

ORIGINAL RESEARCH

Association of pre-operative estimated GFR on post-operative pulmonary complications in laparoscopic surgeries

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ABSTRACT

Background: To evaluate the association of pre-operative estimated GFR on post-operative pulmonary complications in laparoscopic surgery.

Materials & Methods: A total of 200 subjects who were undergoing laparoscopic surgery were included. The mean age was 56.2 years. The p-value <0.001 was considered significant. The results were analysed using SPSS software. **Results:** A single patient (constituting 0.5% of the total) encountered postoperative complications (PPCs) such as pneumonia or being on a ventilator for more than 48 hours, within the 30 days following the surgery.

Conclusion: It can be concluded that eGFR levels are linked to an elevated risk of experiencing post-operative pulmonary complications.

Keywords: GFR, pulmonary complications, laparoscopic surgery.

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INTRODUCTION

Post-operative pulmonary complications (PPCs) such as pneumonia, failure to wean off the ventilator, and post-extubation respiratory failure are the most frequent morbidity and causes of death after surgery.¹ The overall incidence of PPCs has been estimated to range from 2.0 to 10.0%.^{2,3} The American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP), which is a large national cohort, found that PPCs were by far most costly among post-operative complications.⁴ Therefore, it may improve patient outcome and reduce medical cost if an efficient strategy is developed to identify and manage patients at risk for PPCs. The occurrence of postoperative pulmonary complications (PPCs) is frequently observed and has been linked to elevated levels of morbidity and mortality, which have adverse effects on both clinical and financial outcomes in healthcare settings.⁵ The incidence of PPC varies depending on the clinical treatment setting, the type of surgery, and the definition of PPC used, ranging from 1% to 23%.⁶ Several studies have shown pulmonary complications to be more common than cardiac complications and more frequent following abdominal and thoracic surgery.⁷ Significant morbidity associated with PPC results from a higher

length of hospital stay due to the increased necessity for admission to intensive care units, with a possible need for re-intubation and ventilatory support.⁸ Therefore, the cost burden associated with PPCs is substantial to the point where preventing these pulmonary complications will be of enormous interest to the healthcare system.⁸ PPC is defined as any pulmonary abnormality occurring in the postoperative period that produces an identifiable disease or dysfunction that is clinically significant and adversely affects the clinical course after surgery.⁹ This leads to a wide variety of disorders ranging from self-limited alterations, such as mild degrees of atelectasis or bronchospasm, to more severe conditions with substantial morbidity and mortality, such as pneumonia or respiratory failure. The conventional definition of PPC includes conditions such as atelectasis, bronchospasm, pneumonia, and exacerbation of chronic lung disease.¹⁰ However, the list can be extended to include acute upper airway obstruction, complications from obstructive sleep apnea, pleural effusions, chemical pneumonitis, pulmonary edema, hypoxemia, and tracheal laceration or rupture.¹⁰ Hence, this study was conducted to evaluate the association of pre-operative estimated

GFR on post-operative pulmonary complications in laparoscopic surgery.

MATERIALS & METHODS

A total of 200 subjects who were undergoing laparoscopic surgery were included. The mean age was 56.2 years. The estimated glomerular filtration rate (eGFR) <30, 30 to <60, 60 to <90, 90 to <120, and ≥ 120 mL/min/1.73 m² were included. Laboratory investigations were done. The association of estimated GFR with post-operative pulmonary complications was noticed. Prevalence of diabetes, hypertension, chronic obstructive pulmonary disease, dyspnea at moderate exertion, and chronic heart failure, lower concentrations of serum albumin and hematocrit, and a lower prevalence of smoking

history was considered. The p-value <0.001 was considered significant. The results were analyzed using SPSS software.

RESULTS

A single patient (constituting 0.5% of the total) encountered postoperative complications (PPCs) such as pneumonia or being on a ventilator for more than 48 hours, within the 30 days following the surgery. There was a noticeable upward trend in the occurrence of PPCs as eGFR categories decreased. The frequency of PPCs stood at 0% for patients with eGFR ≥ 120 , 0% for those with eGFR between 90 and <120, 1.4% for eGFR between 60 and <90, 4% for eGFR between 30 and <60, and 8% for patients with eGFR less than 30 mL/min/1.73 m².

