

Correlation of Chronic Kidney Disease with In-Hospital Outcomes Following Total Joint Arthroplasty

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Introduction

- Chronic kidney disease (CKD) is classified by glomerular filtration rate (GFR), with lower GFR values indicating more advanced stages of kidney dysfunction.
- CKD can significantly affect recovery following major surgical procedures, including total joint arthroplasty (TJA).
- TJA is a common surgical procedure performed to replace damaged joints, aiming to restore mobility and improve quality of life.
- Patients with CKD may face increased risks and postoperative complications following TJA due to their underlying health status.

Aims and Objectives

Aim:

- This study serves to understand how various stages of CKD affect postoperative recovery after undergoing TJA with special attention to various outcomes.

Objectives:

- To stratify patients by chronic kidney disease (CKD) stages.
- To assess whether higher CKD severity correlates with increased rates of postoperative complications and prolonged hospital stays.
- To identify specific postoperative challenges and trends unique to patients with advanced CKD following TJA.

Methods

This retrospective study utilized data from the National Inpatient Sample (NIS) Database. Patients who underwent total joint arthroplasty (TJA) between 2006 and 2016 were identified using ICD-9 procedural codes. A multivariable logistic regression analysis was performed to calculate odds ratios for various postoperative complications, including:

- Any complication
- Central nervous system (CNS) complications
- Cardiac complications
- Deep vein thrombosis (DVT)
- Genitourinary (GU) complications
- Hematoma
- Infection
- Wound dehiscence
- Postoperative anemia

The analysis was adjusted for age, sex, year of surgery, and race. Postoperative complication rates were compared across different stages of chronic kidney disease (CKD) to assess the relationship between CKD severity and postoperative outcomes following TJA.

Results

Patients with CKD stages 4 and 5 experienced the highest rates of complications across all postoperative outcomes analyzed. CKD stage 4 showed statistically significant increased odds ratios ($p < 0.0001$) for every outcome category except for central nervous system (CNS) complications. In comparison, CKD stage 5 demonstrated statistically significant increased odds ratios for the following outcomes:

- Any complication ($p = 0.0024$)
- CNS complications ($p = 0.0010$)
- Genitourinary (GU) complications ($p = 0.0028$)
- Postoperative anemia ($p = 0.0218$)

Overall, more outcome categories reached statistical significance in patients with CKD stage 4 compared to those with CKD stage 5.

Table 1: This table shows the odds ratio for each outcome across various stages of CKD. The 95% confidence intervals and p-values are shown as well. *Indicates that the p-value is statistically significant

Variable	CKD 1	CKD 2	CKD 3	CKD 4	CKD 5
Any Outcome	1.48 (1.27 - 1.72) $p < .0001^*$	1.84 (1.71 - 1.99) $p < .0001^*$	1.97 (1.89 - 2.06) $p < .0001^*$	2.60 (2.42 - 2.80) $p < .0001^*$	1.56 (1.17 - 2.07) $p = 0.0024^*$
CNS	3.21 (0.80 - 12.89) $p = 0.1009$	1.47 (0.66 - 3.29) $p = 0.3468$	1.43 (1.00 - 2.06) $p = 0.0523$	2.04 (0.92 - 4.54) $p = 0.0791$	10.67 (2.60 - 43.68) $p = 0.0010^*$
Cardiac	1.89 (1.02 - 3.52) $p = 0.0437^*$	1.23 (0.91 - 1.66) $p = 0.1821$	1.65 (1.46 - 1.87) $p < .0001^*$	2.35 (1.80 - 3.08) $p < .0001^*$	1.25 (0.31 - 5.05) $p = 0.7573$
DVT	0.37 (0.05 - 2.62) $p = 0.3181$	1.43 (0.94 - 2.16) $p = 0.0918$	1.46 (1.21 - 1.76) $p < .0001^*$	2.44 (1.65 - 3.61) $p < .0001^*$	1.35 (0.19 - 9.62) $p = 0.7678$
GU	0.50 (0.12 - 2.03) $p = 0.3347$	1.88 (1.44 - 2.45) $p < .0001^*$	2.05 (1.82 - 2.32) $p < .0001^*$	3.01 (2.33 - 3.89) $p < .0001^*$	3.70 (1.57 - 8.73) $p = 0.0028^*$
Hematoma	0.88 (0.33 - 2.35) $p = 0.7927$	1.13 (0.80 - 1.61) $p = 0.4769$	1.48 (1.28 - 1.71) $p < .0001^*$	2.20 (1.59 - 3.03) $p < .0001^*$	2.66 (0.98 - 7.24) $p = 0.0560$
Infection	1.00 (0.14 - 7.08) $p = 0.9974$	1.20 (0.57 - 2.52) $p = 0.6283$	1.70 (1.25 - 2.32) $p = 0.0007^*$	4.08 (2.36 - 7.06) $p < .0001^*$	2.53 (0.35 - 18.20) $p = 0.3552$
Anemia	1.54 (1.30 - 1.82) $p < .0001^*$	1.83 (1.70 - 1.98) $p < .0001^*$	2.02 (1.92 - 2.12) $p < .0001^*$	2.52 (2.33 - 2.74) $p < .0001^*$	1.44 (1.06 - 1.98) $p = 0.0218^*$
Wound	2.82 (0.70 - 11.35) $p = 0.1447$	2.04 (1.06 - 3.94) $p = 0.0329^*$	1.22 (0.82 - 1.80) $p = 0.3239$	3.47 (1.86 - 6.48) $p < .0001^*$	4.53 (0.63 - 32.61) $p = 0.1333$

