

The Association Between Modifiable Anesthetic Parameters and Renal Function After Nephrectomy

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INTRODUCTION

- Acute and chronic kidney injury may develop in patients undergoing nephrectomy, increasing the risk for further functional decline and mortality.
- Intraoperative anesthetic parameters, primarily intraoperative hypotension, are associated with renal function after surgeries which do not involve the kidney; few studies report their effect in patients undergoing nephrectomy.

OBJECTIVES

- To evaluate the association between modifiable anesthetic parameters and kidney function after radical and partial nephrectomy.

METHODS

- After obtaining institutional review board approval, we reviewed data from 3,240 consecutive patients who underwent nephrectomy between 2010 – 2018.
- Intraoperative anesthetic parameters evaluated included duration of hypotension (mean arterial pressure (MAP) <55mmHg), tachycardia (heart rate >100bpm), hypothermia (body temperature <35.5°C) and volatile anesthetic use. MAP at arrival to the post-anesthesia care unit was also evaluated.
- Outcomes included acute kidney injury (AKI) and estimated glomerular filtration rate (eGFR) within 1 year after nephrectomy.
- The associations between the anesthetic parameters and outcomes were evaluated with multivariable logistic regression for AKI and longitudinal analyses for eGFR, adjusted for known predictors of renal function after nephrectomy.

RESULTS

Baseline patient and tumor characteristic (Table 1)

- The study cohort included 2111 (65%) males, and the median age was 60 years (IQR 52, 68).
- Prior to nephrectomy, 677 (21%) patients had stage ≥3 chronic kidney disease (CKD).
- Over two-thirds (69%) underwent partial nephrectomy.

Anesthesia variables of the study cohort (Table 2)

- Most patients were not exposed to intraoperative hypotension [median duration 0 minutes (IQR 0, 2)].
- Volatile anesthetics were used for a median of 81% of the anesthesia time.
- The median duration patients were hypothermic during surgery was 4 minutes (IQR 0, 58).

Functional outcomes of the study cohort

- A quarter of the patients had AKI in the immediate postoperative period.
- One third of patients had stage ≥3 CKD 12-months after surgery.
- We did not find evidence that intraoperative hypotension was associated with postoperative renal function.
- Longer duration of inhaled anesthetic use and higher blood pressure at arrival to PACU were associated with higher eGFR during followup.

Table 1 - Baseline clinical and pathological variables, stratified by procedure type; data presented as median (IQR) and frequency (%), N=3,240

	Radical Nephrectomy (N=1053; 33%)	Partial Nephrectomy (N=2187; 68%)
Age at Nephrectomy (years)	61 (53, 69)	60 (52, 67)
Male	729 (69%)	1382 (63%)
BMI	28.8 (25.5, 32.8)	29.1 (25.7, 33.1)
ASA Score 3-4	740 (70%)	1413 (65%)
Charlson Comorbidity Index > 3	659 (63%)	334 (15%)
Preoperative Hyperlipidemia	420 (40%)	975 (45%)
Preoperative Chronic Kidney Disease Stage		
Stage 1 (Normal or High)	191 (18%)	558 (26%)
Stage 2 (Mild)	570 (54%)	1244 (57%)
Stage 3A (Mild, Moderate)	212 (20%)	282 (13%)
Stage 3B (Moderate, Severe)	58 (5.5%)	90 (4.1%)
Stage 4 (Severe)	8 (0.8%)	13 (0.6%)
Stage 5 (Kidney Failure)	14 (1.3%)	0 (0%)
Preoperative Smoking Status		
Never	489 (46%)	1198 (55%)
Former or Current	535 (51%)	944 (43%)
Unknown	29 (3%)	45 (2%)
Tumor Histology		
Clear cell	732 (70%)	1177 (54%)
Other Malignant	259 (24%)	721 (33%)
Benign	62 (6%)	289 (13%)
Tumor Size (cm)	7.1 (5.0, 9.8)	2.9 (2.0, 4.0)

