Original Article

Incidence, risk factors, and outcomes of acute kidney injury in patients undergoing emergency laparotomy - A prospective observational exploratory study

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ABSTRACT

Background and Aims: Acute kidney injury (AKI) can occur in post-laparotomy patients, with a variable incidence. This study aimed to determine the incidence of AKI in patients undergoing emergency laparotomy under general anaesthesia, the effect of preoperative variables on the development of AKI, and the association of post-operative AKI with patient outcomes. **Methods:** This prospective exploratory study in patients undergoing emergency laparotomy was followed up for 7 days to determine the incidence of post-operative AKI. We determined the patients developing different severity of AKI based on kidney disease improving global outcome staging. Fisher's exact test or Chi-squared test was used to study the association of demographic variables, and various periopertaive variables on the development of postoperative AKI. The association of AKI with the duration of hospital stay was estimated using the Wilcoxon–Mann–Whitney U Test, and Fisher's exact test was used to study the association between AKI and mortality. **Results:** No patient had AKI in the pre-operative period. On day 3, 18 patients; on day 5, 28 patients; and on day 7, 24 patients developed AKI. Overall, a maximum of 33 patients (out of 100) developed AKI at any time. Our study found that the American Society of Anesthesiologists (ASA) IV and sepsis were independent risk factors for post-operative AKI. Our results also show a moderate-to-high independent association between AKI and duration of hospital stay and mortality (within 30 days). **Conclusion:** Incidence of post-operative AKI following emergency laparotomy was 33%. Higher preoperative ASA physical status and sepsis were significantly associated with postoperative AKI development.

Keywords: Acute kidney injury, anaesthesia, emergency, laparotomy, postoperative care

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INTRODUCTION

Laparotomy is a common abdominal surgery performed for various indications, either as an elective or emergency procedure. When undertaken as an emergency procedure, there is inadequate time for optimising the patients, and patients at presentation are usually sick. This can result in both surgical and medical complications in the perioperative period. These include pneumonitis, urinary tract infection, sepsis, septic shock, adult respiratory distress syndrome, acute kidney injury (AKI), and multi-organ failure.[1,2]

AKI has been shown to occur in the post-operative period after major surgical procedures, with an

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incidence rate of 6.7%–49.9%.[3,4] Risk factors for AKI after emergency laparotomy include preoperative renal insufficiency, sepsis, preoperative dehydration, intraoperative blood transfusion, intra-abdominal hypertension, use of nephrotoxic drugs, inadequate fluid resuscitation during the perioperative period, repeated contrast studies, and preparation of bowel for surgeries.[5]

A study[6] conducted on 161,185 patients undergoing major surgeries by using the Kidney Disease: Improving Global Outcomes (KDIGO) guidelines showed post-operative AKI in 11.8% of participants. However, to date, there are no studies conducted in developing countries like India on the incidence of postoperative AKI following emergency laparotomy. Thus, our study aimed to analyse the incidence (primary objective), outcome, and risk factors for AKI in patients undergoing emergency laparotomy under general anaesthesia.

METHODS

It was a prospective exploratory study conducted from September 2021 to August 2022. The Institutional Ethics Committee approved this study (vide approval number AIIMS/IEC/22/169, dated 11/06/2021), and it was registered in Clinical Trials Registry-India (vide registration number CTRI/2022/02/040415, www.ctri.nic.in/). The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines, and all procedures were done in accordance with the Helsinki Declaration of 1975, revised in 2013. The patients aged >18 years, either gender undergoing emergency laparotomy under general anaesthesia, with an American Society of Anesthesiologists (ASA) physical status I–IV were included. Patients diagnosed with end-stage renal disease, preoperative serum creatinine value >3 mg/dL (value >1.5 times the upper limit of normal, more likely to have pre-existing AKI), hourly urine output <0.5 mL/kg/h for more than 6 hours, systolic blood pressure <90 mmHg, mean arterial pressure <65 mmHg, requiring inotropes to maintain mean arterial pressure >65 mmHg, obstructive urological disease, left ventricular ejection fraction <45%, chronic liver disease, and those who do not give consent were excluded from the study.

In the preoperative room, after explaining the study, written informed consent was obtained for participation in the study and the use of the patient data for education and research. Preoperative (day 0) patient's blood pressure, pulse rate, oxygen saturation, respiratory rate, and temperature were noted.

