Intraoperative nursing safety precautions for open heart surgery patients on cardiopulmonary bypass machine

Shimaa Taha Badwy Rateb[1], Mona Aly Mohamed[2] & Naglaa Ahmed Ahmed[3]
[1.] Professional Nurse at Heart Hospital, Assiut University, Assiut, Egypt,
[2.] Assistant Professor of Critical Care Nursing Department, Faculty of Nursing, Assuit University Egypt,
[3.] Assistant Professor of Critical Care Nursing Department, Faculty of Nursing, Assuit University Egypt,

Abstract

Background: Cardiopulmonary bypass machine is a machine that takes over the function of the heart and lungs during open heart surgeries. It incorporates an extracorporeal circuit to provide physiological support with safety precautions to deliver optimum patient care. **Aim of the study:** To assess intraoperative nursing safety precautions for open heart surgery patients on cardiopulmonary bypass machine in cardiac surgery unit. **Research design:** Descriptive research design was adopted to conduct this study. This study was conducted in cardiac surgery unit, Heart Hospital of Assuit University. **Subjects** A convenient sample of 60 adult male and female patients who presented for undergoing cardiac surgery using cardiopulmonary bypass machine in addition to 20 critical care nurses acts as a perfusionist and willing to participate in the study. **Tools:** Patient assessment sheet and nursing safety precaution assessment sheet was used. **Results:** Most of nurses (90%) had satisfactory performance for patient safety, while Assessment of possible complications during cardiopulmonary bypass machine, founded that off 21 studied complications Arrhythmias is the commonest complication present in 11of studied patients.in cardiac surgery unit. **Conclusion:** Critical care nurses in cardiac surgery unit had satisfactory performance for patient safety. **Recommendations:** Perfusion safety and communication with the whole team must be at the highest level. In line with this information, the use of these systems can become standard in cardiac surgery.

Keywords: Cardiopulmonary bypass, Machine, Cardiac surgery & Nursing safety precautions.

Introduction

Open heart surgery including Coronary artery bypass grafts surgery (CABG), or valve replacement surgery can be performed either with cardiopulmonary bypass machine, which exposes the blood to a non-physiological environment, or on beating heart without cardiopulmonary bypass support. One of the most challenging aspects of coronary artery bypass grafting surgery is the management of high-risk patients and management of possible complications due to cardiopulmonary bypass machine to achieve acceptable morbidity, mortality, and quality of life **(Andrea, 2020)**

Nursing safety precautions during cardiopulmonary bypass surgery begins with the perfusionists and critical care nurses experience and knowledge of all the possible errors that may occur. This knowledge fosters the anticipation of problems and promotes vigilance safety precautions for prevention of possible complications which may occur as a result of cardiopulmonary bypass machine**. (Mohammed, 2020)**

Complications of Cardiopulmonary Bypass due to its mechanical components and interactions with blood, CPB can cause significant changes in the body. Factors such as contact between artificial materials

and blood, continuous flow, haemodilution, hypothermia and anticoagulation affect all organs during CPB, and may result in various complications. The main complications of CPB include bleeding, low cardiac output, arrhythmias, respiratory failure, renal failure, neurological or neuropsychiatric changes, fluid and electrolyte imbalances, hemolysis, systemic inflammatory response syndrome, and inflammation**. (Bisar, et al, 2021)**

The highly qualified nursing perfusionist is a highly trained individual has undergone years of instruction to operate the heart lung machine. He or she also operates the cell saver, a machine that processes any blood loss so that the patient's own blood can be given back to them. The anesthesiologist (a physician), possibly assisted by an anesthetist (a nurse or physician assistant). They insert monitoring lines, administer the general anesthesia to the patient, and act as critical care specialists during the surgery**. (Luc Puis, 2019)**

Nursing safety precautions related to cardiac surgery with cardiopulmonary bypass machine were written with collaboration from the Society of Cardiovascular Anesthesiologists, and an update to these safety precautions that have collaborated on nursing safety precautions for anticoagulation, as Clotting on

cardiopulmonary bypass is life-threatening. Temperature management, acid base balance management, anasethia and monitoring on cardiopulmonary bypass, ultrafilteration during and after cardiopulmonary bypass removes inflammatory mediators and weaning management. These safety precautions provide professional nurses with actionable evidence informed by expert opinion, to achieve acceptable morbidity, mortality, and quality of life. **(Ambra, 2020)**