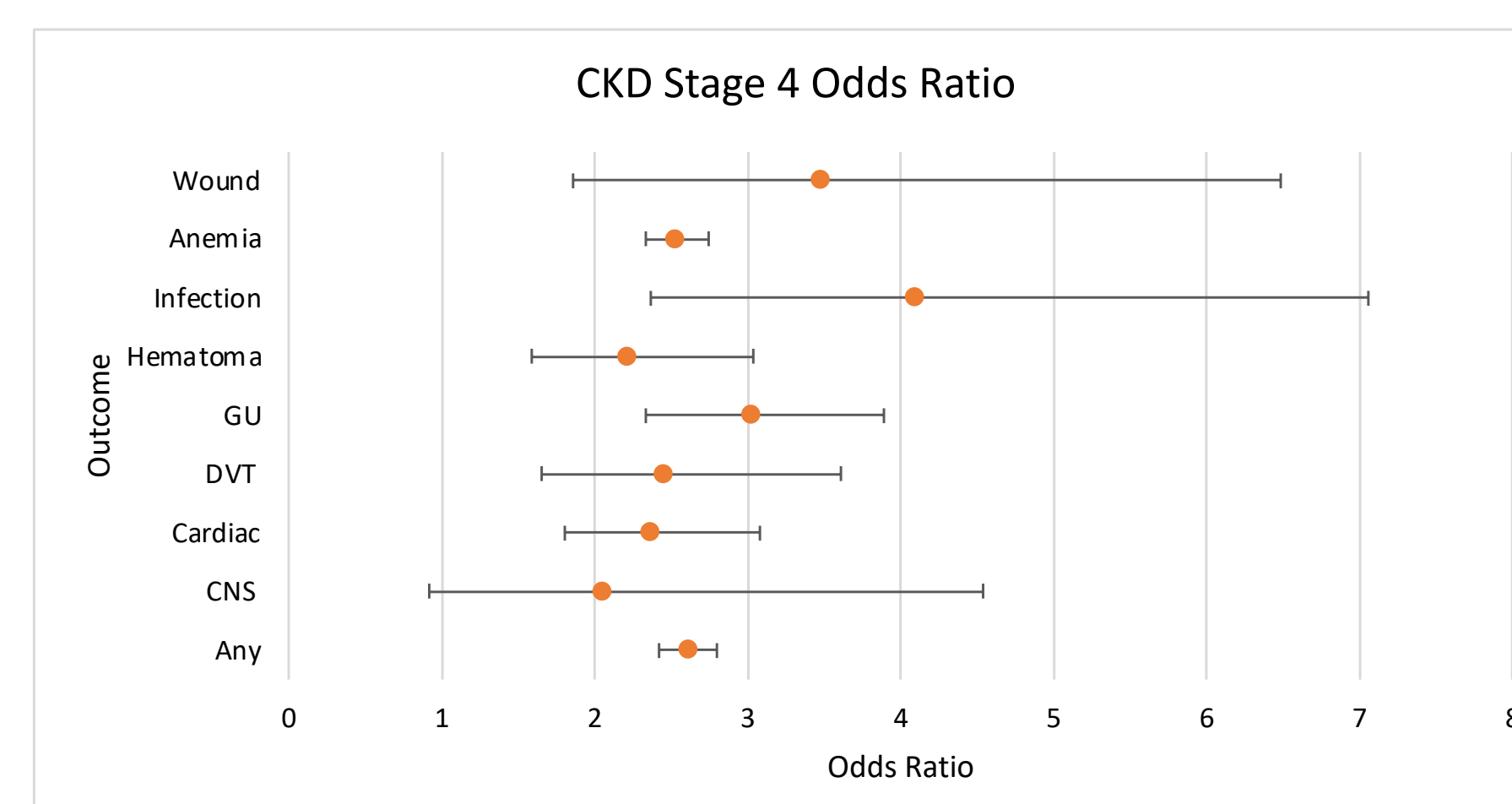


Figure 1: Patients with CKD Stage 4 are 2.6 times more likely to experience any postoperative complication compared to healthy patients. CKD Stage 4 patients showed increased risk for all outcomes except CNS complications.

