Original Article

Incidence of acute kidney injury and its associated risk factors in patients undergoing elective oesophagectomy surgeries at a tertiary care cancer institute - A pilot prospective observational study

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ABSTRACT

Background and Aims: Acute kidney injury (AKI) is a significant postoperative complication. Multiple perioperative factors are implicated in the causation of AKI in the postoperative period in patients with oesophageal cancer. The study aimed to find out the incidence, causes and effects of AKI following oesophagectomy surgery. **Methods:** A prospective observational study was conducted in consecutive adult patients undergoing elective oesophagectomy at a tertiary cancer care hospital. Patients with preoperative chronic renal insufficiency (serum creatinine >1.5 mg/dl), AKI in the past and a history of renal replacement therapy were excluded. Serum creatinine values were measured on postoperative days 1, 3, 5, the day of discharge or day 15 and on the day of first follow-up or day 28, following oesophagectomy surgery. The incidence of AKI was measured using the 'Kidney Disease Improving Global Outcome' (KDIGO) criteria. **Results:** The incidence of AKI was 14.7% [95% confidence interval (CI) 9.9%, 20.7%] (i.e., 27/183) in patients who underwent elective oesophagectomy. AKI was associated with prolonged hospital stay [median- 13 days (interquartile range {IQR} 11–21.5) versus 9 days (IQR 8–12), $P < 0.001$] and increased in-hospital mortality (14.8% versus 1.3%, P 0.004, odds ratio = 13.2, 95% CI 2.3, 77.3). After multivariate analysis, age, anastomotic leak and use of vasopressors in the postoperative period were independent predictors of AKI. **Conclusion:** The incidence of AKI was 14.7% after elective oesophagectomy. AKI was associated with prolonged hospital stay and in-hospital mortality. Higher age, anastomotic leak and use of vasopressors in the postoperative period were independent predictors of AKI.

Keywords: Acute kidney injury, anaesthesia, creatinine, KDIGO, oesophageal cancer, oesophagectomy

INTRODUCTION

Oesophagectomy is a definitive treatment modality for patients with early and locally advanced oesophageal cancers, more often as a part of multimodality management. Major complications after oesophagectomy are common despite improvements in surgical techniques and postoperative care. Of these, acute kidney injury (AKI) is not only a potentially hazardous complication associated with chronic kidney disease, but also a cause of prolonged hospital

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stays, delayed return to the intended oncological treatment and poor clinical outcomes. Various perioperative factors associated with oesophageal cancers and surgery predispose the patient to develop postoperative AKI. These include old age, preoperative nutritional depletion, preoperative chemotherapy, presence of comorbidities, intraoperative fluid shifts, haemodynamic fluctuations, postoperative surgical complications, need for contrast-enhanced imaging and use of nephrotoxic antibiotics and other drugs. The reported incidence of AKI in the published literature varies widely between 2.4% and 35.3% across the world.[1-4] The reasons for the wide variations could be the heterogeneous populations, different practices of fluid administration and differences in the criteria used to diagnose AKI.

According to the Global Cancer Statistics, oesophageal cancer is the sixth most common cancer in the Indian population, with a reported incidence of 5.04%.[5] Little is known about the incidence of AKI following oesophagectomy in the Indian population. Hence, we conducted a prospective observational study to determine the incidence of AKI in patients undergoing elective oesophagectomy as a primary objective. The secondary objectives were to identify the risk factors for the development of AKI and its effect on perioperative outcomes, viz., duration of postoperative hospital stay and in-hospital mortality.