Significance of the study
According to Assiut cardiothoracic surgery department records total cardiac procedures are 358 including 296 adult cardiac surgeries and 62 congenital cardiac surgeries. Total thoracic procedures are 108 including 75 conventional open procedures and 33 procedures through video assisted thoracic Surgeries approach. They performed 178 endoscopic procedures including Esophagoscopes and bronchoscopes. From 296 adult cardiac surgeries there were 142 coronary artery bypass graft surgery and 116 Valvular surgery. **(Kareem & Ali, 2021)**
According to this study which done on 60 patients who performed open heart surgery using cardiopulmonary bypass machine, assessment of intraoperative safety precautions by 20 critical care nurses acts as cardiac perfusionists using scoring system founded that unsatisfactory level presented in just 10% of total nurses and with maximum score <85%, while satisfactory level presented in 90% of them with maximum score≥85% and with Mean±SD(range) 85±3.57(75-89).

Aim of the study
To assess intraoperative nursing safety precautions for open heart surgery patients on cardiopulmonary bypass machine.

Research question:
To fulfill the aim of this study, the following research questions are formulated: -
1. What are the different risk factors for cardiopulmonary bypass related injury among critically ill patients?
2. What are the different complications of cardiopulmonary bypass appearing on critically ill patients at Assiut University Hospital during the pre-determined data collection period?
3. What are the different management actions and nursing safety precautions performed to such group of patients during the pre-determined data collection period?

Research Design:
Descriptive research design was adopted to conduct this study.

Sampling and setting
Setting: -
This study was conducted in the cardiothoracic surgery unit at cardiac Assuit university hospital.
Sample: -
Convenient sample of 60 adult male and female patients who presented to cardiothoracic unit for undergoing cardiac surgery using cardiopulmonary bypass machine were included in addition to 20 critical care nurses acts as a perfusionist who are willing to participate in the study. except those patients mentioned in the exclusion criteria.

Inclusion criteria
- Aged 18–60years.
- Coronary artery bypass grafting patients.
- Aortic valve replacement/repair patients.
- Mitral valve replacement/repair patients.
- Tricuspid valve replacement/repair patients.
- In addition to critical care nurses whom are also willing to participate in this study.

Exclusion criteria:
- The exclusion criteria are as follow:
- patients with previous open-heart surgery.
- Patients with high bleeding tendency.
- patients with associated aneurysm of the left ventricle or ischemic ventricular septal defect with recent cardiac infarction.

Tools of data collection
Four tools were utilized to collect necessary patients' data:
Tool one: -   risk factors for complications assessment sheet
This tool will be developed by researcher to assess condition of the patient and composes of four parts.

Part 1: Patient characteristics
It includes the assessment of preoperative demographic data including (age, sex), in addition to clinical data which include (weight, hight, body mass index, patient diagnosis, ejection fraction, type of operation. **(Andrea ,2020)**

Part 2: Assessment of preoperative hemodynamic and biomedical data
This part was included: Assessment and monitoring of hemodynamic variables and vital signs (temperature, heart rate, respiratory rate, venous blood pressure, arterial blood gases, blood pressure) and assessment of computerized tomography chest (CT Chest). Assessment and monitoring of intake and output balance **(Luc Puis, 2019) . (Mihajlo, 2020)**

Part 3: laboratory tests findings during preoperative period.
This part refers to data related to the results of laboratory investigations (complete blood count, serum albumin or liver function tests and serum electrolytes, renal function test, arterial blood gases,

coagulation test including, INR, PT, PTT, and blood sugar test.) *(Mohammed, 2020)*

Part 4: Assessment of intraoperative cardiopulmonary bypass machine data.

This part was including assessment and monitoring of the patient on cardiopulmonary bypass machine for the following data. **(Luc Puis, 2019).**

- Ischemic time.
- Recuric time.
- Total cardiopulmonary bypass time.

