than two thirds of them have past history of hypertension. Also, less than half of them have 18.5- 24.9 regarding BMI and. Less than 50% of the patients in the study did not smoke

From researcher point of view, this result might be due to the majority of patients are males due to their higher risk than females due to estrogen hormones effect at females, hypertension are most common chronic disease precipitate AKI .

This result is consistent with the findings of Jabayeva et al. (2024) all individuals included in the sample were assessed using standardized tools to ensure consistencydiagnosed with (AkI) patients were between thirty-one and seventy-four years old and were predominantly male. Moreover, more than one-quarter of the patients reported a previous medical history of hypertension, and their body mass index ranged from twenty-five point six to thirty point five.

On disagreement with this study, **Stephan, et al., (2022).** studied the impact of radial access on contrast-induced acute kidney injury in patients who underwent coronary artery bypass grafting reported that more than half of the studied sample..." are females, majority of patient with AKI had previous vulvar heart diseases. Also with **Wang, et al.,(2019).**Who investigated independent risk factors for postoperative acute kidney injury (AKI) and its impact on 30-day postoperative outcomes in patients with Type A acute aortic dissection found no significant association between body mass index (BMI) and the development of AKI**.**

Regarding distribution of risk factor:

The present study showed, percentage distribution of the studied patients regarding risk factor occurrence, the current study revealed that **preoperative risk factors** occurrence, less than one quarter of total studied patient have severity of acute illness and one quarter of total patients have chronic comorbidities. As regard to **intraoperative risk factors** less than two thirds of the total studied patients have on-pump use, more than half of them have hemodynamic instability, less than two thirds have hypovolemia and over half of the studied

patients developed hemorrhagic complications. Regarding **post-operative risk factors** more than one third of total studied patients have hemodynamic instability, more than three quarters of them have hypovolemia and one quarter of they have inflammation

From researcher point of view, the findings highlight the multifactorial nature regarding the risk of Acute Kidney Injury (AKI) in patients undergoing open-heart surgery with significant contributions from a range of preoperative, intraoperative, and postoperative variables are involved. The substantial presence of risk factors in the intraoperative and postoperative phases such as hypovolemia, hemodynamic instability, and hemorrhage emphasizes the need for vigilant perioperative monitoring and prompt intervention. Addressing these modifiable risks through comprehensive care strategies can potentially decrease the risk and extent of AKI, contributing to improved clinical outcomes

Conduct a study with a research done by Yang, et al., (2021) whoA study investigating the risk factors for acute kidney injury (AKI) following coronary artery bypass graft (CABG) surgery in a Chinese population, along with the development of a predictive model, reported a strong association between the occurrence of AKI and several factors. These included advanced age (>65 years), presence of diabetes, use of on-pump surgical techniques, transfusion of more than one unit of red blood cells, and prolonged mechanical ventilation. Additionally, patients aged over 65 years with a preoperative estimated glomerular filtration rate (EGFR) ≤ 60 ml/min were identified as having a higher risk of developing cardiac surgery-associated acute kidney injury (CSA-AKI).**Also on agreement with (Hu , et al ,.(2022).** who Investigated the incidence, associated risk factors, and clinical outcomes of acute kidney injury among critically ill patients undergoing emergency surgical procedures. and find most prevalence of intra- and post-operative risk factors are hypovolemia, hemodynamic instability.

Regarding the incidence of acute kidney injury:

The present study show classification based on the RIFLE criteria for defining AKI, the current study demonstrated that the patients were categorized into two groups: the AKI group, which included 48 patients diagnosed with acute kidney injury, and the non-AKI group, comprising 72 patients without evidence of AKI. Furthermore, the AKI group was sub classified according to the RIFLE classification as follows: minority of them is risky, Injury (less than one quarter), Failure (minority), and Loss of kidney function (nothing).

This result might be due to this distribution indicates that while AKI is prevalent among a notable proportion of patients, its severity may be mitigated with appropriate and timely management. It also the RIFLE classification as a useful tool not only for diagnostic purposes but also for monitoring disease trajectory and tailoring individualized care.

This result agrees with **Erawanet al., (2021)** who applied study entitled " A "RIFLE Criteria for Acute Kidney Injury in Burn Patients: Prevalence and Risk Factors and reported that the majority of AKI cases were classified in the Risk and Injury stages, with very few in Failure and none in Loss, aligning with your study's findings.

This study result agreed with **Bellomo et al., (2024).** who studied RIFLE classification for sepsis-associated Acute Kidney Injury: Its incidence, clinical impact, and associated mortality, and reported that approximately 1 in 6 ICU patients experienced AKI, with most cases categorized as "Risk" and "Injury" within the RIFLE framework, while fewer patients progressed to "Failure." Notably, the study confirms that urine-output-defined AKI (often early stages) had substantially lower mortality compared to creatinine-based or combined criteria.

Regarding distribution outcomes:

Regarding mortality, the majority of the studied patients survived, and most of them succeeded in the first weaning trial. In terms of the number of weaning attempts, more than three-quarters of the patients underwent only one weaning trial. Furthermore, more than half of the patients developed arrhythmia as a recorded complication during their hospital stay.