Investigation reports such as complete blood count to know baseline haemoglobin, renal function tests for baseline blood urea, serum creatinine, hourly urine output, liver function tests, and the ratio of partial pressure of oxygen to the fraction of inspired oxygen (PaO_2/FiO_2) were documented. Sequential Organ Failure Assessment (SOFA) score was calculated to determine the presence of sepsis (SOFA score >2) in patients. Patients were then taken up for laparotomy under general anaesthesia, and the duration of surgery was noted. If the duration of surgery was >120 minutes, it was considered prolonged surgery as the same is shown to be associated with an increased incidence of AKI.[3]

Patient follow-up was done postoperatively on days 3, 5, and 7 with blood urea, serum creatinine, and urine output. AKI was assessed based on KDIGO guidelines and AKI was classified into three stages based on severity. Stage 1 is a rise in serum creatinine up to 1.5–1.9 times the baseline value, or >0.3 mg/dL increase from baseline, or a urine output of <0.5 mL/kg/h for 6–12 hours. Stage 2 includes the rise in serum creatinine up to 2.0–2.9 times from baseline or a urine output of <0.5 mL/kg/h for ≥12 hours. Stage 3 is a three-fold increase in serum creatinine from baseline with a urine output of <0.3 mL/kg/h for ≥24 hours, anuria for 12 hours, or an increase in serum creatinine up to 4.0 mg/dL (>353.6 mmol/L), or beginning of renal replacement therapy.

The incidence of AKI (KDIGO stage 1 and higher) in patients undergoing emergency laparotomy under general anaesthesia (within the first 7 days) was calculated. We determined the number (and percentage) of patients developing different levels of severity of AKI based on KDIGO staging. The effect of age, gender, body mass index (BMI), ASA, preoperative anaemia, preoperative sepsis, and duration of surgery >120 min on the development of post-operative AKI was studied. We also analysed the association of AKI with the duration of hospital stay, prolonged hospital stay, and mortality. Duration of hospital stay was defined as the number of days the patient had to stay in the hospital from surgery to discharge. Mortality was calculated for a period of up to 30 days.

As per a previous study,[4] the incidence of AKI following major surgery was calculated to be 49.9%. Using this value for sample size calculation in estimating the incidence of a binary outcome, using a 95% confidence interval, and assuming a maximum marginal error of 0.1, we calculated the sample size to be 96 participants. However, we decided to include 100 participants in our study to compensate for dropouts.

Data was recorded in MS Excel spreadsheet (Microsoft Corporation, USA). Statistical package for the Social Sciences version 23 (SPSS Inc., Chicago, IL, USA.) was used for data analysis. Descriptive statistics were elaborated in the form of mean (standard deviation) for continuous variables (i.e., age, weight, height, BMI, duration of surgery and SOFA score) and frequencies and percentages for categorical variables (i.e., gender, ASA physical status, duration of surgery >120 minutes, comorbidities). Group comparisons for non-normally distributed data (duration of hospital stay and AKI) were made using appropriate non-parametric tests in the form of the Wilcoxon–Mann–Whitney U Test. The Chi-squared test was used for group comparisons of categorical data. If the expected frequency in the contingency tables was <5 for >25% of the cells, we used Fisher's exact test instead. To study the strength of association between two variables, we used Cramer's V test (when both variables were categorical) or point-biserial correlation (when one variable was continuous and one was categorical). We kept statistical significance at $P < 0.05$.

RESULTS

We assessed 128 patients for eligibility for possible inclusion in our study. Of these, 100 were included [Figure 1].

The demographic profiles of the patients are given in Table 1. The preoperative diagnosis is mentioned in Supplementary Table 1. The distribution of hourly urine output and serum creatinine is shown in Supplementary Table 2. No patient had AKI in the preoperative period. On day 3, 18% patients developed AKI; on day 5, 28% of patients had AKI; on day 7, 24% of patients had AKI [Figure 2]. Overall, 33% of patients developed AKI post laparotomy, with 11% of patients in KDIGO stage I, 8% in stage II, and 14% in stage III [Figure 2].