Tool Two: Adult cardiopulmonary bypass complications assessment sheet

This part refers to assessment of possible complications due to cardiopulmonary bypass machine, including the assessment of; respiratory complication as pulmonary hypertension, acute lung injury

Cardiovascular complication as myocardial stunning, myocardial infarction Right ventricular dysfunction, arrhythmias, heart block, systemic multi organ dysfunction syndrome.

Neurological complication as stroke, neurocognitive impairment

Electrolytes and endocrine complication as hypothermia, hyperglycemia. Renal complication as acute kidney injury, cold diuresis, electrolyte derangement.

Hematological complication as coagulopathy, bleeding, anemia **(Manjula, 2017), (Alfred, et al 2022).**

Tool three: Nursing safety precautions assessment sheet.

- This part was including assessment of nursing safety precautions during surgery for patients on cardiopulmonary bypass machine using scoring system.
- Nursing safety precautions consists of four main items each item divided into steps, each step takes a score ranging from 0 to 2, minimum score is 0 (not apply), medium score is1 (need improve) and maximum score is 2 (well done).
- Total steps in four items which include Safety precautions regarding infection control, Safety precautions regarding preparation of the patient and environment, Safety precautions regarding setup of CPB Machine, Safety precautions regarding weaning from CPB Machine   are 45 steps their total score is 90, scoring system transformed into percent:**(< 85% unsatisfactory), (>= 85% satisfactory). (Wahba, et al 2019) (Akhtar, et al, 2021)**

Methods:

The study field of work was carried out through the following phases:

Preparatory phase:

Ethical considerations:

An official letter approval from dean of the faculty of nursing was sent to the director of Heart Assuit University Hospital. This letter included a brief explanation of the objectives of the study and permission to carry out the study. Verbal consents were obtained from patients about their participation. The aim of the study was explained to every patient before participation. Permission for voluntary participation was obtained from nurses and the nature and purpose of the study was explained by the researcher.

Field work:

Data collected through a period of seven months, from first of November 2021 to the end of May 2022. Data which was totally voluntary and oral consent was obtained

A pilot study:

Pilot study was conducted and involved 10% of sample size, feedback and problems experienced during the pilot implementation were discussed.

Validity and reliability of tools:

Content validity of tools were reviewed by two jury experts, two of them in the field of critical care nursing, department for revision of its content validity and clarity.

Assessment Phase

- The studied sample fulfilling the research criteria including patients undergoing open heart surgery using cardiopulmonary bypass machine in addition to high qualified critical care nurses acts as cardiac perfusionists.
- Each patient involved in the study assessed by the researcher using first and second tool including six pats. Assess patient sociodemographic and medical data from patient file and then assess hemodynamic status on admission base line data.
- The researcher assessed baseline hemodynamic status for all patients preoperative and during the operation.
- The researcher assessed patient demographic data including (age, sex), in addition to clinical data which include (weight, hight, body mass index, patient diagnosis.
- The researcher assessed and monitored patient for hemodynamic variables and vital signs during preoperative and intraoperative periods (temperature, heart rate, respiratory rate, systolic and diastolic blood pressure and blood gases.
- The researcher assessed Patient for possible complications
- The researcher assessed critical care nurses for safety precautions during surgery for patients on cardiopulmonary bypass machine using scoring

system in tool three. For safe conduct of cardiopulmonary bypass machine, temperature management, anticoagulation, anesthesia and monitoring, ultrafilteration, acid base balance and weaning management through observation of nursing performance by a nursing performance check list of daily routine of care.

Statistical analysis:
Data entry and data analysis were done using SPSS version 19 (Statistical Package for Social Science). Data were presented as number, percentage, mean± standard deviation.

