

# Incidence and Predictors of Postoperative Acute Kidney Injury in Non-Cardiac Surgery

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## Abstract

**Background and Aims:** Incidence of Postoperative (Postop) Acute Kidney Injury (AKI) and related comorbidities can be prevented by identifying various preoperative and intraoperative predictors in the patients. Early recognition of risk factors and timely intervention can reduce morbidity and mortality related to AKI in a patient with preoperative normal renal function .

**Method:** This prospective observational cohort study was done in 100 patients undergoing major noncardiac surgery under spinal, epidural or general anaesthesia, who were having normal preoperative renal function. Intraoperative predictors of AKI monitored were bloodloss, hypotension, duration of surgery, volume of fluid infused, urine output (UOP), use of vasopressor and diuretics. Postoperatively urine output and serum creatinine level were noted for 3 days. Postoperative AKI was defined and classified as per RIFLE criteria.

**Results:** Total 33% patients were diagnosed to have Postop AKI and the major risk factors identified were duration of surgery, volume of fluid given intraoperatively, blood loss and UOP postoperatively (p value <0.001). Non significant risk factors were demographic data, mode of anaesthesia given, diuretic usage, drug therapy.

**Conclusion:** We concluded in our study that in patient with preoperative normal renal function undergoing noncardiac surgery various predictors for AKI can be identified early and optimised for better outcome. These factors are duration of surgery, blood loss, volume of fluid infused.

**Keywords:** Acute kidney injury, Diuretics, non cardiac surgery, RIFLE criteria, S.creatinine.

## Introduction

Acute kidney injury (AKI) is defined as “A syndrome that manifest within 48 hours and characterized by rapid decline in Glomerular filtration rate (GFR), retention of Blood urea nitrogen (BUN) and creatinine.”<sup>[1]</sup>

The etiology of Acute Renal Failure (ARF) is multifactorial and most common is ischemia leading to acute tubular necrosis.<sup>[2]</sup> Others are various toxin injury and rhabdomyolysis. The development of ARF postoperatively in non cardiac surgeries can increase morbidity, mortality and postoperative (postop) hospital stay and cost.<sup>[3]</sup> There are only few studies available that hypothesised incidence of postop AKI in non cardiac and non vascular surgeries having normal preoperative renal function,hence we initiated this study to identify preoperative, intraoperative and postoperative predictors that can be useful to prevent outcome related to AKI.

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**Aims and Objectives:** The aim of this study is to predict and identify the risk factors for Postop AKI in

non cardiac surgical patients with baseline normal renal function.

**Material and Method**

After approval from the institutional ethical committee and written informed consent, hundred patients of either sex had been enrolled in this prospective, observational, cohort study. Patients undergoing major non cardiac surgeries under spinal, epidural or general anaesthesia having preoperative normal renal function were included in this study. Patients who were undergoing cardiac or vascular surgery, having altered renal function, sepsis and who were given radioactive contrast 48 hours before surgery were excluded from the study. Preoperative complete haemogram, blood sugar, urine examination, Serum (S.) creatinine, S.urea, S.electrolytes, Electrocardiogram (ECG), Chest Xray and other relevant investigations

were done. GFR was calculated using Cockcroft - Gault formula. Intraoperative predictors monitored were type of anaesthesia, duration of surgery (more than 2 hours), blood loss, occurrence of intraoperative hypotension (Systolic Blood Pressure [SBP]<90 mm of Hg), volume of intravenous fluid, vasopressor used and Urine output (UOP). Postoperatively UOP, S.creatinine and urea were noted for 3 days. AKI was defined and classified as per RIFLE criteria<sup>[4]</sup>(increase in S.creatinine >0.3 mg/dl above baseline or >1.5 times

within 48 hours, decrease in UOP <0.5 ml/kg/hour for at least 6 hours postoperatively.)