The effect of preoperative risk factors on the development of post-operative AKI was studied [Table 2

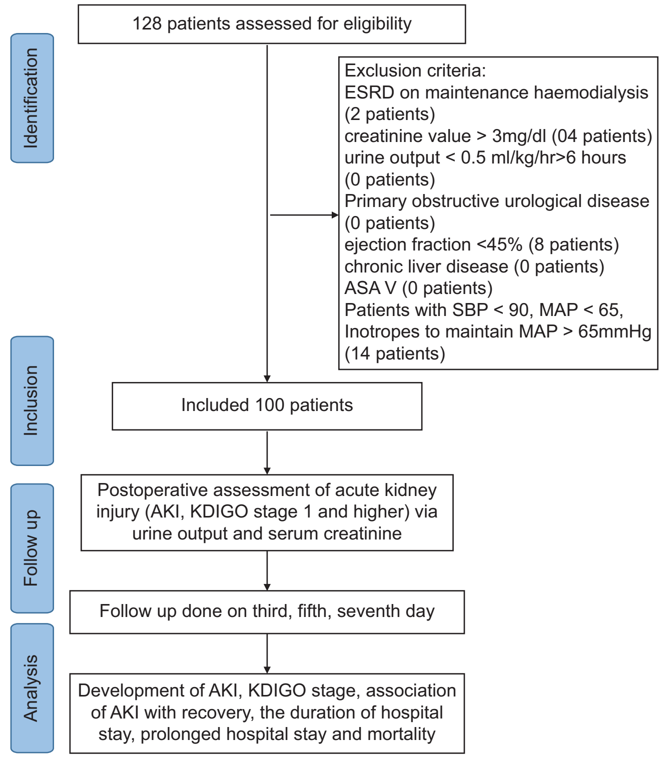

Figure 1: Participants flow diagram. AKI: Acute kidney Injury, ESRD: end-stage renal disease, ASA: American Society of Anesthesiologists physical status, KDIGO: Kidney Disease Improving Global Outcomes

Table 1: Patient demographics

Parameters	Mean (SD)/Number (Percentage) *n*=100
Age (years)	41.21 (15.81)
Gender- Male/Female	52 (52.0%)/48 (48.0%)
Weight (kg)	62.35 (8.70)
Height (m)	1.64 (0.08)
Body mass index (kg/m^2)	23.21 (2.77)
ASA physical status I/II/III/IV	30 (30%)/45 (45%)/10 (10%)/15 (15%)
Duration of surgery (min)	200.35 (55.01)
Duration of surgery >120 min	90 (90.0%)
Preoperative SOFA** Score	1.35 (1.21)
Sepsis (SOFA >2)	13 (13.0%)
Comorbidities	
Any	30 (30.0%)
Anaemia	22 (22.0%)
Smoker	19 (19.0%)
HTN	16 (16.0%)
DM	14 (14.0%)
Sepsis	13 (13.0%)
Hypothyroidism	6 (6.0%)
CAD	2 (2.0%)
Alcoholic	1 (1.0%)
ARDS	1 (1.0%)
PTB	1 (1.0%)

ASA physical status: American Society of Anesthesiologists Physical status classification, SOFA: Sequential Organ Failure Assessment score. HTN: Hypertension, DM: Diabetes mellitus, CAD: Coronary artery disease, ARDS: Acute respiratory distress syndrome, PTB: Pulmonary tuberculosis, *n*-number of patients

Table 2: Association between preoperative factors and acute kidney injury (*n*=100)