Results:

Table (1): Distribution of Patients demographic data for Study sample (n=60)

	No	%
Age group		
<50 years'	21	35.0
>50 years	39	65.0
Mean ±SD (range)	**50.92±11.19(21-60)**	
Sex		
Male	41	68.3
Female	19	31.7
Hight	159.75±10.48(100-177)	
Weight	73.04±13.93(43-105)	
BMI	22.88±4.31(14.3-38)	
BMI Level		
Normal Wight	16	48.3
Overweight	24	48.7
Obese	20	33.3

Table (2): Distribution of Patients Clinical data for Study sample (n=60)

	No	%
Diagnosis		
Ventricular septal rupture	1	1.7
Valvular heart disease	28	46.7
Ischemic heart disease	29	48.3
Ischemic heart. Valvular heart disease	2	3.3
Medical history		
Hypertension	19	31.7
Diabetes	16	26.7
Rheumatic heart	24	40.0
Hepatitis C Virus	7	11.7
Congestive heart failure	7	11.7
Echocardiography.		
Normal	33	55.0
Abnormal	27	45.0
Electrocardiogram.		
Normal	49	81.7
Abnormal	11	18.3
Pressure		
Normal	60	100.0

Table (3): Adult cardiopulmonary bypass complications assessment sheet (n=60)

	No	%
Respiratory complication		
Pulmonary hypertension	5	8.3
Acute lung injury	0	0.0
Cardiovascular complication		
Myocardial stunning	0	0.0
Myocardial infarction	0	0.0
Right ventricular dysfunction	0	0.0
Arrhythmias	11	18.3
Heart block	0	0.0
Systemic MODS	0	0.0
Neurological complication		
Stroke	0	0.0
Neurocognitive impairment	0	00
Electrolytes and endocrine complication		
Hypothermia	0	0.0
Hyperglycemia	10	16.6
Renal complication		
Acute kidney injury	6	10
Cold diuresis	0	0.0
Electrolyte derangement	0	0.0
Hematological complication		
Coagulopathy	0	0.0
Bleeding	7	11.6
Anemia	7	11.6

Table (4): Correlation Co-efficient between Socio demographic and Medical data with Patients Complication (n=60)

		Age	Sex	Education	BMIL	Diagnosis	Medical History
Pulmonary hypertension	R	0.050	0.054	-0.155	-0.022	0.143	.275*
	P	0.707	0.682	0.238	0.866	0.274	0.034
Acute lung injury	R	-0.011	-0.089	0.022	0.160	-0.131	-0.185
	P	0.931	0.501	0.869	0.221	0.317	0.158
Myocardial stunning	R	0.149	0.191	-0.199	-0.016	0.233	-0.096
	P	0.256	0.143	0.127	0.903	0.073	0.465
Arrhythmias	R	.264*	-0.045	-0.139	0.186	-0.159	0.253
	P	0.041	0.734	0.289	0.156	0.226	0.051
Neurocognitive impairment	R	0.052	0.008	-0.092	0.085	0.052	-0.034
	P	0.695	0.950	0.486	0.520	0.691	0.797
Hyperglycemia	R	0.072	-0.112	0.222	0.132	-.286-*	0.079
	P	0.583	0.394	0.089	0.314	0.027	0.547
Acute kidney injury	R	.274*	0.012	-0.129	.335**	-0.078	-0.227
	P	0.034	0.928	0.324	0.009	0.555	0.082
Coagulopathy	R	-0.231	0.173	0.038	-0.019	0.194	0.029
	P	0.075	0.187	0.772	0.886	0.137	0.824
Haemolysis	R	0.190	-0.038	-0.069	0.058	-0.146	.354**
	P	0.145	0.771	0.601	0.662	0.266	0.006
Anemia	R	0.241	0.054	0.052	0.208	-0.081	.257*
	P	0.064	0.682	0.692	0.111	0.541	0.048

Statistically Significant Correlation at P. value <0.05,   Statistically Significant Correlation at P. value <0.01

Table (5): Assessment of vital signs during Preoperative and Intraoperative periods (n=60)

	Pre		Intra		P. value
	Mean±SD	**Range**	**Mean±SD**	**Range**	
Temp	36.69±0.29	36-37	36.5±0.29	36-37.3	0.001**
Pulse	101.42±13.06	70-122	106.43±15.23	67-130	0.055
Resp	21.52±4.72	14-33	23.58±3.99	16-36	0.011*
Systolic Blood pressure	115.48±17.9	90-160	112.36±18.32	80-161	0.348
Diastolic Blood pressure	68.93±11.2	50-98	66.02±10.86	50-99	0.150