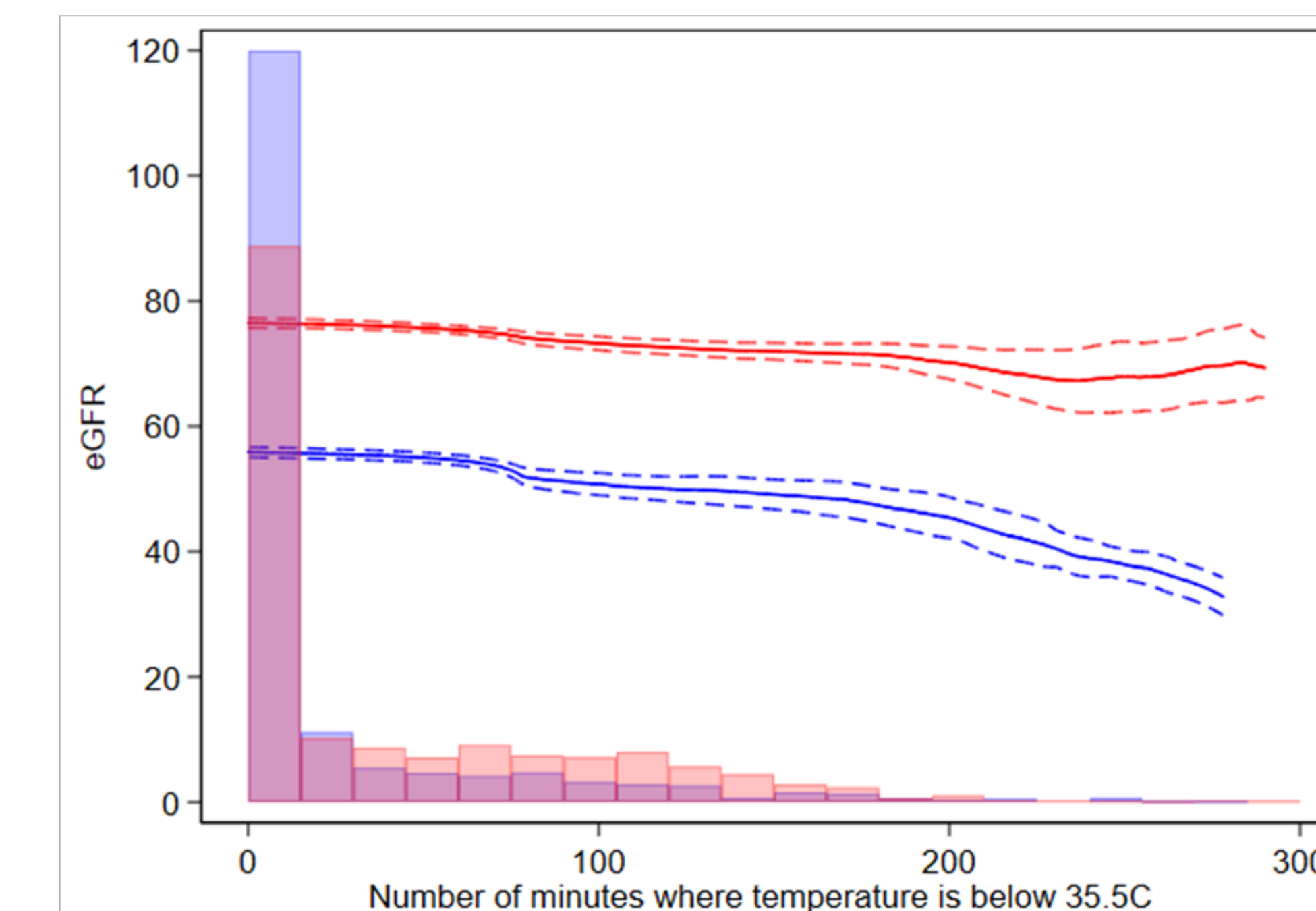
Table 2 - Anesthesia variables, stratified by procedure type; data presented as median (IQR) and frequency (%), N=3,240

	Radical Nephrectomy (N=1053; 33%)	Partial Nephrectomy (N=2187; 68%)
Anesthesia time (minutes)	213 (179, 261)	209 (183, 244)
Operating Room Time (minutes)	141 (110, 186)	134 (112, 165)
Volatile anesthetic present (minutes)	168 (135, 215)	166 (141, 199)
Volatile anesthetic present (% minutes)	80 (75, 85)	81 (76, 85)
Minimal mean arterial pressure	57 (52, 63)	58 (52, 63)
Maximal mean arterial pressure	115 (105, 126)	115 (105, 126)
Number of minutes where MAP < 65	10 (2, 27)	11 (2, 26)
Number of minutes where MAP < 55	0 (0, 2)	0 (0, 2)
Minimum heart rate	54 (48, 60)	53 (47, 58)
Maximum heart rate	96 (86, 106)	95 (86, 104)
Number of minutes where HR > 100	0 (0, 2)	0 (0, 1)
Number of minutes where temperature < 35.5 C	1 (0, 19)	8 (0, 73)
Mean blood pressure at arrival to PACU (N=3193)	87 (79, 98)	90 (81, 99)

RESULTS (continued)

- Prolonged hypothermia (per 10-min) was consistently associated with an increased rate of AKI (OR 1.02; 95% CI 1.00, 1.04; p=0.024), and a decrease in eGFR (change in eGFR -0.19; 95% CI -0.27, -0.12; p<0.0001). However, while statistically significant, these results have limited clinical significance, aside for a small number of patients exposed to very long hypothermia (Figure 1).

Figure 1 – Relationship between duration of hypothermia and eGFR undergoing radical (blue) or partial (red) nephrectomy, overlaid on distribution of hypothermia.



CONCLUSION

- Current practice is aimed at tightly maintaining blood pressure during surgery.
- Within this setting we did not find an association between intraoperative hypotension and renal function after nephrectomy.

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