Parameters		AKI (Day 3)	AKI (Day 5)	AKI (Day 7)	AKI (Any time)
Age (Years)	18–30 (*n*=35)	3 (8.6%)	6 (17.1%)	5 (14.7%)	9 (25.7%)
	31–40 (*n*=17)	7 (41.2%)	7 (41.2%)	3 (18.8%)	7 (41.2%)
	41–50 (*n*=18)	2 (11.1%)	5 (27.8%)	3 (17.6%)	5 (27.8%)
	51–60 (*n*=16)	1 (6.2%)	3 (18.8%)	3 (18.8%)	3 (18.8%)
	61–70 (*n*=11)	4 (36.4%)	6 (54.5%)	7 (63.6%)	7 (63.6%)
	71–80 (*n*=3)	1 (33.3%)	1 (33.3%)	1 (33.3%)	2 (66.7%)
	P	0.016[1]***	0.135[1]	0.031[1]***	0.101[1]
Gender	Male (*n*=52)	10 (19.2%)	15 (28.8%)	11 (22.0%)	17 (32.7%)
	Female (*n*=48)	8 (16.7%)	13 (27.1%)	11 (23.9%)	16 (33.3%)
	P	0.739[2]	0.844[2]	0.824[2]	0.946[2]
BMI (Kg/m^2)	<18.5 (*n*=3)	0 (0.0%)	1 (33.3%)	0 (0.0%)	1 (33.3%)
	18.5–22.9 (*n*=46)	9 (19.6%)	10 (21.7%)	9 (20.0%)	13 (28.3%)
	23.0–24.9 (*n*=22)	4 (18.2%)	7 (31.8%)	6 (30.0%)	9 (40.9%)
	25.0–29.9 (*n*=29)	5 (17.2%)	10 (34.5%)	7 (25.0%)	10 (34.5%)
	P	1.000[1]	0.578[1]	0.717[1]	0.781[1]
ASA physical status	I (*n*=30)	4 (13.3%)	4 (13.3%)	2 (6.7%)	6 (20.0%)
	II (*n*=44)	4 (9.1%)	11 (25.0%)	10 (22.7%)	13 (29.5%)
	III (*n*=10)	1 (10.0%)	3 (30.0%)	4 (40.0%)	4 (40.0%)
	IV (*n*=15)	9 (60.0%)	10 (66.7%)	6 (54.5%)	10 (66.7%)
	P	<0.001[1]***	0.003[1]***	0.004[1]***	0.016[2]***
Anaemia	Yes (*n*=22)	5 (22.7%)	9 (40.9%)	9 (42.9%)	11 (50.0%)
	No (*n*=78)	13 (16.7%)	19 (24.4%)	13 (17.3%)	22 (28.2%)
	P	0.536[1]	0.127[2]	0.020[1]***	0.055[2]
Sepsis	Yes (*n*=13)	10 (76.9%)	11 (84.6%)	7 (77.8%)	11 (84.6%)
	No (*n*=87)	8 (9.2%)	17 (19.5%)	15 (17.2%)	22 (25.3%)
	P	<0.001[1]***	<0.001[1]***	<0.001[1]***	<0.001[1]***
Duration of surgery >120 min	Yes (*n*=90)	14 (15.6%)	24 (26.7%)	18 (20.9%)	29 (32.2%)
	No (*n*=10)	4 (40.0%)	4 (40.0%)	4 (40.0%)	4 (40.0%)
	P	0.077[1]	0.460[1]	0.230[1]	0.726[1]

***Significant at $P<0.05$, 1: Fisher's exact test, 2: Chi-squared test, AKI: Acute kidney injury, BMI: Body mass index, ASA: American Society of Anesthesiologists, *n*=number of patients

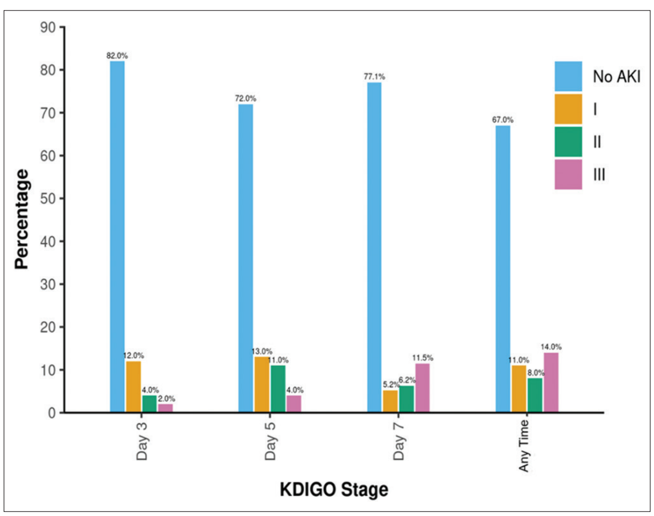

Figure 2: Bar graph depicts the distribution of Kidney Disease Improving Global Outcomes Stage/Acute kidney injury in post-laparotomy patients. KDIGO: Kidney Disease Improving Global Outcomes, AKI: Acute kidney injury

and Supplementary Table 3]. There was a significant difference between the various age groups in terms of the distribution of AKI on day 3 (moderate association) [Table 2]. Participants in the group aged 31–40 years had the largest proportion of AKI on day 3. There was a significant difference between the various age groups in terms of the distribution of AKI (day 7) (moderate association), and participants in the group aged 61–70 years had the largest proportion of AKI. There was no significant difference between various groups in terms of the distribution of AKI at any time.

