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STUDY TO ESTIMATE INCIDENCE OF ACUTE KIDNEY INJURY IN PATIENTS UNDERGOING OPEN HEART SURGERY DURING POST-OPERATIVE PERIOD.

Anaesthesiology

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ABSTRACT

Background: An acute kidney injury (AKI) following cardiac surgery with cardiopulmonary bypass (CPB) can be a devastating complication associated with high morbidity, mortality and resource utilization. **Objective:** This study was conducted to estimate incidence of acute kidney injury in patients undergoing open heart surgery during post-operative period. **Material And Methods:** This was cross sectional study conducted at cardiovascular thoracic surgery department of Lokmanya Tilak Municipal medical college and general hospital, Sion, Mumbai from June 2014 to June 2017. Patients planned for open heart surgery was the study population for our study. **Results:** There was no significant difference in proportion of patients with acute kidney injury according to gender. we observed that proportion of patients with AKI were more in AVR surgery followed by in MVR surgery. **Conclusion:** It can thus be concluded that the incidence of AKI after cardiopulmonary bypass is high in patients undergoing open valvular heart surgery. There is need for various prophylactic and/or therapeutic techniques to prevent AKI for improving morbidity and mortality.

KEYWORDS

Acute kidney injury, cardiopulmonary bypass.

INTRODUCTION

Cardiac surgery is viewed as one of the great medical advances of the 20th century. The key to the success and advancement of the procedure has been the development of Cardiopulmonary bypass (CPB) by extracorporeal circulation. However, the procedure is not without complications.

An acute kidney injury (AKI) following cardiac surgery with cardiopulmonary bypass (CPB) can be a devastating complication associated with high morbidity, mortality and resource utilization. [1,2] The incidence of cardiac surgery-associated Acute Kidney Injury (CSA-AKI) has ranged between 5-30%.[3,4]

An acute kidney injury is defined as an increase in serum creatinine by ≥1.5 times baseline within 7days (RIFLE CRITERIA). [5] This study was conducted to estimate incidence of acute kidney injury in patients undergoing open heart surgery during post-operative period.

MATERIALS AND METHOD

This was cross sectional study conducted at cardiovascular thoracic surgery department of Lokmanya Tilak Municipal medical college and general hospital, Sion, Mumbai from June 2014 to June 2017.

Patients planned for open heart surgery was the study population for our study. Following inclusion and exclusion criteria was used to enrol the patients in our study.

Inclusion Criteria: -

1. Patient undergoing open heart surgery requiring cardiopulmonary bypass
2. Patient giving written informed consent
3. Patients having age >18 yrs and <60 yrs
4. Patients having pre-operative sr. creatinine <1.2 mg/dl

Exclusion Criteria: -

1. Hemodynamically unstable patient
2. Patients on nephrotoxic drugs
3. Patient having dye study within 24 hr before surgery

Sample Size

Sample size estimated by using proportion of patients with acute kidney injuries in previous study.

Proportion = 5%[3,4]
Sample size = $4pq/d^2$
P = Prevalence
q = 1 – p
d = 5% (Absolute error)
Sample size = 4×0.05×0.95/0.05×0.05
Sample size = 76

The study was carried out in 80 adult patients undergoing open heart surgery requiring cardiopulmonary bypass.

Methodology

After the approval of institutional ethics committee and thorough pre-anaesthetic evaluation, patients were selected for the study(n=80). Detailed history and clinical examination was carried out and all relevant investigations were checked and adequate starvation status was confirmed. Written valid consent was taken from the patient to monitor urine output, sr. creatinine on Cardiopulmonary bypass. Patients were explained about the recording of haemodynamic during the procedure and that no new intervention will be done. After preoperative premedication as per OT protocol, patient was anaesthetised with routine Induction agents and Muscle relaxants (Premedication-Fentanyl 4-5µgm/kg + Midazolam 0.02mg/kg IV). Induction agent thiopentone 5mg/kg till loss of eyelash reflex or propofol till loss of consciousness and Rocuronium 1mg/kg. Maintenance Agents -O2 + Air + Sevoflurane + Fentanyl infusion 5-10µg/kg/hr + rocuronium infusion 0.45-0.6 mg/kg/hr). After intubation and IJV cannulation patient was catheterised. Urine output was measured before the patient goes on cardiopulmonary bypass. In post-operative period urine output and serum creatinine at 24,48 and 72 hours was noted.

Statistical Analysis

After data collection, it was entered in Excel datasheet. Data analysis was done with the help of open epi version 2.3.1 and SPSS version 23. Qualitative data was presented with Frequency and Percentage tables. To assess the association between two categorical variables in a univariable analysis, Chi-square test was used. P-value of <0.05 was used to identify statistical significance.

RESULTS AND OBSERVATION

Table 1: Mean Age And Mean Weigh Of Study Participants

n=80	Mean	Standard Deviation	Median	Range
Age (years)	44.13	11.33	46.5	18-60
weight (kg)	53.52	9.74	55	32-76

Table 1 showing demographic profile of the patients included in this study. The mean age of the 80 patients undergoing valvular open-heart surgery on cardiopulmonary bypass in this study was 44.13± 11.33

years with a range of 18 - 60 years. The mean weight of the patients in the study was 53.52± 9.74 Kg with a range of 32-76 Kg.