METHODS

We conducted a prospective observational study to determine the incidence of AKI and its associated risk factors in adult patients undergoing elective oesophagectomy in a tertiary cancer care hospital. After obtaining Institutional Ethics Committee (IEC) approval (vide approval number IEC/0719/3349/001 dated 17/07/2019) and registering the study at the Clinical Trials Registry- India (CTRI/2019/08/020656, dated 09/08/2019, accessible at https://ctri.nic.in/), the study was conducted from October 2019 to February 2022. The study was halted twice for a total duration of 5 months, that is, from 10 November 2019 to 31 December 2019, to seek IEC approval for an alternate method of reimbursement to the patients, and from 18 March 2020 to 29 June 2020 due to the coronavirus disease 2019 pandemic, when most of the study team members were absent due to national lockdown. The preoperative schedule list was screened to find eligible patients for the study. We included all consecutive adult patients undergoing elective oesophagectomy. Patients with preoperative chronic renal insufficiency (diagnosed by serum creatinine >1.5 mg/dl), patients with a history of AKI (i.e., previous medical records of kidney diseases, rise in serum creatinine or history of dialysis in the past as per their previous medical records) and patients with a history of receiving renal replacement therapy (RRT) were excluded from the study. Patients who had inoperable disease and those who died within 72 h of surgery were not considered for the analysis. Informed written consent was obtained, a day before surgery, from all patients for participation in the study and the use of the data for educational and research purposes only. The study was carried out in accordance with the principles of the Declaration of Helsinki, 2013 and good clinical practice.

Demographic details, comorbidities, concomitant medications, details of preoperative chemotherapy and preoperative functional status [determined by Eastern Cooperative Oncology Group (ECOG) score 0–5] were recorded in the case record form. Standard monitoring was instituted for all patients in the operation theatre. In our institute, we have a dedicated team of thoracic anaesthesiologists who conduct most of the thoracic surgeries. Perioperative management is standard based on the 'Enhanced Recovery After Surgery' protocols. Mid-thoracic epidural analgesia was used in all patients undergoing surgery with an open thoracotomy–laparotomy approach. In patients undergoing minimally invasive oesophagectomy (MIE), the choice of regional analgesia technique was left to the discretion of the anaesthesiologist. General anaesthesia with controlled ventilation was used in all patients. Anaesthesia was induced using standard intravenous (IV) induction agents (IV propofol 2 mg/kg or etomidate 0.3 mg/kg) and non-depolarising neuromuscular blocking drugs (IV vecuronium 0.1 mg/kg or atracurium 0.5 mg/kg), at the discretion of the anaesthesiologist, with lung isolation via a double-lumen tube or an endobronchial blocker for patients undergoing MIE. All patients received arterial blood pressure monitoring. Depth of anaesthesia was maintained using inhalational agents (viz. isoflurane or sevoflurane) titrated to the minimum alveolar concentration of 0.8–1.0. A self-retaining urinary catheter was inserted in all patients after induction of anaesthesia. The rate and type of IV fluids and blood products, choice of intraoperative systemic analgesics, and use of vasopressors and antiemetics were left to the clinical judgement of the anaesthesiologist. The use of colloids was left to the discretion of the anaesthesiologist. Commonly used colloids were either gelatin-based or human albumin-based solutions. However, starch-based solutions were not used in any of the patients as per the institutional policy. Intraoperative analgesia was offered using IV opioids (fentanyl or morphine in appropriate bolus doses), IV paracetamol (15 mg/kg) and IV diclofenac (1 mg/kg) at the discretion of the anaesthesiologist. Epidural analgesia using the local anaesthetic solution of bupivacaine (0.1%) mixed with fentanyl (2 μg/ml) was used judiciously during the surgery. Antibiotic prophylaxis (IV amoxicillin and clavulanic acid 20 mg/kg) was administered before incision. It was repeated intraoperatively if surgery took longer than 4 h. Intraoperative hypotension events (defined as a drop in mean arterial pressure >30% of baseline, which is recorded during preanaesthesia checkup) were treated with IV fluids, IV mephentermine 6 mg or vasopressor infusion, as per the judgement of the anaesthesiologist. An IV infusion of noradrenaline, titrated to maintain desired perfusion pressure, was the most commonly used vasopressor during intraoperative and postoperative periods. Data about sustained intraoperative hypotension (defined as a drop in mean arterial pressure >30% of baseline that persisted for more than 20 min), use of vasopressors, details of IV fluids administered and intraoperative blood loss were noted. The trachea was extubated at the end of the surgery if the patient was warm, awake and conscious with adequate respiratory efforts.

Postoperatively, the patients were nursed in the recovery ward or intensive care unit (ICU) for up to 24 h. Acute postoperative pain was managed by a dedicated 'acute pain service' team, which followed standard protocols to offer multimodal analgesia (oral and IV analgesics along with regional analgesic techniques) to all the patients undergoing oesophagectomy. IV paracetamol (15 mg/kg, three times a day) and non-steroidal anti-inflammatory drugs (IV diclofenac 1 mg per kg, two or three times a day) were used judiciously according to the investigations and clinical findings of the patient. Postoperative pain scores were maintained between 0 and 4 on the Numerical Rating Scale.