There was a significant difference between the various ASA physical status patient groups in terms of the distribution of AKI (moderate association) [Table 2]. The ASA-IV participants had the most significant proportion of AKI (on days 3, 5, 7, and any time). There was a significant difference between the anaemic and non-anaemic patients in terms of distribution of AKI on day 7 [$\chi^2 = 6.050$, $P = 0.020$; Cramer's V = 0.25 (low association)] [Table 2] [Supplementary Table 2]. At the rest of the time points (i.e., days 3, 5, and any time), we did not find any significant association between preoperative anaemia and the development of AKI. There was a significant association between sepsis and the distribution of AKI on day 3 (high association) [Table 2] and days 5, 7, and any time (moderate association). The odds ratio (95% CI) of developing AKI (at any time) with sepsis present was 10.67 (2.72–41.78), and the relative risk (95% CI) was 7.44 (2.4–23.55). We could not find any significant association between gender [Table 2, B], BMI [Table 2], duration of surgery >120 min [Table 2], and development of post-operative AKI at any of the time points.

There was a significant difference between the two groups (AKI and no AKI, at any time) in terms of duration of hospital stay [W = 1389.5, $P = 0.027$; point-biserial correlation = 0.37 (large effect size)] [Table 3]. There was a significant difference between the various groups (AKI and no AKI) in terms of mortality on days 3, 5, 7, and any time (high association) [Tables 4 and 5].

DISCUSSION

In this prospective observational exploratory study of patients undergoing emergency laparotomy, we found that AKI had a total incidence of 33% (at any time) during the first 7 days after the surgery. Incidence of AKI after

Table 3: Association between duration of hospital stay and acute kidney injury (*n*=100)

Duration of Hospital Stay	AKI (Day 3)		Wilcoxon–Mann–Whitney *U* Test		
	Yes	No	Mann–Whitney statistic (W)	Point-biserial correlation	*P*
Mean (SD)	10.11 (4.66)	8.01 (1.47)	895.500	0.33	0.134
Median (IQR)	8 (7.25–15)	8 (7–8)			
Min– Max	5–18	7–16			
	AKI (Day 5)				
	Yes	No			
Mean (SD)	10.04 (4.17)	7.75 (0.71)	1305.000	0.42	0.015*
Median (IQR)	8 (7.75–15)	8 (7–8)			
Min–Max	5–18	7–10			
	AKI (Day 7)				
	Yes	No			
Mean (SD)	11.18 (3.95)	7.74 (0.68)	1272.000	0.6	<0.001*
Median (IQR)	9 (8–15)	8 (7–8)			
Min–Max	7–18	7–10			
	AKI (Any Time)				
	Yes	No			
Mean (SD)	9.70 (3.92)	7.75 (0.70)	1389.500	0.37	0.027*
Median (IQR)	8 (7–12)	8 (7–8)			
Min–Max	5–18	7–10			

*Significant at $P<0.05$, AKI: Acute kidney injury, Min–Max: minimum–maximum, SD: standard deviation, IQR: interquartile range

Table 4: Association between mortality and acute kidney injury (*n*=100)

AKI (Day 3)	Mortality			Fisher's exact test		
	Yes	No	Total	χ^2	Cramer's V	*P*
Yes	12 (70.6%)	6 (7.2%)	18 (18.0%)	38.376	0.62	<0.001
No	5 (29.4%)	77 (92.8%)	82 (82.0%)			
Total	17 (100.0%)	83 (100.0%)	100 (100.0%)			
AKI (Day 5)						
Yes	17 (100.0%)	11 (13.3%)	28 (28.0%)	52.668	0.73	<0.001
No	0 (0.0%)	72 (86.7%)	72 (72.0%)			
Total	17 (100.0%)	83 (100.0%)	100 (100.0%)			
AKI (Day 7)						
Yes	13 (100.0%)	9 (10.8%)	22 (22.9%)	50.576	0.73	<0.001
No	0 (0.0%)	74 (89.2%)	74 (77.1%)			
Total	13 (100.0%)	83 (100.0%)	96 (100.0%)			
AKI (Any Time)				Chi-squared test		
				χ^2	Cramer's V	*P*
Yes	17 (100.0%)	16 (19.3%)	33 (33.0%)	41.585	0.64	<0.001
No	0 (0.0%)	67 (80.7%)	67 (67.0%)			
Total	17 (100.0%)	83 (100.0%)	100 (100.0%)			