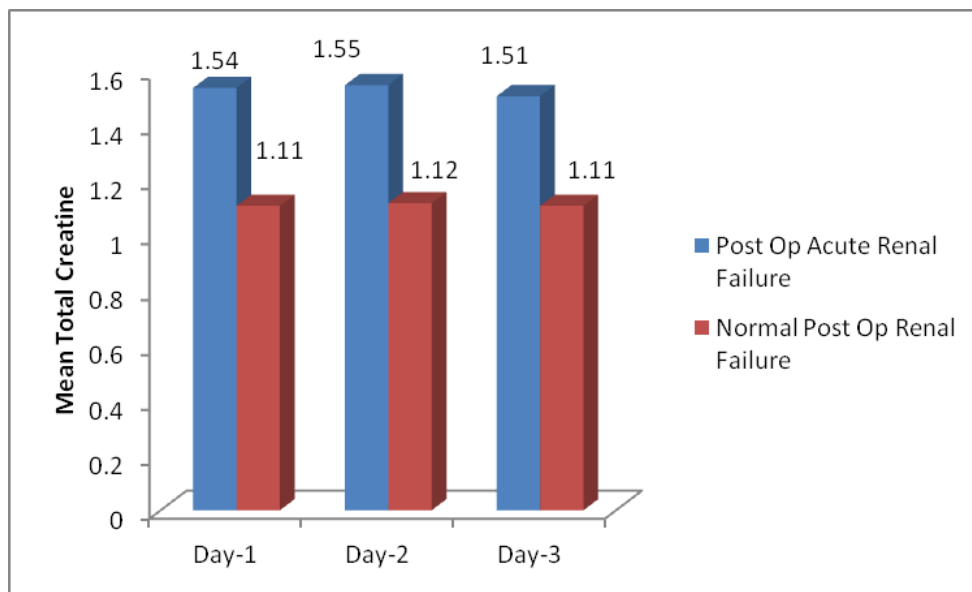
**Statistical Analysis:** The result of continuous variables were given as mean ± SD. The difference between the two group was assessed by unpaired ‘t’ test. P value <0.05 was considered significant.

**Observation and Results**

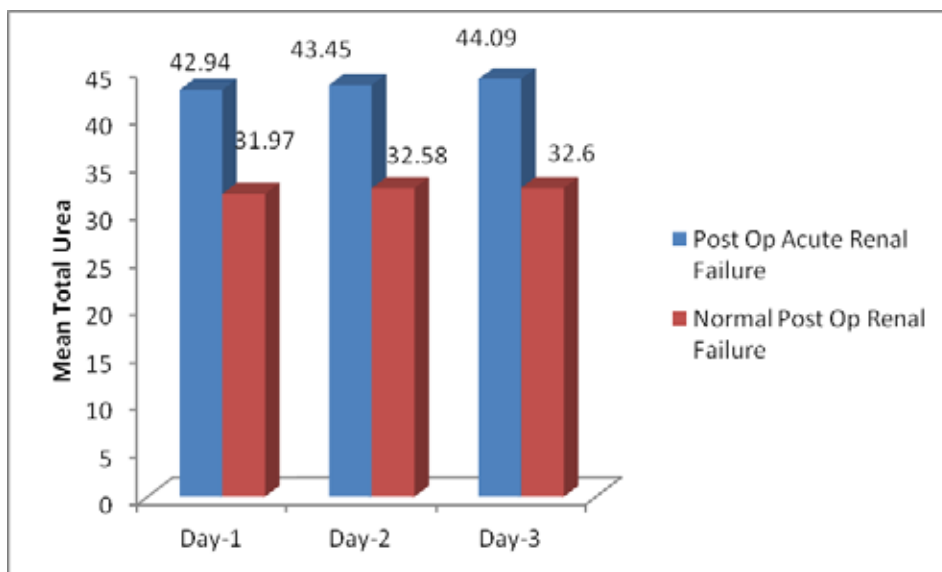
A total of 100 cases were reviewed and 33% of patients were diagnosed to have Post op AKI according to RIFLE criteria.

The preoperative mean serum creatinine and serum urea levels were comparable in both groups . Among the 67 patients who had normal post-operative renal function had mean pre-operative serum creatinine value of 1.18±0.19, while among the 33 patients who developed post op ARF had pre op mean serum creatinine value of 1.18±0.165, p value of 0.914 which was statically non-significant. Similarly mean pre-operative blood urea value in both groups were 37.91±4.4779 and 38.42±5.512 respectively and p value was 0.632 which was also statistically non-significant.