Also the study revealed that most patients had a short hospital stay and a moderate duration on mechanical ventilation, with the majority successfully completing the first weaning trial. However, over half of the patients experienced arrhythmia as a complication. These findings suggest that while recovery was generally favorable, managing arrhythmia and minimizing complications should remain a priority in postoperative care.

This is in line with a research done by (**Yang, et al., (2021)** who examined the risk factors for acute kidney injury (AKI) following coronary artery bypass graft (CABG)surgery in a Chinese population, along with the development of a predictive model, reported an AKI incidence rate of 50%. All 15 recorded deaths occurred in patients who had developed AKI. Although AKI was not identified as the direct cause of death, varying degrees of renal dysfunction were considered indicative of concurrent multi-organ impairment. For AKI patients without hypovolemia or low cardiac output syndrome (LCOS), early initiation of bedside continuous renal replacement therapy (CRRT) may be beneficial—particularly in cases with poor diuretic response—potentially reducing postoperative mortality and associated

complications. **Also in agreement with Amini, etal, (2019).** Who studied Factors associated with the development and prognosis of acute kidney injury after isolated CABG surgery and find most prevalence complications post-operative are arrhythmias.

According to relationship between hemodynamic state assessment and AKI Incidence:

The present study showed that the Pre, intra and post operation, the current study demonstrated a statistically significant association between the incidence of acute kidney injury (AKI) and patients' blood pressure (BP) and mean blood pressure (MBP) in the preoperative phase. Furthermore, a highly statistically significant relationship was observed between AKI and additional clinical parameters. The studied patients' temperature, BP and MBP at post operation. Furthermore, there is a statistically significant relation between AKI incidence and the studied patients' respiration post operation.

The findings suggest that a Statistically significant association between Acute Kidney Injury (AKI) incidence and hemodynamic parameters, such as blood pressure (BP), mean blood pressure (MBP), temperature, and respiration, both pre- and post-operation. These results indicate the importance of maintaining stable hemodynamic conditions during the surgical period to help prevent the onset of AKI Monitoring vital signs closely could help prevent kidney injury in surgical patients.

This is in line with a research done by Luther, (2023) who studied research focusing on renal perfusion and oxygen dynamics in the context of AKI during severe infections revealed a significant relation between AKI occurrence and hemodynamic indicators. **Also in agreement with Amekoudi, et al., (2024).** A study conducted on the risk factors for mortality in acute kidney injury (AKI) in intensive care units reported a statistically significant association between the incidence of AKI and several clinical variables and hemodynamic parameters, such as blood pressure and body temperature.

According to relationship between risk factors occurrence and AKI Incidence:

The current study demonstrated a highly statistically significant association between occurrence of preoperative risk factors and AKI incidence, and between intraoperative risk factors occurrence except inflammation and AKI incidence as well as between postoperative risk factors and AKI incidence.

This might be as result of the relationship between the occurrence of risk factors and AKI incidence preoperative risk factors such as chronic comorbidities (e.g., hypertension, diabetes) or severe acute illnesses may compromise baseline renal function, reducing the kidneys' ability to cope with additional stress. During surgery, factors like hemodynamic instability, blood loss, and the use of cardiopulmonary bypass can directly reduce renal blood flow, leading to ischemia and further kidney injury. In the postoperative phase, continuing hemodynamic fluctuations and complications such as hypovolemia contribute to the progression of AKI. These risk factors, individually and synergistically, create a hostile environment for renal perfusion and function, which helps explain their strong association with AKI incidence observed in the study.

Li, et al., (2021). who studied identification of predictors for acute kidney injury after coronary artery bypass grafting in a Chinese cohort and the formulation of a predictive model. And find a significant relation between AKI incidence and pre-post-operative risk factors. **Also in agreement with Pabla (2024).** who studied Development and Validation of Models to Predict the Risk of Major Cardiovascular Events and Death in Individuals with Kidney Failure Undergoing Non-Cardiac Surgery" reported a statistically significant association between the incidence of acute kidney injury (AKI) and several clinical variablespre-post-operative risk factors.

Regarding correlation between AKI incidence and outcomes:

The current study revealed that among the studied patients, there was a highly statistically significant positive correlation between the occurrence of acute kidney injury (AKI) and the development of postoperative complications. In contrast, a statistically significant negative correlation was observed between AKI and success of first weaning trial.

This might be due the incidence of AKI increases, so does the risk of postoperative complications. Moreover, the statistically negative correlation between AKI and the success of the first weaning trial suggests that Patients suffering from AKI are less likely to achieve successful weaning from mechanical ventilation on their initial attempt. These observations emphasize the vital importance of timely identification and effective intervention of AKI to improve clinical outcomes and optimize patient recovery in the postoperative setting.

This result also in agreement with Stephan, et al., (2022). who studied The influence of radial access on the incidence of contrast-induced acute kidney injury in patients undergoing coronary artery bypass grafting and reported that statistically positive correlation between AKI and occurrence of complication.

Conclusion:

1. The current study show that acute kidney injury represents a significant complication following open-heart surgery, occurring more frequently in male patients.

2. Acute kidney injury (AKI) continues to be a prevalent and severe postoperative complication in patients undergoing open-heart surgery, substantially affecting both morbidity and mortality rates.

Recommendation:

1. Strict hemodynamic monitoring and important of renal function test and renal output.
2. Educating healthcare providers on early AKI detection and perioperative care helps reduce AKI risk after open heart surgery.

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