Data expressed as numbers (percentages). AKI: acute kidney injury, n: number of patients

Table 5: Odds ratios and relative risks

Predictor/Risk Factor	Outcome	Odds Ratio (95% CI)	Relative Risk (95% CI)
AKI (Day 3): Yes	Mortality: Yes	30.8 (8.12–116.88)	10.93 (4.53–26.54)
AKI (Day 5): Yes	Mortality: Yes	220.65 (12.4–3927.38)	Inf (11.93–Inf)
AKI (Day 7): Yes	Mortality: Yes	211.74 (11.62–3857.03)	Inf (11.9–Inf)
AKI (Any Time): Yes	Mortality: Yes	143.18 (8.18–2505.67)	Inf (9.44–Inf)

AKI: acute kidney injury, CI: confidence interval

days 3,5, and 7 were 18%, 28%, and 22%, respectively. Our study found that ASA physical status IV and sepsis were independent risk factors for post-operative AKI. Patients in the age group of 31–40 years had the highest incidence of AKI on day 3. Old age (61–70 years) and anaemia were risk factors for AKI on day 7, but the overall association was not statistically significant. Our results also showed a moderate-to-high independent association between AKI and duration of hospital stay and mortality (within 30 days).

Our findings were similar to a study on 239 patients undergoing emergency laparotomy,[7] which reported an AKI incidence of 39.7%. Another study conducted on 10,538 adult patients who underwent major surgeries found an incidence of post-operative AKI of 32%.[8] However, a study[9] conducted in 5,862,657 emergency general surgery procedures reported an incidence of 7.4%. The reported incidence was less due to the inclusion of laparoscopic surgeries, low-risk emergency surgeries such as cholecystectomy and appendectomy, and proper fluid resuscitation in emergency surgeries.

A study[10] on 251 patients who underwent explorative laparotomy and temporary abdominal closure found that age >65 years was a predictive factor for AKI stage II and stage III, 48 hours after temporary abdomen closure. We could not find any significant impact of increasing age on the overall incidence of AKI, probably due to the lower sample size used in our study. Our study found that there was a significant association between ASA physical status and the development of AKI. In a similar study[11] on patients undergoing major abdominal surgeries, AKI occurred more in patients with ASA V. On multivariate logistic regression analysis, ASA physical status was found to be an independent risk factor for the development of AKI. Furthermore, in a study by STARSurg Collaborative,[12] ASA physical status was one of the strongest predictors of the development of post-operative AKI.

Previous studies have found an association between AKI and anaemia. A previous study[2] found an AKI incidence of 44.9% in patients with preoperative anaemia ($P = 0.01$). In another study, AKI incidence was found to be 42% (446/1042) in chronic anaemia patients compared to an overall incidence of 32%;[8] 11 out of 13 with sepsis had AKI, and 22 out of 87 without sepsis had post-operative AKI ($p = < 0.001$). Similar findings were reported in another study,[2] which reported an AKI incidence of 22.5% in sepsis patients. Another study[8] on 10,538 patients with sepsis reported an AKI incidence of 11%.

Patients with AKI had a mean duration of hospital stay of 10 days, and the duration of hospital stay in patients without AKI was 8 days. Similar findings were reported in another study,[13] which found that patients with AKI had prolonged hospital stay with a mean duration of 15 days versus 10 days in patients without AKI.

In our study, overall mortality was 17%. In patients with AKI, 57.5% mortality was reported, and no mortality was reported in patients without AKI. No mortality in non-AKI patients could be due to the low sample size used in our study. Another study found a mortality of 14% in all patients and 30% in AKI patients.[10] Similarly, a study on 10,022 patients undergoing abdominal surgeries found 30-day mortality to be 17.8% in patients with AKI and 2.1% in patients without AKI ($P < 0.001$).[14] This high mortality may be due to the development of AKI and the presence of other factors, such as sepsis and old age, which resulted in AKI.