There were significant increase in Serum Creatinine and Serum Urea levels in Day 1,2,3 in 33% of patients who developed Post op AKI as depicted in Graph 1 and 2.



**Graph 1: Mean of Total Creatinine 72Hrs.**



**Graph 2: Mean of Total Urea 72Hrs**

There was significant decrease in urine output in Postop Day 1,2,3 in patients who developed Postop AKI as compared to those who had normal Postop renal function as shown in Table 1.

**Table 1: Mean of Total Urine Output 72Hrs**

Postop Day	Urine Output (ml)		p-value
	Postop Acute Renal failure (n=33)	Normal Postop Renal Function (n=67)	
1	730.94±344.546	1297.01±432.484	<0.001
2	690.61±299.426	1264.15±379.57	<0.001
3	730.3±377.521	1241.73±369.891	<0.001

On evaluating the predictors for Post op Acute Kidney Injury, it was found that, both groups were comparable with respect to their demographic profile .Both groups did not differ significantly with respect to type of anaesthesia provided – spinal anaesthesia, general anaesthesia and epidural anaesthesia (p value – 0.78, 0.58 and 0.44 respectively). Diabetes Mellitus and Hypertension were not found to be significant risk factors for Postop AKI (p value-0.357, 0.022 respectively.)

The significant intraoperative parameters were duration of surgery, volume of fluid used and blood loss. It was found that longer duration of surgery, increased blood loss and increased volume of intravenous fluid played a significant role in the development of Postop AKI as shown in Table 2.

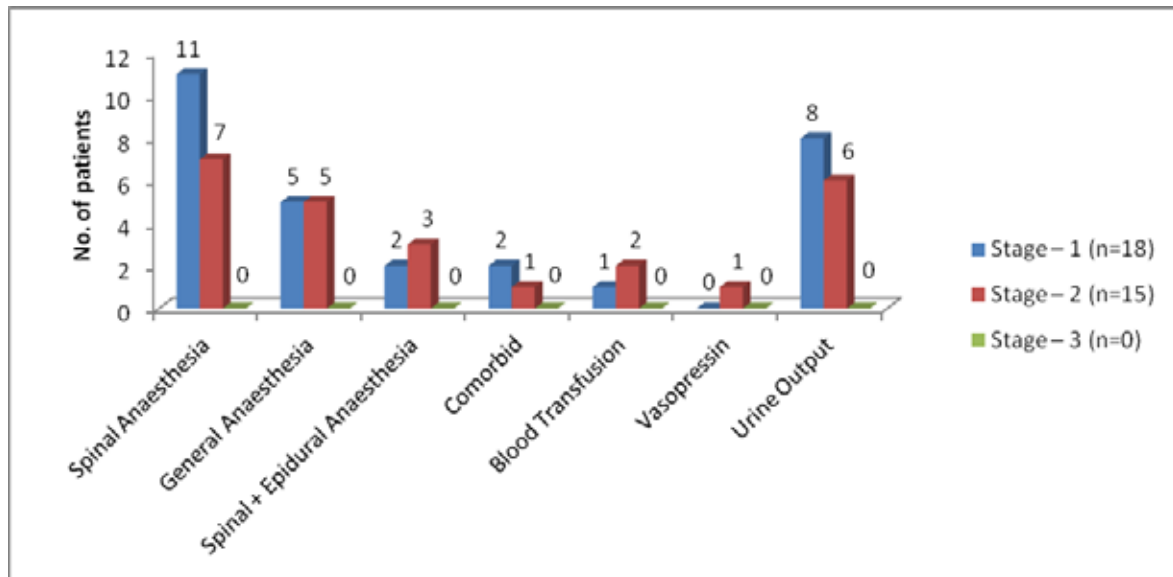
**Table 2 : Mean of Intra Operative Data**

	Post op Acute Renal failure (n=33)	Normal post op Renal Function (n=67)	p-value
Duration of Sx (hours)	2.9139±0.69652	1.9422±0.6987	<0.001
Vol. of Fluid in Sx (ml)	2374.55±617.789	1718.81±482.545	<0.001
Blood loss (ml)	398.79±84.512	190±119.598	<0.001

S<sub>x</sub>– Surgery, Vol- Volume.