The primary outcome of the study was to find out the incidence of AKI in adult patients following elective oesophagectomy surgery under anaesthesia. The secondary outcomes were to find out the associated perioperative factors and the effect of AKI on postoperative outcomes like mortality and hospital stay. Preoperative serum creatinine, measured within a month before the surgery, was used as the baseline value. The occurrence of AKI following oesophagectomy was identified according to the Kidney Disease Improving Global Outcome (KDIGO) criteria.[6] The KDIGO criteria define AKI as an increase in serum creatinine by ≥0.3 mg/dl within 48 h or an increase in serum creatinine to 1.5 times the baseline value, which is known or presumed to have occurred within the previous seven days or urine volume <0.5 ml/kg/h for six consecutive hours. Accordingly, serum creatinine values were assessed on postoperative days 1, 3, 7, 15 or the day of discharge (whichever was later) and on the day of the first outpatient clinic follow-up or day 28 (whichever was later). In addition, the urine flow rate was monitored from the time of insertion of the self-retaining urinary catheter until the time the urinary catheter was removed in the postoperative period. Accordingly, patients who developed AKI in the postoperative period were considered as an 'AKI group', and those who did not develop AKI were considered as a 'non-AKI group'. Perioperative factors and postoperative outcomes were compared between the two groups. The occurrence of postoperative complications was noted daily by the member of the study team until the time of discharge from the hospital or death of the patient. Surgeons and the ICU team jointly managed the postoperative complications as per the standard institutional protocols. The length of ICU and hospital stay and postoperative outcomes were noted.

We included 183 consecutive cases undergoing oesophagectomy at a high-volume tertiary referral centre. Continuous variables [age, height, weight, body mass index (BMI), duration of surgery, serum albumin levels, quantity of IV fluids, postoperative hospital stay, etc.] were expressed as mean and standard deviation and categorical variables were expressed as frequency and percentage. Two by two, contingency tables were plotted for perioperative variables against the occurrence of AKI. Categorical data (comorbidities, occurrence of postoperative complications, etc.) were compared using the Chi-square test or Fisher's exact test. For normally distributed continuous variables (age, BMI, height, weight, etc.), means were compared using the independent *t*-test. For those variables which were not normally distributed (serum albumin, intraoperative blood loss, postoperative hospital stay, etc.), medians with interquartile range (IQR) were compared using the Mann–Whitney *U* test. Variables with a *P* value <0.05 on univariate analysis and those found significantly associated in previous studies were included in multivariate analysis. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated. The receiver operating characteristic (ROC) curve was plotted to determine the area under the curve (AUC) to test the goodness of fit of the model. We considered a *P* value <0.05 (two-tailed) to be statistically significant.

RESULTS

Between October 2019 and February 2022, we accrued 183 patients in the study, except during the periods when the study was halted [Figure 1]. The demographic details of the population are shown in Table 1.

Of the 183 patients, 27 patients (14.7%, 95% CI: 9.9%, 20.7%) developed AKI in the postoperative period [stage 1 AKI: 15/183 (8.2%), stage 2 AKI: 7/183 (3.8%), stage 3 AKI: 5/183 (2.7%)]. Stage 1 and 2 AKI occurred in the early postoperative period and recovered by the seventh postoperative day in all patients. Stage 3 AKI persisted until the 28^{th} postoperative day in two patients. RRT was used in two patients; however, both patients died in the third week following the surgery. The median duration of hospital stay was significantly prolonged in patients with AKI [13 days (IQR: 11–21.5) versus 9 days (IQR: 8–12) ($P < 0.001$)]. The in-hospital mortality rate was significantly higher in patients with AKI compared to those without AKI (14.8% versus 1.3%, *P*- 0.004, OR = 13.2, 95% CI: 2.3, 77.3).