Our study had certain limitations. Firstly, the small sample size may have impacted some of our outcomes. Secondly, ours was a single-institution study; because peri-operative management varies from institution to institution, AKI's incidence and outcomes may differ. Thirdly, we did not include patients <18 years of age, hemodynamically unstable patients requiring inotropes, and pregnant patients. Including such cases might have influenced the results. Finally, we used available serum creatinine in the pre-operative period as a baseline value. Because previous serum creatinine values were not available in most cases, we could not check if there was a rise in serum creatinine. However, we used pre-operative serum creatinine value >3 mg/dL (value >1.5 times the upper limit of normal, more likely to have pre-existing AKI) as an exclusion criterion.

CONCLUSION

Our study found that the incidence of post-operative AKI following emergency laparotomy was 33% in the Indian population with varying degrees of severity. Pre-operative high ASA grade and sepsis were found to be significantly associated with the development of post-operative AKI. AKI was significantly associated with increased duration of hospital stay and higher mortality.

Statement on data sharing

De-identified data may be requested with reasonable justification from the authors (e-mail to the corresponding author) and shall be shared after approval as per the authors' Institution policy.

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Conflicts of interest

There are no conflicts of interest.

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Supplementary Table 1: Pre-operative diagnosis		
Pre-operative diagnosis	**Number of patients**	**Percentage (%)**
Perforation peritonitis	28	28
Acute intestinal obstruction	26	26
Acute intestinal obstruction with right obstructed hernia	01	01
Acute intestinal obstruction with volvulus	02	02
Anorectal carcinoma with acute intestinal obstruction	04	04
Appendicular perforation	02	02
Bladder perforation	02	02
Blunt trauma abdomen	02	02
Ca ovary with bleeding	02	02
Carcinoma stomach with intestinal obstruction	01	01
Duodenal perforation	02	02
Grade III pancreatic injury	02	02
Gastric perforation	01	01
Grade IV liver injury	01	01
Hollow viscous perforation	03	03
Ileal perforation	06	06
Koch abdomen	01	01
Multiple ileal perforation	01	01
Necrotising pancreatitis	02	02
Obstructed incisional hernia	01	01
Post-cholecystectomy post-choledochotomy bile leak	01	01
Post dilatation and curettage uterine perforation	01	01
Postpartum haemorrhage	01	01
Prepyloric perforation	01	01
Rectosigmoid perforation	01	01
Ruptured ectopic pregnancy	03	03
Sigmoid perforation	01	01

Supplementary Table 2: Distribution of urine output (mL/h) and serum creatinine (mg/dL)			
	Mean (SD)	**Median (IQR)**	**Min–Max**
Urine Output (mL/h)			
Pre-operative	77.70 (10.45)	80.00 (70.00–85.00)	40.0–95.0
Day 3	55.45 (13.26)	60.00 (50.00–60.00)	20.0–75.0
Day 5	54.11 (14.58)	60.00 (50.00–60.00)	15.0–70.0
Day 7	53.32 (14.59)	60.00 (53.00–60.00)	15.0–70.0
Serum Creatinine (mg/dL)			
Pre-operative	0.87 (0.51)	0.70 (0.51–1.10)	0.2–2.9
Day 3	0.91 (0.54)	0.70 (0.51–1.19)	0.2–3.0
Day 5	0.92 (0.58)	0.72 (0.53–1.20)	0.2–2.9
Day 7	0.89 (0.61)	0.65 (0.51–0.94)	0.2–3.4

"mL" denotes millilitre, h: hour, "mg" denotes milligram, dL: decilitre, SD: standard deviation, IQR: interquartile range, min: minimum, max: maximum

Supplementary Table 3: Association between Pre-operative variables and development of AKI (*n*=100)

Parameters	Age (Years) (A)						χ^2	Cramer's V	*P*
	18–30 (*n*=35)	31–40 (*n*=17)	41–50 (*n*=18)	51–60 (*n*=16)	61–70 (*n*=11)	71–80 (*n*=3)			
AKI (Day 3) (Yes)***	3 (8.6%)	7 (41.2%)	2 (11.1%)	1 (6.2%)	4 (36.4%)	1 (33.3%)	13.361	0.37	0.016[1]
AKI (Day 5) (Yes)	6 (17.1%)	7 (41.2%)	5 (27.8%)	3 (18.8%)	6 (54.5%)	1 (33.3%)	8.077	0.28	0.135[1]
AKI (Day 7) (Yes)***	5 (14.7%)	3 (18.8%)	3 (17.6%)	3 (18.8%)	7 (63.6%)	1 (50.0%)	13.035	0.37	0.031[1]
AKI (Any time) (Yes)	9 (25.7%)	7 (41.2%)	5 (27.8%)	3 (18.8%)	7 (63.6%)	2 (66.7%)	9.253	0.3	0.101[1]