Independent T-test quantitative data between the Two Mean
*Statistically Significant difference at P. value <0.05,   **Statistically Significant difference at P. value <0.01

Table (6): Assessment of ABG (Arterial blood gases) (n=60)

	Preoperative		Intraoperative		Value
	No	**%**	**No**	**%**	
PH					
Normal	60	100.0	60	100.0	-
Pao2					
Normal	60	100.0	60	100.0	-
Paco2					
Normal	60	100.0	60	100.0	-
Hco3					
Normal	60	100.0	60	100.0	-
HCT					
Normal	60	100.0	51	85.0	
High	0	0.0	0	0.0	0.002**
Low	0	0.0	9	15.0	

- Chi square test for qualitative data between the two groups or more
**Statistically Significant difference at P. value <0.01

Table (7): Descriptive of total Nursing safety precautions assessment sheet

	Max Score	**Mean ±SD**	**Range**	**Mean%**	**Level of performance**
Safety precautions regarding infection control assessment by scoring system.	8	7.35±0.88	5-8	91.9	Satisfactory
Safety precautions regarding preparation of the patient and environment assessment by scoring system.	16	15.05±1	13-16	94.1	Satisfactory
Safety precautions regarding setup of CPB Machine assessment by scoring system.	42	39.95±2.04	33-42	95.1	Satisfactory
Safety precautions regarding weaning from CPB Machine assessment by scoring system.	24	22.65±1.42	19-24	94.4	Satisfactory
Total Nursing safety precautions score	90	85±3.57	75-89	94.4	Satisfactory

Table (8): Distribution of Level of performance for Nursing safety precautions for Study Nursing (N=20)

Level of performance for Nursing safety precautions	**Max Score**	**No**	**Level of satisfactory %**
Unsatisfactory	<85%	2	10.0
Satisfactory	≥85%	18	90.0
Mean±SD(range)	90	85±3.57(75-89)	

Table (1): Illustrates Characteristics of the studied subjects in relation to their profile and risk factors. the mean age of the studied patients which are from 21 to 60 years was found to be more than half of them their age were above 50 Yrs. respectively with no statistical significance difference between them. Concerning the gender of the sample, 68.3% of the studied patients were males and 31.7% of them were females. Regarding weight and body mass index About, 48.7% of the studied patients were overweight and about 48.3% were normal weight and about 33.3% were obese.

Table (2): Shows that (48.3%) of the patients indicated for coronary artery bypass graft surgery (CABG) with cardiopulmonary bypass machine were diagnosed with Ischemic heart disease with a medical history of   Hypertension in a percent of 31.7%. Whereas (46.7%) of the studied patients were diagnosed with valvular heart disease (VHD) indicated for mitral, tricuspid, aortic valve repair surgery with cardiopulmonary bypass machine with a medical history of rheumatic heart disease in a percent of 40%. With an Echocardiography normal in a percent of 55%and abnormal in 45%of patients and an electrocardiogram was normal in 81.7 % of patients and with normal pressure in all patients.

Table (3): Shows assessment of possible complications during cardiopulmonary bypass machine, including the assessment of; Cardiac arrhythmias. Bleeding. Cardiac arrest. Pulmonary dysfunction. Renal failure. Central nervous system complications.   Founded that   off 21 studied complications Arrhythmias   is the commonest complication present in 11of studied patients and account for 18.3% of all patients followed by hyperglycemia present in 10 op patients with a percent of   16.6%, Followed by bleeding and Anemia present in 7 0f patients with a percent of 11.6%, Followed by Acute kidney injury present in 6 of patients with a percent of 10%, Followed by Pulmonary hypertension which present in 5 of patients with a percent of 8.3%.

Table (4): Shows relationship between socio demographic and Medical data with Patients Complication it was founded that there was a statically significant positive correlation between patient Sociodemographic data and medical data (Age and past medical history) and intraoperative cardiac arrhythmia with (respectively P= 0.041*, P=0.034*). The results also revealed a statically significant positive correlation between patients' body mass index (obesity) and acute kidney injury with (P=0.009**). There is also statistically significant positive correlation between patients' past history, medical diagnosis and intraoperative hyperglycemia with (P=0.027*). There is also statistically significant

positive correlation between patients' past history and intraoperative hemolysis and anemia with (respectively P= 0.006**, P=0.048*).