Perioperative factors that were significantly associated with the incidence of AKI are shown in Table 2. The following variables were considered for a multivariate logistic regression analysis based on their significant association with the incidence of AKI on univariate analysis: age, ECOG status, preoperative albumin levels, total blood loss, intraoperative use of vasopressors, mechanical ventilation, anastomotic leak, postoperative use of vasopressors, exploration under general anaesthesia, use of contrast-enhanced computed tomography scan, postoperative arrhythmia and postoperative pulmonary complications. After multiple imputations, three independent predictors of AKI were identified, viz., age of the patient (OR = 5.4, 95% CI: 1.9, 15.9, *P*-0.002; cutoff for age was identified as 57 years by ROC curve analysis), use of vasopressors in the postoperative period (OR = 4.2, 95% CI: 1.6, 10.7, *P*-0.003) and occurrence of anastomotic leak (OR = 4.4, 95% CI: 1.2, 17.0, *P*- 0.029). A ROC curve was plotted to know the goodness of fit of the multivariate model. The AUC of the model was 0.789 (95% CI: 0.70, 0.87) [Figure 2].

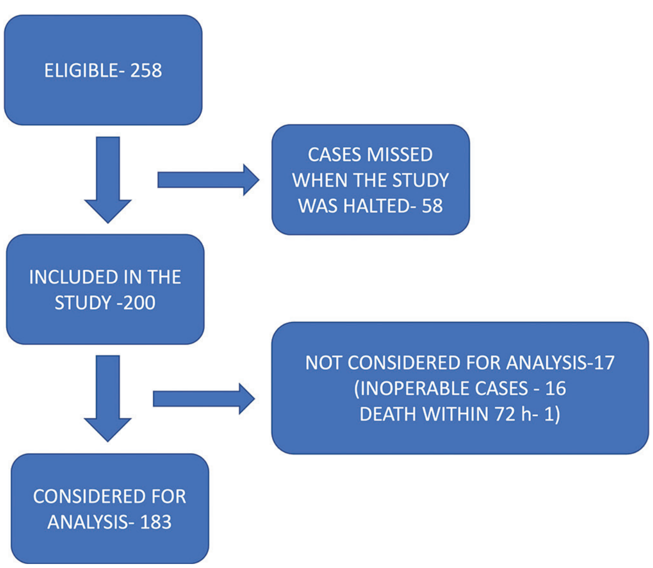

Figure 1: Flow chart for recruitment of patients

DISCUSSION

In this prospective observational study, the incidence of AKI in patients undergoing elective oesophagectomy surgery was 14.7%. Higher age, postoperative use of vasopressors and occurrence of anastomotic leak were independent predictors of AKI. Postoperative AKI was associated with higher in-hospital mortality and length of hospital stay.

Table 1: Demographic details of the population

Variable	Value
Age (years), mean (SD)	54.4 (11.8)
Gender – male/female, *n*	98/85
Height (cm), mean (SD)	159.5 (9.9)
Weight (kg), mean (SD)	55.8 (13.5)
BMI (kg/m^2), mean (SD)	21.9 (4.4)
ASA physical status- I/II/III, *n*	81/93/9
ECOG performance status - 0/1/2, *n*	28/138/27
Types of surgeries (*n*=183)	
• Transthoracic oesophagectomy, *n*	124
• Ivor Lewis oesophagectomy, *n*	30
• Transhiatal oesophagectomy, *n*	3
• Lateral thoracoabdominal oesophagectomy, *n*	26
Approach of surgeries (*n*=183)	
• Open, *n*	116
• VATS + laparoscopic, *n*	47
• Robotic, *n*	20
Duration of surgery (min), mean (SD)	327 (102)

Data expressed as mean (SD) or number. ASA=American Society of Anesthesiologists, BMI=Body mass index, ECOG=Eastern Cooperative Oncology Group, SD=Standard deviation, VATS=Video-assisted thoracoscopic surgery, *n*=number of patients