Table: 1 Pulmonary complications

Variable	Total	eGFR < 30	30 < eGFR < 60	60 < eGFR < 90	90 < eGFR < 120	eGFR > 120	P-value
N	200	12	25	68	80	15	-
Respiratory complications	1 (0.5%)	1 (8%)	1 (4%)	1 (1.4%)	0	0	<0.001
Pneumonia	1 (0.5%)	0	0	0	0	0	<0.001
Ventilator >48 hours	1 (0.5%)	1	1	0	0	0	<0.001
Unplanned re-intubation	1 (0.5%)	1	1	0	0	0	<0.001

DISCUSSION

Laparoscopy has been employed in many surgical procedures to reduce post-operative complications and promote patient recovery.¹¹ However, the use of laparoscopy can impair respiratory function through the formation of atelectasis and the ventilation-perfusion mismatch caused by the combined effects of supine position and muscle paralysis.¹² Pneumoperitoneum with carbon dioxide during laparoscopic surgeries causes cephalad displacement of the diaphragm and accelerates atelectasis formation, which decreases respiratory compliance and arterial oxygenation.^{13,14} These unfavorable conditions may be aggravated in the presence of CKD. Hence, this study was conducted to evaluate the association of pre-operative estimated GFR on post-operative pulmonary complications in laparoscopic surgery. In the present study, a single patient (constituting 0.5% of the total) encountered postoperative complications (PPCs) such as pneumonia or being on a ventilator for more than 48 hours, within the 30 days following the surgery. A study by Shimomura A et al, multivariable logistic regression analyses with 3-level hierarchical adjustments to identify the association of pre-operative estimated glomerular filtration rate (eGFR) with PPCs in laparoscopic surgeries. Among 452,213 patients between 2005 and 2013 in the American

College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) Database, a total of 3,727 patients (0.9%) experienced PPCs. In the case-mix adjusted model, a reverse-J-shaped association was observed; a small albeit significant association with the highest eGFR category emerged. Further adjustment slightly attenuated these associations, but the PPCs risk in the eGFR groups of <30, 30–60, and ≥ 120 mL/min/1.73 m² remained significant: odds ratios (95% confidence intervals) of 1.82 (1.54–2.16), 1.38 (1.24–1.54), and 1.28 (1.07–1.53), respectively (reference: 90–120 mL/min/1.73 m²). The findings propose a need for careful pre-operative evaluation of cardiovascular and pulmonary functions and post-operative fluid management among patients with not only lower but also very high eGFR.¹⁵ Wu Q et al, discharged patients aged ≥ 80 years without chronic kidney disease who underwent surgery prior to intensive care unit (ICU) admission from 2017 through 2018 were included. Clinical, biological and surgical data were recorded. Mean of outpatient creatinine values from the year prior to ICU admission was used as the baseline value to determine the occurrence of AKI. Among 243 very elderly postoperative patients admitted during the study period, 48 had AKI during their ICU stay. The occurrence of postsurgical AKI was associated with longer ventilation times

($p < .001$) and higher mortality ($p < .001$). The e GFR pre Surg, which is calculated based on the Modification of Diet in Renal Disease study equation, was a risk factor for postoperative AKI (OR = 2.662, $p = .010$). The incidence of postoperative AKI was significantly higher among patients with lower e GFR pre Surg than among those with an e GFR pre Surg ≥ 70 mL/min/1.73 m² ($p = .003$). Postsurgical AKI in very elderly patients has a high incidence and is a risk factor for mortality. The study confirmed that e GFR preSurg could be used as an index for AKI risk stratification.¹⁶ Berg et al. undertook a study to compare the incidence of postoperative pulmonary complications following the use of neuromuscular blocking drugs, namely long-acting pancuronium and the intermediate-acting drugs atracurium and vecuronium; the authors also determined whether residual neuromuscular blockade was a risk factor for the development of PPC. The overall incidence of PPCs was 6.7%. The long-acting group had a greater incidence of PPC than the intermediate-acting group (8.3% vs. 11.7%, respectively; n.s.). In addition, the incidence of postoperative neuromuscular block, defined as a train-of-four (TOF) ratio < 0.7 , wasn't statistically different between groups (26% vs. 11%, respectively, n.s.); however, the long-acting group had a greater incidence of PPC and neuromuscular residual block when compared with the intermediate-acting group (16.9%* vs. 4.2%, respectively; * $p < 0.02$).¹⁷ Park et al. study evaluated the length of hospital stay and recorded the need for postoperative noninvasive ventilation or mechanical ventilation. They verified that LOS did not differ between groups (10 days in both groups; $p = 0.499$), but the incidence of PNIV was higher in the conventional ventilation with alveolar recruitment maneuver group when compared with the protective lung ventilation group (42% vs. 13%, respectively; $p = 0.049$). None of the patients needed POMV (0% in both groups; NA).¹⁸ Karalpillai et al. likewise evaluated unplanned requirements for postoperative mechanical ventilation, continuous positive airway pressure, or noninvasive ventilation and patients' LOS. They found that 2.5% of the patients in the low tidal volume group required unplanned noninvasive or invasive ventilation compared with 2.4% of the patients in the conventional tidal volume group ($p = 0.92$). LOS was 8.3 days in the low tidal volume group versus 7.9 days in the conventional tidal volume group ($p = 0.40$).¹⁹

CONCLUSION

To summarize, it can be concluded that eGFR levels are linked to an elevated risk of experiencing postoperative pulmonary complications.

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