Table (5): Shows vital signs during the periods before conduct of cardiopulmonary bypass machine and during surgery founded that 60 cardiac surgery patient presented with normal ranges of vital signs regarding temperature ranging from 36-37with Mean±SD of 36.69±0.29pre bypass and ranging from36-37.3 with Mean±SD36.5±0.29 with a highly statistical difference between them with P. value 0.001**,   pulse   range   70-122 Mean±SD101.42±13.06pre bypass and range67-130with Mean±SD106.43±15.23 with no statistical difference between them P. value 0.055 , respiration rang 14-33pre bypass and range 16- 36 intra operatively   with **a statistical difference between them P. value** 0.011*.

Table (6): Shows (Arterial blood gases of 60 cardiac surgery patients before conduct and during cardiopulmonary bypass surgery are presented with normal ranges except hematocrit level low than normal ranges in 9 patients due to exposure to loss of blood during surgical procedure with a percent of 15% there was a highly statistical significance difference p. value 0.002**

Table (7): Shows description of nursing safety precautions assessment sheet it consists of four main items, their total score according to their steps was 90 with   Mean ±SD 85±3.57 and satisfactory level of performance.

 Table (8): Shows distribution of total Nursing safety precautions it was founded that unsatisfactory level presented in just 10% of total nurses and with maximum score <85%, while satisfactory level presented in 90% of them with maximum score≥85% and with Mean±SD(range) 85±3.57(75-89).

Discussion

Nursing safety precautions on cardiopulmonary bypass defined as "the avoidance of unnecessary incidents that result in adverse patient outcomes." These incidents fall into four main categories: Defective or malfunctioning equipment or supplies, a failure of communication among healthcare professionals, Human error, Failure to anticipate adverse event **(Mitchell, 2016)**

Nursing safety precautions during cardiopulmonary bypass surgery begins with the perfusionists and critical care nurses experience and knowledge of all the possible errors that may occur. This knowledge fosters the anticipation of problems and promotes vigilance safety precautions for prevention of possible complications which may occur as a result of cardiopulmonary bypass machine. Perfusion safety is not an isolated component of cardiac surgery, but

encompasses many factors including equipment, safety devices, conduct of perfusion, surgical technique, vigilance and communication within the operating room. **(Mohammed, 2020)**

Regarding assessment of characteristics of the studied subjects in relation to their risk factors including age and sex, results displays that mean age of the studied patients were from 21 to 60 years and more than half of them were above 50 years old and most of studied patients were men. This explains the importance of assessment of Preoperative cardiac surgery risk factors distribution and pattern may also have an important role in determining major adverse cardiovascular events during and after surgery. As supported by **(Babak, et al, 2021).**

As regards patient weight, it was found that about more than half of patients were overweight and about half of them were obese. This is explained by the ischemic heart disease that happened as a result of atherosclerosis. As supported by **(Luca, 2018)** which explain that**,** obesity significantly affects all aspects of healthcare including perioperative care. Indeed, obese individuals appear to be at a higher risk for perioperative complications concerning all organ systems. and found that obesity was associated with a nominally statistically significant, slightly higher risk of postoperative atrial fibrillation, which, in turn was associated with substantially higher risk of the major postoperative complications (stroke, respiratory failure) and operative mortality after all types of cardiac surgical procedures.