Table 2: Association of perioperative factors with incidence of AKI

Variable	AKI group (*n*=27)	Non-AKI group (*n*=156)	Total (*n*=183)	Odds ratio	95% Confidence interval		*P*
					Upper	Lower	
ECOG performance grade 0	2 (7.4%)	26 (16.7%)	28 (15.3%)				0.009
ECOG performance grade 1	18 (66.7%)	120 (76.9%)	138 (75.4%)	0.513	0.112	2.347	0.390
ECOG performance grade 2	7 (25.9%)	10 (6.4%)	17 (9.2%)	0.110	0.019	0.621	0.012
Age (years), mean (SD)	61.8 (6.7)	53.1 (12)	54.4 (11.8)	6.000	2.160	16.667	<0.001
BMI (kg/m^2), mean (SD)	22.4 (4.6)	21.8 (4.3)	21.9 (4.4)	1.031	0.941	1.13	0.509
Albumin (g/dl), median [IQR]	3.8 [3.6–3.9]	3.9 [3.7–4.2]	3.9 [3.7–4.2]	2.52	0.966	6.900	0.023
Preoperative paclitaxel-based chemotherapy	19 (70.4%)	96 (61.5%)	115 (62.8%)	1.484	0.612	3.603	0.508
No preoperative paclitaxel-based chemotherapy	8 (29.6%)	60 (38.5%)	68 (37.2%)				
Preoperative carboplatin-based chemotherapy	15 (55.6%)	66 (42.3%)	81 (44.3%)	1.705	0749	3.881	0.284
No preoperative carboplatin-based chemotherapy	12 (44.4%)	90 (57.7%)	102 (55.7%)				
Preoperative cisplatin-based chemotherapy	10 (37.0%)	47 (30.1%)	57 (31.1%)	1.364	0.582	3.200	0.623
No preoperative cisplatin-based chemotherapy	17 (63.0%)	109 (69.9%)	126 (68.9%)				
History of hypertension	8 (29.6%)	32 (20.6%)	40 (21.8%)	1.618	0.649	4.033	0.430
No history of hypertension	19 (70.4%)	123 (79.4%)	142 (77.6%)				
Missing data	0	1 (0.6%)	1 (0.5%)				
History of diabetes mellitus	1 (3.7%)	1 (0.6%)	2 (1.1%)	5.923	0.359	97.57	0.214
No history of diabetes mellitus	26 (96.3%)	154 (98.7%)	180 (98.4%)				
Missing data	0	1 (0.6%)	1 (0.5%)				
Intraoperative crystalloid fluid (ml), mean (SD)	2440.7 (424.5)	2251.3 (644.5)	2279.2 (619.7)	1.000	0.999	1.000	0.276
Number of patients receiving colloid	13 (48%)	58 (37%)	71 (38.7%)	1.000	0.998	1.001	0.074
Intraoperative use of vasopressor	9 (33.3%)	21 (13.5%)	30 (16.4%)	3.403	1.343	8.623	0.010
No intraoperative need for vasopressor	17 (62.9%)	135 (86.5%)	152 (83.1%)				
Missing data	1 (3.7%)	0	1 (0.5%)				
Total blood loss (ml), median [IQR]	600 [400–775]	400 [300–600]	400 [300–600]	0.999	0.998	1.000	0.045
Need for postoperative use of vasopressor	13 (48.1%)	23 (14.7%)	36 (19.6%)	5.289	2.204	12.692	<0.001
No need for postoperative use of vasopressor	14 (51.9%)	133 (85.2%)	147 (80.3%)				
Required mechanical ventilation	13 (48.1%)	26 (16.7%)	39 (21.4%)	4.607	1.941	10.937	0.001
No requirement for mechanical ventilation	14 (51.9%)	130 (83.3%)	144 (78.6%)				
Requirement of postoperative antibiotics	16 (59.2%)	47 (30.1%)	63 (34.4%)	2.481	1.048	7.702	0.012
No requirement for postoperative antibiotics	11 (40.7%)	107 (68.6%)	118 (64.5%)				
Missing data	0	2 (1.2%)	2 (1.1%)				
Postoperative pulmonary complications	12 (44.4%)	29 (18.5%)	41 (22.4%)	2.750	1.161	6.516	0.003
No postoperative pulmonary complications	15 (55.6%)	127 (81.4%)	142 (76.5%)				
Arrhythmia	6 (22.2%)	4 (2.6%)	10 (5.5%)	10.786	2.810	41.397	<0.001
No arrhythmia	21 (77.8%)	152 (97.4%)	173 (94.5%)				
Anastomotic leak	7 (25.9%)	16 (10.3%)	23 (12.6%)	6.041	1.852	19.705	0.002
No anastomotic leak	20 (74.0%)	140 (89.7%)	160 (87.4%)				
Contrast-enhanced CT scan in the postoperative period	10 (37.0%)	25 (16.0%)	35 (19.2%)	3.059	1.252	7.454	0.014
No contrast-enhanced CT scan in the postoperative period	17 (63.0%)	131 (84%)	148 (80.8%)				
Exploration under GA	8 (29.6%)	11 (7.1%)	19 (10.4%)	5.512	1.970	15.420	0.001
No exploration under GA	19 (70.4%)	145 (92.9%)	164 (89.6)				
Use of NSAIDs in the postoperative period	19 (73.1%)	122 (81.9%)	141 (80.6%)	0.601	0.230	1.571	0.299
No use of NSAIDs in the postoperative period	7 (26.9%)	27 (18.1%)	34 (19.4%)				
Missing data	1 (3.7%)	7 (4.4%)	8 (4.3%)				