Parameters	Gender (B)		*P*
	Male (*n*=52)	Female (*n*=48)	
AKI (Day 3) (Yes)	10 (19.2%)	8 (16.7%)	0.739[2]
AKI (Day 5) (Yes)	15 (28.8%)	13 (27.1%)	0.844[2]
AKI (Day 7) (Yes)	11 (22.0%)	11 (23.9%)	0.824[2]
AKI (Any Time) (Yes)	17 (32.7%)	16 (33.3%)	0.946[2]

Parameters	BMI (C)				*P*
	<18.5 kg/m^2 (*n*=3)	18.5–22.9 kg/m^2 (*n*=46)	23.0–24.9 kg/m^2 (*n*=22)	25.0–29.9 kg/m^2 (*n*=29)	
AKI (Day 3) (Yes)	0 (0.0%)	9 (19.6%)	4 (18.2%)	5 (17.2%)	1.000[1]
AKI (Day 5) (Yes)	1 (33.3%)	10 (21.7%)	7 (31.8%)	10 (34.5%)	0.578[1]
AKI (Day 7) (Yes)	0 (0.0%)	9 (20.0%)	6 (30.0%)	7 (25.0%)	0.717[1]
AKI (Any Time) (Yes)	1 (33.3%)	13 (28.3%)	9 (40.9%)	10 (34.5%)	0.781[1]

Parameters	ASA (D)				χ^2	Cramer's V	*P*
	I (*n*=30)	II (*n*=44)	III (*n*=10)	IV (*n*=15)			
AKI (Day 3) (Yes)***	4 (13.3%)	4 (9.1%)	1 (10.0%)	9 (60.0%)	21.002	0.46	<0.001[1]
AKI (Day 5) (Yes)***	4 (13.3%)	11 (25.0%)	3 (30.0%)	10 (66.7%)	14.449	0.38	0.003[1]
AKI (Day 7) (Yes)***	2 (6.7%)	10 (22.7%)	4 (40.0%)	6 (54.5%)	12.273	0.36	0.004[1]
AKI (Any Time) (Yes)***	6 (20.0%)	13 (29.5%)	4 (40.0%)	10 (66.7%)	10.384	0.32	0.016[2]

AKI	Anaemia (E)		*P*
	Yes (*n*=22)	No (*n*=78)	
AKI (Day 3) (Yes)	5 (22.7%)	13 (16.7%)	0.536[1]
AKI (Day 5) (Yes)	9 (40.9%)	19 (24.4%)	0.127[2]
AKI (Day 7) (Yes)***	9 (42.9%)	13 (17.3%)	0.020[1]
AKI (Any time) (Yes)	11 (50.0%)	22 (28.2%)	0.055[2]

	Sepsis (F)		χ^2	Cramer's V	*P*
	Yes (*n*=13)	No (*n*=87)			
AKI (Day 3) (Yes)***	10 (76.9%)	8 (9.2%)	31.484	0.56	<0.001[1]
AKI (Day 5) (Yes)***	11 (84.6%)	17 (19.5%)	20.651	0.45	<0.001[1]
AKI (Day 7) (Yes)***	7 (77.8%)	15 (17.2%)	14.009	0.38	<0.001[1]
AKI (Any time) (Yes)***	11 (84.6%)	22 (25.3%)	15.291	0.39	<0.001[1]

	Duration Of Surgery >120 Minutes (G)		*P*
	Yes (*n*=90)	No (*n*=10)	
AKI (Day 3) (Yes)	14 (15.6%)	4 (40.0%)	0.077[1]
AKI (Day 5) (Yes)	24 (26.7%)	4 (40.0%)	0.460[1]
AKI (Day 7) (Yes)	18 (20.9%)	4 (40.0%)	0.230[1]
AKI (Any time) (Yes)	29 (32.2%)	4 (40.0%)	0.726[1]

***Significant at *P*<0.05, 1: Fisher's Exact Test, 2: Chi-Squared Test, AKI: Acute kidney injury, BMI: Body Mass Index, ASA: American Society of Anesthesiologists