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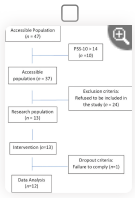

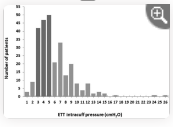

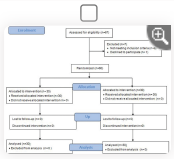

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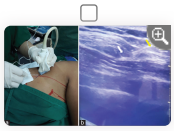

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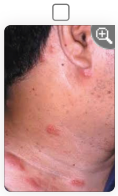

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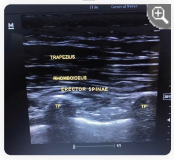

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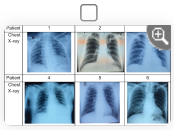

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Faculty of Medicine, University of Indonesia
Cipto Mangunkusumo General Hospital
Jakarta, Indonesia

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CASE REPORT

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Acute kidney injury after a coronary artery bypass graft surgery

Kun Arifi Abbas[1], Nancy Margarita Rehatta[1], Yan Efrata Sembiring[2], Ghuraba Adisurya[1], Prananda Surya Airlangga[1], Hamzah Hamzah[1], Hardiono Hardiono[1], Bambang Pujo Semedi[1], Christijogo Sumartono Waluejo[1]

[1] Department of Anesthesiology and Reanimation, Faculty of Medicine, Airlangga University - Dr. Soetomo General Hospital, Indonesia

[2] Department of Cardiovascular Thoracic Surgery, Faculty of Medicine, Airlangga University - RSUD Dr. Soetomo General Hospital Surabaya, Indonesia

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Correspondence Address:
Dr. Kun Arifi Abbas
Jalan Mayjend. Prof. Dr. Moestopo no - 6-8, Surabaya
Indonesia
Login to access the email ID

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Abstract

Coronary artery bypass graft (CABG) is performed on patients with blocked coronary arteries by creating a shortcut to resolve and improve blood flow to the heart muscle. The CABG procedure can be performed using a cardiopulmonary bypass (CPB) or an off-pump artery bypass graft technique. One complication in heart surgery is acute kidney injury (AKI) incidence. The risk factors in the incidence of AKI include CPB, complications from surgery (e.g., bleeding and blood transfusions), type of surgery, preoperative high-osmolarity state, preoperative serum creatinine level, age >60 years, the presence of comorbid conditions (e.g., hypertension, diabetes, and dyslipidemia), impaired left ventricular function, hemodynamic disturbances, hypoperfusion, use of vasopressor drugs/inotropes, and preoperative hypoalbuminemia. We report an observation to six of our recent patients underwent CABG aged 36–69 years old. Five patients with coronary arterial diseases (CAD) underwent CABG, and one patient with CAD and mitral regurgitation underwent CABG surgery and mitral valve replacement. All patients had a preoperative albumin level of >3.5 g/dL. Two patients developed AKI <24 h postsurgery and three followed by the next day. Serum creatinine monitoring was carried out daily for 7 days, where two patients showed improvement in serum creatinine, and other two had their creatinine returned to normal. This case series found that AKI incidence after CABG was relatively high despite an excellent clinical outcome. Further research is needed with a larger number of cases to find the risk factors for AKI for perioperative prevention.

Keywords: Comorbid, complication, hemodynamic, hypoperfusion, vasopressor

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Introduction

Coronary artery bypass graft (CABG) is performed on patients with blocked coronary arteries by creating a bypass to clear the blockage and improve blood flow to the heart muscle. This procedure uses the patient's autologous blood vessels (veins or arteries) as grafts to bypass the coronary arteries that are partially or wholly blocked due to the atherosclerotic plaque.[1]

All CABG procedures performed in our institution, the Dr. Soetomo General Hospital, currently use the on-pump method. In 2018, our hospital had 82 cases of CABG procedures.[1],[2] The cardiopulmonary bypass (CPB) machine temporarily replaces the heart–lung function to provide oxygen, eliminates carbon dioxide in the blood during the surgical procedure, and creates a “bloodless” surgical field.[3],[4]

Acute kidney injury (AKI) is a syndrome of rapid abrupt in kidney function within hours to days and is often associated with patients suffering from other acute diseases and appears in critically ill patients.[5] The incidence of AKI is higher in heart surgery using CPB. The incidence of AKI in heart surgery ranges from 5% to 42% and even up to 70% depending on the type of surgery and the definition of AKI.[5],[6],[7],[8] Postoperative AKI can lead to prolonged stay, increased complication, increased mortality, and treatment costs.[5],[7],[9],[10]

Case Report

Six patients underwent CABG aged 36–69 years old were observed. Five patients with coronary arterial diseases (CAD) underwent CABG only, and one patient with CAD and mitral regurgitation underwent CABG surgery and mitral valve replacement. The comorbidities found in the patients were hypertension, diabetes mellitus, dyslipidemia, and no previous history of AKI. Two patients received diuretic therapy, and two patients received anticoagulant therapy. The lowest ejection fraction was 51%, and the highest was 76%. Chest X-ray examination showed no pulmonary edema, two patients presented with cardiomegaly [Figure 1].

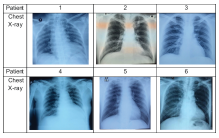

Figure 1: Photo image of chest X-ray (CTR: Cardio Thorax Ratio)

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All patients had a preoperative albumin level of >3.5 g/dL. The lowest preoperative hemoglobin was 9.8 g/dL, and the highest was 16.2 g/dL. An increase in serum creatinine was found in one patient, 1.6, with a BCR ratio of 20.6. Hypernatremia (150 mEq/L) was found in one patient. Blood sugar levels were within the normal limits.