Data expressed as numbers (percentages). AKI=Acute kidney injury, BMI=Body mass index, CT=Computed tomography, ECOG=Eastern Cooperative Oncology Group, GA=General anaesthesia, IQR=Interquartile range, NSAID=Non-steroidal anti-inflammatory drug, SD=Standard deviation, *n*=number of patients

The reported incidence of AKI after oesophagectomy surgeries varies widely in previous studies. Wang *et al.*[3] reported an incidence of 2.4% in Chinese patients, whereas Lee *et al.*[2] found an incidence of 35.3% in Korean patients undergoing oesophagectomy. Konda *et al.*[1] and Murphy *et al.*[4] found AKI in 11.9% of American patients and 18.3% of British patients, respectively. Variations in perioperative fluid administration and different criteria used to diagnose AKI could be the reasons for the wide variations of AKI reported. Wang *et al.*[3] used the KDIGO criteria, whereas the other studies used the Acute Kidney Injury Network (AKIN) criteria to diagnose AKI.[1,2,4]

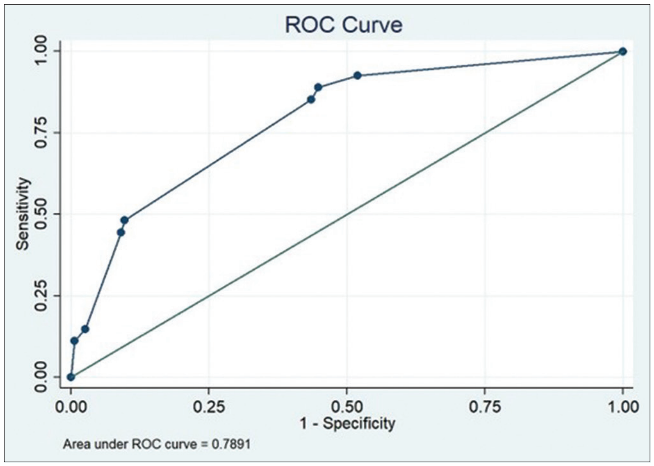

Figure 2: ROC curve. ROC = receiver operating characteristic

Although various risk factors (age, preoperative BMI, dyslipidaemia, comorbidities like hypertension, serum albumin and creatinine levels, use of angiotensin-converting enzyme inhibitors and use of perioperative colloids) were identified by different studies, a common risk factor identified by three studies was high BMI.[1,2,4] High BMI is associated with hypertension, dyslipidaemia and coronary artery disease. Visceral adiposity results in exaggerated systemic inflammation after surgical laparotomy.[7] Obesity is also associated with renal maladaptation and glomerulopathy.[8,9] The mean BMI of our population was 21.8 kg/m^2, which was less than the BMI noted in other studies. This could be the reason why BMI was not associated with AKI in our study. Murphy *et al*.[4] identified dyslipidaemia as a predictor of AKI following oesophagectomy, whereas Wang *et al*.[3] identified hypertension as an independent predictor of AKI. Konda *et al*.[1] found that the presence of comorbidities increased the risk of AKI. In contrast, consumption of antihypertensive medications like angiotensin-converting enzyme (ACE) inhibitors was associated with AKI in the study by Lee *et al*.[2] All these variables share a common pathophysiology – chronic vasculopathy. It impairs organ perfusion during stressful surgical periods. However, we could not find an association between comorbidities and the incidence of AKI.