Table 2: Showing Age Wise Distribution Of Study Participants

Age-group	AKI		Total
	Present	Absent	
0 - 20	0	3	3
21 – 40	7	20	27
41 - 60	12	38	50
Total	19	61	80

Table 2 showing age wise distribution of study population. In this study 3 patients were in 0 -20 yr of age, 27 patients were in 21-40 yr of age and 50 patients were in 41-60 yr of age. We have observed that 19(23.75%) patients out of 80(100%) patients have developed acute kidney injury. There was no significant difference in proportion of patients with acute kidney injury according to different age group ($p>0.05$).

Table 3: Sex Wise Distribution Of Study Participants

Gender	AKI		Total
	Present	Absent	
Female	7	32	39
Male	12	29	41
Total	19	61	80

$X^2=1.41$, $P=0.23$

Table 3 showing sex wise distribution of study population. In this study 41 were male patients and 39 were female patients. There was no significant difference in proportion of patients with acute kidney injury according to gender ($p>0.05$).

Table 4: Distribution Of Study Participants According To Type Of Surgery

Type of surgery	AKI		Total
	Present	Absent	
AVR	7	8	15
DVR	0	3	3
MVR	12	42	54
ASD CLOSURE	0	5	5
VSD CLOSURE	0	3	3
Total	19	61	80

Table 4 showing type of surgery in this study. 54 patients were undergone mitral valve replacement surgery, 15 patients were undergone aortic valve replacement surgery, 5 patients were undergone ASD closure, 3 patients were undergone VSD closure and 3 patients were undergone double valve replacement. So, here we observed that proportion of patients with AKI were more in AVR surgery followed by in MVR surgery.

DISCUSSION

Cardiac surgery has certainly advanced over the years, particularly with the development of the cardiopulmonary bypass machine. Being able to operate on a completely motionless heart is an incredible progression that has helped to save many lives. The CPB machine itself has come a long way in development since the first surgery and will continue to develop to enhance every patient's quality of life. Although the CPB is an amazing machine, many adverse effects can occur. A systemic inflammatory response is the most common due to the blood being introduced to an entirely new environment. This inflammatory response can lead to many other problems throughout the body and ultimately organ failure may occur. Other adverse effects are atrial fibrillation, pulmonary damage including edema and ischemia, renal failure, and neurocognitive deficits. While some of these are not common effects, research has shown that they certainly are possible and harmful. The goal of any surgery, in particular cardiac surgery, is to fix the previous problem and prevent adverse effects. Preventing these adverse effects is an ongoing process and will continue to be so. Using membrane oxygenators and adding filters throughout the machine have been useful in preventing micro emboli from travelling throughout the body. Research has shown that coating the circuit with heparin may reduce inflammation, bleeding, the need for blood transfusions, and pulmonary injury. Ultrafiltration is being studied and found to reduce inflammation and pulmonary harm as well. Medications such as corticosteroids are also identified to be beneficial in reducing cardiac complications and reducing the inflammatory response. It is the hope of all healthcare professionals that the incidence of harmful consequences of cardiopulmonary bypass will continue to decline and someday the risks associated will be close to zero. Until that day, research will continue and new methods will be tested to improve this already incredible machine.

AKI is a common complication following cardiac surgery. It is associated with prolonged hospital stay and increased overall mortality [6]. More specifically in patients with postoperative AKI requiring hemodialysis, 30-day mortality can be as high as 60%[7]. Its complex pathophysiology, which includes genetic factors, inflammation, oxidative stress and use of nephrotoxic agents, makes both risk stratification and effective prevention of AKI an ongoing challenge[8]. The spectrum of CPB-induced pathophysiologic changes includes the systemic inflammatory response, changes in renal vasomotor tone, destruction of red cells, pigment nephropathy, loss of pulsatile flow, activation of complement and coagulation pathways, and generation of micro emboli (fibrin, platelet aggregates, cellular debris, fat, and air). Other established patient and surgical risk factors include advanced age, preoperative renal insufficiency, ejection fraction <40%, excessive haemodilution on CPB, use of circulatory support devices (eg, intra-aortic balloon pumps), type of cardiac surgery (cardiac valve and combined valve-coronary artery bypass grafting procedures), length of CPB, and emergency cardiac surgery. An acute kidney injury is defined as an increase in serum creatinine by ≥1.5 times baseline within 7days RIFLE CRITERIA [5]. The incidence of cardiac surgery-associated Acute Kidney Injury (CSA-AKI) has ranged between 5-30%.[3,4]

Various studies have investigated the incidence of AKI following cardiopulmonary bypass in valvular heart surgery patients. The results have been variable. The incidence of postoperative AKI in patients undergoing cardiac surgery ranges from 7.7% to 28.1% [9] in different studies, probably in relation to the criteria adopted to define AKI. Thakar et al. [10], Bove et al. [11], Mangano et al. [12] in their large-scale studies observed an incidence of 15.7%, 5.3% and 7.7% respectively in post-cardiac surgery patients. The different incidences may be due to varying definitions of AKI. It is important to stress the fact that there is no universal definition for AKI. The incidence of AKI varies depending on the chosen definition. Even minor changes of the definition cause major differences in the frequency of AKI. The incidence of AKI in our study defined as an increase in serum creatinine by ≥1.5 times baseline within 7days was 23.75%.

CONCLUSION

It can thus be concluded that the incidence of AKI after cardiopulmonary bypass is high in patients undergoing open valvular heart surgery. There is need for various prophylactic and/or therapeutic techniques to prevent AKI for improving morbidity and mortality.

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