The patients in our study were staged according to RIFLE criteria and also along with the parameters as depicted in Graph 3. In our study, most of the Acute

Kidney Injury patients belonged to Stage 1 and 2 and there were none in Stage 3.



**Graph 3: RIFLE Criteria staging according to parameters.**

**Discussion**

In our study of 100 patients, who were operated for non cardiac surgeries, the incidence of Postop Acute Kidney Injury according to RIFLE criteria was 33%. Based on RIFLE criteria staging of Acute Kidney Injury, most of the patients belonged to Stage 1 and 2 and none were in Stage 3. The rate of perioperative AKI is difficult to know precisely as it is dependent on definitions used and type of surgery studied .In the cardiac surgery population, ARF defined as 25% increase in creatinine, occurs in 17% of these high risk surgical patients according to Fengwang MD et al. [5] After aortic aneurysm repair, incidence of renal failure have been reported as 15%to 46%. [6]

Kheterpal et al[3] studied a total of 65,043 cases, with pre-operative normal renal function operated for noncardiac surgeries and noted an incidence of renal failure defined by GFR less than 50 mL/min as 0.8%.

In our study, co morbid diseases like Diabetes Mellitus and Hypertension were not significantly related to the development of Postop AKI whereas the study which was done in cardiac patients with co morbid conditions mentioned above by Robert C. Albright et al[7] found significant changes in the renal function

which were more so in Hypertensive patients than in patients with Diabetes Mellitus.

We had included in our study, patients undergoing major non cardiac surgeries under Spinal, Epidural or General Anesthesia and we concluded that there were no significant changes in the renal functions postop because of the mode of anesthesia given for surgery. This was in concordance with the results found by Marijana et al[8] in hisstudy.

The significant intra operative predictors which we had found in our study were duration of surgery, volume of fluid given and the total blood loss. The patients who developed postop AKI had longer duration of surgery with greater blood loss and increased volume of intravenous fluid administered to compensate hypotension as compared to those who had normal postop renal function. Kheterpal et al[3] studied patients with preoperative normal renal function posted for noncardiac surgery and developed a preoperative renal-risk index that identified the following independent risk factors for postop renal failure : age, emergent surgery, liver disease, body mass index, high-risk surgery, peripheral vascular occlusive disease and chronic obstructive pulmonary disease (requiring chronic broncho dilator therapy).[3] The

intraoperative risk factors which he identified were : use of a vasopressor infusion, mean number of vasopressor bolus doses administered, administration of furosemide or mannitol, units of packed red blood cells required and hypotension defined as Mean Arterial Pressure less than 50mmHg.

Namrata Khanal et al(2007)<sup>[9]</sup> studied the factors predicting renal outcome in patients developing acute renal failure in pregnancy. She concluded that Ante-Partum Haemorrhage and prolonged oliguria were strong predictors of irreversible renal failure. This inference highlighted the need for early recognition of the predictors and the importance of trained birth attendants and antenatal care.

Sean A Josephs et al (2009)<sup>[10]</sup> from his observations reflected that there is no single therapy that will prevent perioperative AKI. Clinical risk factors are similar but not identical in different surgical populations. He concluded that there were more likelihood of reducing perioperative AKI through better optimization and management of the many comorbidities and hemodynamic derangements that have been shown to impact renal function.

### Conclusion

In our study we observed that the incidence of Postop Acute Kidney Injury in non Cardiac Surgery was 33% according to RIFLE criteria. The highly predictive factors were duration of surgery, blood loss and volume of fluid infused.

We can conclude that the incidence of postop AKI can be decreased by early recognition and by optimising the comorbidities and predisposing factors.

**Ethical Clearance:** Taken from institutional ethics committee of Sumandeep Vidyapeeth deemed to be University.

**Source of Funding:** Self

**Conflict of Interest:** Nil

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