The surgery duration lasts 6–7 h [Table 1], but one patient had an extended duration (10 h). To that particular patient, due to heart rhythm disturbances (atrial fibrillation) during surgery, the sternal closure is delayed until the next day.

Table 1: Surgery, cardiopulmonary bypass, and aortic cross-clamp duration

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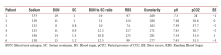
Laboratory tests (hemoglobin, blood urea nitrogen, serum creatinine, and blood gas analysis) were performed after anesthesia induction, during the CPB procedure, and after CPB. Albumin and random blood sugar test were performed after the first cardioplegia during CPB procedures [Table 2].

Table 2: Investigation results



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There was a decrease in albumin during CPB. The average value of albumin levels during CPB was 2.46 g/dL (2.2–2.6 g/dL). Only one patient experienced a decrease in hemoglobin levels <8.0 g/dL, so a 200 ml packed red cell (PRC) transfusion was performed. Hemofiltration of 1500–2000 mL ultrafiltration is performed during the surgery. Urine output during surgery was >1 ml/kg/hour. Serum creatinine levels during the CPB procedure tended to decrease in five patients but increased in one patient.

Postoperative care is carried out in the intensive care unit (ICU) with a length of stay of 3–5 days. Duration of the patients who use the ventilator until extubation is 1–2 days. The average length of treatment days postoperatively until discharge was 6.6 days (5–11 days). During ICU observation, five out of six patients required vasoactive/inotropic drugs to maintain hemodynamics.

Bleeding occurred at 60–700 ml drainage production on the 1st day, improved on the 2nd day, and stopped on the 3rd day. Replacement of blood volume loss using crystalloid, colloid, PRC, and fresh-frozen plasma. During ICU stay, hemoglobin levels were maintained >9 g/dL by blood transfusions. The level of albumin shortly after surgery (day 0) indicated a value of >3 g/dL. There was a decrease in base excess during ICU observation (day 0) in all patients compared to surgery.

Postoperative renal function was assessed by the level of urine production and changes in serum creatinine values after surgery. During postoperative care in the ICU, five out of six patients produced urine >0.5 ml/kg/hour, but there was one patient with urine output <0.5 ml/kg/hour that lasted 9 h.

Two patients developed AKI on day 0 and were followed by three other patients on day 1. Only one patient did not develop AKI at all. According to the kidney disease, Improving Global Outcomes (KDIGO), three patients had Stage-1 AKI, and two patients had Stage 2. Serum creatinine was monitored for 7 days, where two patients showed improvement in serum creatinine, and two other patients were fully recovered.

Discussion

This case series report observed six patients with a length of stay in the ICU was 3–5 days, the length of stay on the ventilator was 2 days, and the length of hospital stay was 5–11 days. In general, the patient's clinical condition and postoperative outcome were satisfactory.

The diagnosis of AKI can generally be enforced with increased serum creatinine and decreased urine production. One of the criteria commonly used to assess AKI is KDIGO.[11],[12] Possible misdiagnosis of AKI can occur in the measurement of serum creatinine and urine production. In most CPB-utilized CABG cases, the blood creatinine levels may be decreased due to excess perioperative fluid (crystalloid, colloid, and transfusion) and hemodilution. Serum creatinine is a reliable test in diagnosing impaired kidney function because the body can still maintain urine production in the normal range even though the glomerular filtration rate has decreased.[12]

Three patients were over 60 years of age and all developed AKI. With age, there is a decrease in the quality of kidney function so that the potential for kidney damage increases. This is due to the kidneys' structure and abilities that are worn out with age and are exacerbated by comorbidities.[13] The BMI of the patients was still normal, so it is not a risk factor for AKI.[14],[15] Hypertension was found in four patients, diabetes in two patients, and dyslipidemia in one. Hypertension, diabetes mellitus, and dyslipidemia are the risk factors for AKI.[10],[12]

The use of CPB is related to the incidence of AKI postcardiac surgery. The longer the CPB procedure will increase the probability of AKI. AKI occurs due to inflammation, reperfusion injury, pulsatile waves, hemolysis, micro embolism, and decreased cardiac output.[5],[16] Heart valve surgery is also a risk factor for AKI.[17]

The target hemoglobin is always maintained by giving blood transfusions to avoid a decrease in oxygen supply.[18] Postoperatively, there is an increase in albumin levels, possibly due to hemofiltration and rearrangement of fluid homeostasis. Hypoalbumin often occurs during the perioperative period and is associated with AKI events.[19],[20] An albumin level of <2.4 g/dL is associated with increased risk of AKI during hospitalization.[20] Preoperative hypoalbumin is often associated with nutritional status and the possibility of edema.

Studies on hypoalbuminemia and perioperative AKI in cardiac surgery show different results. A serum albumin of <3 g/dL during CPB is less correlated with postoperative AKI, but the administration of perioperative albumin transfusion from cardiac surgery is associated with the occurrence of AKI.[21],[22] Administration of albumin during CPB priming does not provide any clinical benefit to patients but can prevent the decrease in platelet counts during CPB.[23],[24],[25] In OPCAB surgery, preoperative administration of albumin to patients with albumin levels <4 g/dL reduces the risk of AKI and increases urine output during surgery but does not benefit patients who are converted to CPB.[26]

Conclusion

This case series found that AKI incidence after CABG was relatively high despite an excellent clinical outcome. Most patients experience AKI only temporarily and recover from AKI. Further research is needed with a larger number of cases to find risk factors for AKI for perioperative prevention.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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Figures

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Tables

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