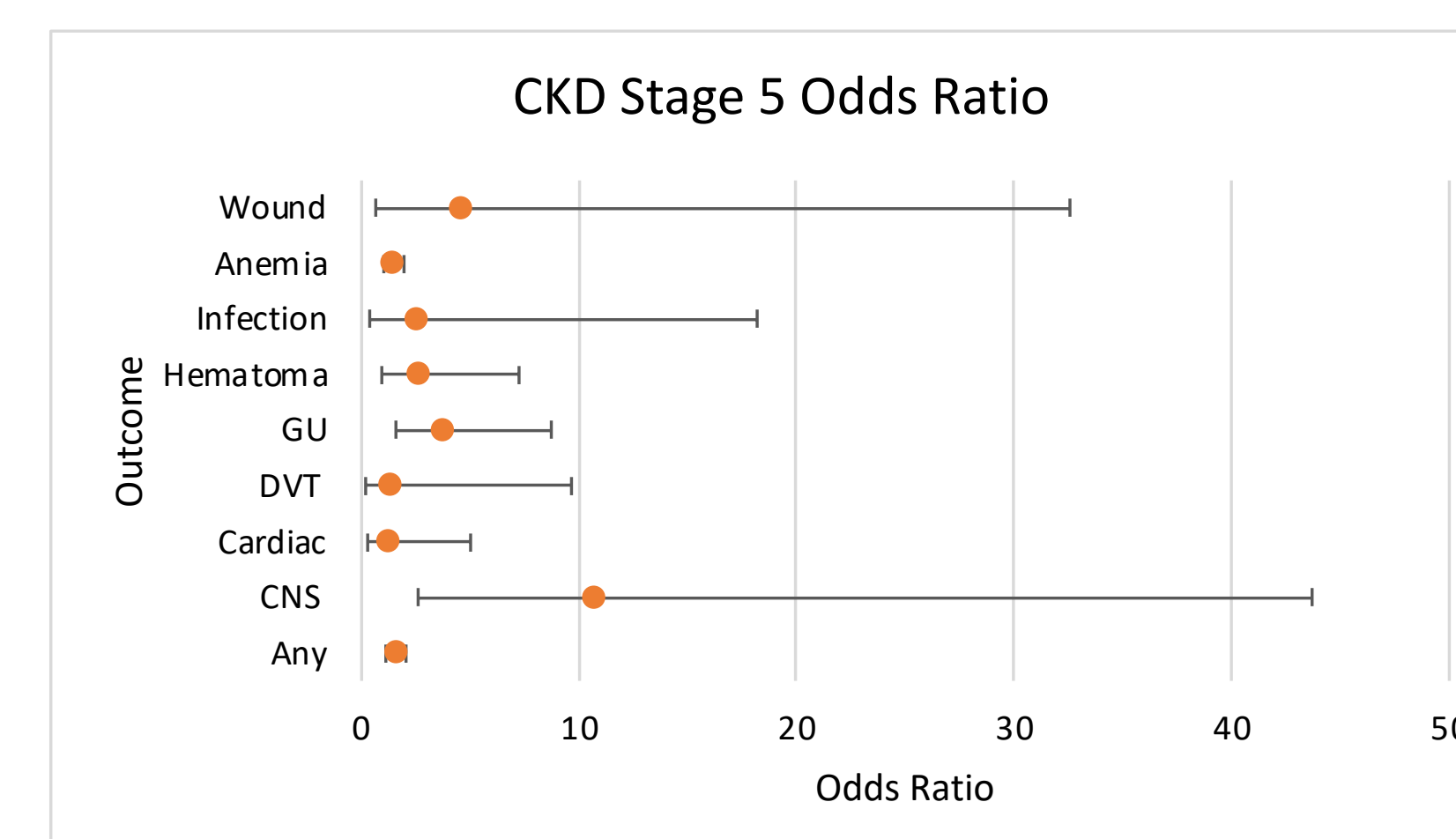


Figure 2: Patients with CKD Stage 5 are 1.56 times more likely to experience any complication compared to healthy patients, with higher risks for CNS complications, genitourinary outcomes, and anemia.

Conclusions

In general, more severe chronic kidney disease is associated with higher odds of postoperative outcomes. However, patients with CKD stage 5 only had statistically significant odd ratios in four outcomes, while patients with CKD stage 4 had statistically significant odds ratio in all except one outcome (See Table 1). Specifically, CKD Stage 5 did not have significant p-values for many variables in this analysis, including cardiac complications, DVT, hematoma, infection, and wound dehiscence. The p-values for most outcomes, with the exception of CNS outcomes, were however statistically significant for individuals with CKD Stage 4.

This may in part be due to selection bias amongst patients who have late-stage CKD, who must undergo a more intense pre-optimization process prior to undergoing surgery. This process includes completing dialysis a day prior to the surgical procedure, obtaining and monitoring electrolytes, and performing coagulation studies. For this reason, only the most optimized patients with CKD Stage 5, who were able to complete this optimization process, were selected for surgery and therefore included in this study.

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Acknowledgements

I would like to thank Dr. Inaya Hajj Hussein and Dr. Mouhanad El Othmani for their invaluable guidance and unwavering support throughout the duration of this project. Special thanks to Jacob Keeley, the statistician who completed the statistical analysis for this project.