Regarding assessment of patient's clinical data including medical diagnosis and past medical history, the present study showed that more than half of patients had ischemic heart disease and valvular heart disease. With medical history of hypertension, diabetes and Rheumatic heart disease. This matches with that Patients with prior medical history should be assessed in a preoperative anesthesia clinic a minimum of one week prior to surgery. This affords time for management changes to optimize the patient's state of health, including blood pressure, blood glucose level as a new concept, the perioperative surgical home, has been described, using a team approach to both optimize the patient preoperatively, and guide care during the postoperative period. as if blood pressure and blood glucose level is well controlled, and history and physical examination are unremarkable, further testing may be unnecessary for uncomplicated surgery or procedures, but is appropriate if history or physical are concerning, and for larger and invasive surgeries**.(Rabia, 2022)**

Regarding the Assessment of intraoperative cardiopulmonary bypass machine data during surgery for total cardiopulmonary bypass time, ischemic time

and Recuric time founded that most of the patients presented with normal cardiopulmonary bypass machine data with expected normal recovery from surgery except a few number of them presented with an abnormal cardiopulmonary bypass machine data, this explains that Prolonged cardiopulmonary bypass is recognized as a risk factor for acute renal failure, but the dose effect of time on bypass is unknown. We therefore examined the risk of acute renal failure associated with increasing cardiopulmonary bypass time stratified by preoperative renal function. As supported by **(Andrea, 2020)**

This explains nursing role of monitoring during cardiopulmonary bypass

Standard monitoring during cardiopulmonary bypass includes: continuous monitoring and measurements of total cardiopulmonary bypass time, Pump flow, Arterial line pressure, Arterial blood gases, hemoglobin or hematocrit, which may be continuous or intermittent. Frequent measurements (approximately every 30 minutes) Potassium and other electrolytes, glucose, urine output, activated clotting time. **(Albert, 2022)**

Regarding the assessment of possible complications during cardiopulmonary bypass machine, founded that while assessment of complications such as; Cardiac arrhythmias. Bleeding. Cardiac arrest. Pulmonary dysfunction. Renal failure. Central nervous system complications. Arrhythmias is the most occurrence complication in cardiac surgery patients which explains correlation between perioperative risk factors and occurrence of Arrhythmias such as age , obesity, structural heart disease, electrolyte disorders as supported by a study of **(Ravali, 2017)** followed by hyperglycemia more expected in patients with a history of preoperative diabetes and exposure to stress during cardiopulmonary bypass followed by bleeding and anemia this explains that Patients undergoing cardiovascular surgery may be exposed to heparin before surgery, during cardiopulmonary bypass, or in the immediate postoperative period. For this reason, cardiovascular surgery patients are at increased risk for heparin-induced thrombocytopenia, occurring in 1 to 3% of patients. This also explain the fact of cardiopulmonary bypass has detrimental effects on hemostasis, resulting in dilution and consumption of clotting factors, platelets activation and hyper fibrinolysis that persist after reversal of the heparin effect by protamine. The risk of significant blood loss and subsequent allogenic transfusion is therefore higher than for other types of surgery**.** This is supported by **(Manjula, 2017)**

Regarding assessment of nursing safety precautions during surgery for patients on cardiopulmonary

bypass machine. Founded that assessment done on the basis of observation of a twenty number of nursing who acts as a cardiac perfusionists performance by a nursing performance check list of daily routine of care for safe conduct of cardiopulmonary bypass machine, temperature management, anticoagulation, anesthesia and monitoring, ultrafilteration, acid base balance and weaning management founded that safety precautions were performed by most and more than half of them with a satisfactory results of a percent of 90%. This explains that with the application of safety precautions during cardiac surgery on cardiopulmonary bypass machine patient outcomes were improved and incidence of complications decreased.   As supported by **(Abdelhadi, 2021)**

Conclusion:
Based on the main results of the present study, it can be concluded that Finding of the current study revealed low incidence of mechanical cardiopulmonary bypass machine complications in the global sample. The nursing safety measures done by the critical care nurses who acts as cardiac perfusionists for cardiac surgery patients on cardiopulmonary bypass machine using pharmacological and mechanical methods were adequately performed. It was observed that nursing safety precautions applied in all of the studied patients**.** While small proportion of the studied patients have a preoperative risk factors for developing physiological complications. It was observed that, most of the studied patients were men and above 50 years and more than half of patients were overweight and about half of them were obese. With a diagnosis of ischemic heart disease that happened as a result of atherosclerosis and valvular heart diseases a result of rheumatic heart disease. With past medical history of hypertension, diabetes, congestive heart failure and hepatitis c virus those patients at higher risk for experiencing physiological complications such as arrhythmias, bleeding, anemia, hyperglycemia, pulmonary hypertension and acute kidney injury.