The incidence of AKI increases if there is intraoperative renal hypoperfusion. The results of the 'RELIEF' study showed that the incidence of AKI increased following overly 'restrictive' fluid administration.[10] The administration of less IV fluids and optimisation of blood pressure using vasopressors have been the commonly followed approaches in recent times, especially in thoracic surgery. Interestingly, in the study by Konda *et al*.,[1] the mean volume of IV crystalloids was higher than that in the study by Lee *et al*.[2] (4062 versus 2764 ml), which seems to be the cause of high incidence of AKI reported by Lee *et al*. However, it must be noted that the duration of surgery (440 versus 370 min) was longer, and the mean BMI of the population (27 versus 23 kg/m^2) was higher in the study by Konda *et al*.[1] This could be the reason for the higher volumes of IV fluids in the study by Konda *et al*.[1] Another factor that could explain the high incidence of AKI in the study by Lee *et al*.[2] was the use of 6% hydroxyethyl starch (HES).[1,2] Studies in critically ill patients have shown the detrimental effect of starch on renal function.[11] In our study, the IV fluids used were mainly crystalloids such as Ringer's lactate and colloids (i.e. gelatine and human albumin) in nearly 40% of patients. None of the patients received HES in our study. However, we found no association between the type and volume of IV fluid and AKI.

Another important finding of the study was that AKI was significantly associated with postoperative complications and interventions. The requirement of vasopressors, the requirement of postoperative antibiotics, prolonged mechanical ventilation, anastomotic leaks, arrhythmia and postoperative pulmonary complications were associated with the development of AKI. In addition, certain postoperative interventions like contrast-enhanced computed tomography scans and exploration under general anaesthesia were significantly associated with AKI. Postoperative complications following oesophagectomy often have multisystemic involvement. These complications lead to systemic inflammation, haemodynamic instabilities and organ hypoperfusion. Nephrotoxicity occurs due to long periods of hypoperfusion and exposure to the contrast dye and antibiotics. In a study by Murphy *et al*.,[4] postoperative complications like pneumonia, atrial fibrillation and postoperative respiratory failure were found to be significantly associated with AKI. We found that the postoperative requirement of vasopressors and the occurrence of anastomotic leaks were independent predictors of AKI.

Several studies have shown that postoperative AKI following oesophagectomy is often mild (stage 1 of AKIN) and resolution occurs within 48 h in most patients.[1,2,4] Higher severity of AKI was noted in nearly 5% of cases and RRT was required in 1.9% of cases in the study by Lee *et al*.[2]

Our study had a few limitations. Firstly, ours is a single-centre study, and institutional practices could affect the results. Our study only involved 1-month follow-up after the surgery. As a result, the effect of AKI on the quality of life, 90-day mortality and return to the intended oncological treatment could not be found. Recently, novel biomarkers (e.g., neutrophil gelatinase-associated lipocalin, kidney injury molecule-1, etc.) have been described to help in the early detection and prognostication of AKI. These biomarkers were not used in our study. Postoperative sepsis is an important contributor to the occurrence of AKI. Although we assessed the requirement of postoperative antibiotics, we did not categorise postoperative infection into various grades of sepsis. Our study had several strengths. It is one of the few prospective studies that determined the incidence of AKI in patients with oesophageal cancer undergoing surgery at a high-volume cancer centre, utilising objective and standard criteria to identify AKI. In a study comparing the predictive efficacy of three criteria to diagnose AKI, KDIGO was superior to AKIN and 'Risk, Injury, Failure, Loss and End-stage Kidney Disease' (RIFLE) in predicting mortality in critically ill patients.[12] We could identify the risk factors associated with this complication, which could help better monitor and utilise renoprotective mechanisms in these subgroups.

CONCLUSION

The incidence of AKI following an oesophagectomy surgery was 14.7%. Age, postoperative anastomotic leak and requirement of vasopressors in the postoperative period were the independent risk factors for the development of AKI. AKI was significantly associated with prolonged hospital stay and in-hospital mortality following oesophagectomy.

Study data availability

De-identified data may be requested with reasonable justification from the authors (email 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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