Assessment of critical care nurses for safety precautions during surgery for patients on cardiopulmonary bypass machine using scoring system, for safe conduct of cardiopulmonary bypass machine, temperature management, anticoagulation, anesthesia and monitoring, ultrafilteration, acid base balance and weaning management through observation of nursing performance by a nursing performance check list of daily routine of care founded that unsatisfactory level presented in just 10% of total nurses and with maximum score <85%, while satisfactory level presented in 90% of them

with maximum score≥85% and with Mean±SD(range) 85±3.57(75-89).

Recommendations:
Results of this study will help in preoperative risk assessment, and understanding possible complications during open heart surgery on cardiopulmonary bypass machine and help in the intraoperative management for optimizing patient care. Rapidly nursing diagnosis to these complications prevent patient's deterioration.

References
▪ **Andrea M, (2020):** Cardiac Surgery Procedures, Published: May 20th, DOI :10.5772, intechopen.80835, ISBN: 978, P 978- 789.
▪ **Mohammed Omara, (2020):** Surgical management of high risk cardiac surgery patients, Banha University, P15-20.

▪ **Bişar A (2021):** Minimal Invasive Extracorporeal Circulation in Cardiac Surgery, Journal of Biomedical and Life Sciences, p 2-8.
▪ **Manjula Sarkar & Vishal Prabhu, (2017):** Basics of cardiopulmonary bypass, Indian J Anaesth, P 760–767.
▪ **Luc Puis, (2019):** Interactive Cardiovascular and Thoracic surgery, European journal of cardiothoracic surgery, P161-202.
▪ **Kareem & Ali, (2020):** Assuit Cardiothoracic surgery department clinical audit. https://www.researchate.net/publication/342690299
▪ **Ambra L (2020)** Journal of cardiothoracic and vascular anathsezia, P 1622:1635.
▪ **Alfred H Stammers, (2022):** The assessment of patients undergoing cardiac surgery for Covid-19:Complications occurring during cardiopulmonary bypass, Division of Thoracic and Cardiovascular Surgery, Department of Surgery, University of Florida PMC9069560.
▪ **Wahba A, Milojevic M, & Boer C, (2019):** EACTS/EACTA/EBCP guidelines on cardiopulmonary bypass in adult cardiac surgery. Eur J Cardiothorac Surg, p 57:210.
▪ **Akhtar, (2021):** Multicenter international survey on cardiopulmonary bypass perfusion practices in adult cardiac surgery J Cardiothorac Vasc Anesth
▪ **Raphael, (2019):** Numerous guidelines and consensus statements for patient blood management in cardiac surgery, research, PMID: 31604540 Review
▪ **Mihajlo M., Carrel T & Arman R.D. (2020):** Recommendations for preoperative assessment and shared decision-making in cardiac surgery. Cur Anesthesia Rep. P 185–195.
▪ **Mitchell I, Schuster A, & Smith K, (2016):** Patient safety incident reporting: A qualitative study

of thoughts and perceptions of experts 15 years after, P 25:92.

▪ **Babak S, (2021):** Sex and age difference in risk factor distribution, trend, and long-term outcome of patients undergoing isolated coronary artery bypass graft surgery, BMC Cardiovascular Disorders, P 21:460.

▪ **Luca Salvatore, (2018):** Implications of obesity in cardiac surgery pattern of referral, physiopathology, complications, prognosis, journal of thoracic disease, P 4532–4539.

▪ **Albert T Cheung, (2022):** management of cardiopulmonary bypass, PMID 29889106.

▪ **Ravali Neerumalla, (2017):** May 26, Cardiopulmonary Bypass - Risk & Complications. Medindia

▪ **Rabia Gill; Sheldon Goldstein, (2021):** Evaluation and Management of Perioperative Hypertension, PMID: 32491762.

▪ **Abdelhadi Ismail; George Semien; Szabolcs Y. Miskolczi, (2021):** Cardiopulmonary Bypass, PMID: 29489210.