Risk factors for acute kidney injury after the use of antibiotic loaded bone cement in orthopedic surgery – a retrospective case-control study

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Background

	2010[1]	2030 projected[2]
Hip arthroplasties	332,000	572,000
Knee arthroplasties	719,000	3,480,000

One study predicted that in 2020, the cost of revisions due to prosthetic joint infections (PJI) will exceed $1.62 billion[3].

Antibiotic loaded bone cement (ALBC) is a commonly used adjunct to systemic antibiotics in the treatment of PJI.

Several case reports have suggested a link between the use of local high dose vancomycin and tobramycin and acute kidney injury[4].

Purpose

Identify patient risk factors that may correlate with an increased risk of AKI and would, therefore, warrant closer monitoring ring of renal function and serum antibiotic levels after surgery.

Hypothesis

Patients who developed AKI after ALBC joint spacer insertion were predisposed to it due to other comorbidities, high antibiotic doses in ALBC, immunosuppression, or the use of other nephrotoxic drugs pre-op.

Clinical Implications

Identification of risk factors for AKI after the use of ALBC can help us target certain patient populations with close-up monitoring. This may reduce post-op complications, length of hospital stay, readmissions, nephrology consults, and improve patient quality of life.

Study Design

Single center, retrospective case-control study at a large academic medical center

Chart review of 428 patients → Identification of 57 patients who fit inclusion criteria → 25 hip, 24 knee, 3 shoulder, 5 ankle arthroplasties → 15 patients had at least a 20% increase from baseline serum creatinine

Study Population

1 Inclusion Criteria

- Patients who underwent an orthopedic surgery that involved insertion of ALBC at our institution between 2015 and 2018

2 Exclusion Criteria

- Patients under age 18 at the time of surgery
- Patients who had antibiotic irrigation only
- Orthopedic injuries as a result of trauma
- Non-arthroplasty surgeries (such as fractures and debridement of deep wounds)
- Patients with missing data for 30 days after the surgery

Matching

Criteria

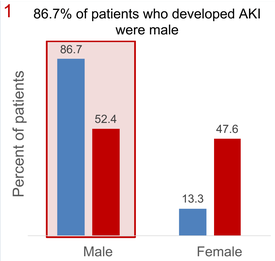
- 2:1 AKI (SCr ≥ 1.2) to non-AKI patients
- age (± 5 years)
- joint operated on (hip/knee/ankle/shoulder)
- antibiotics used

Laboratory values obtained within 30 days pre-op	AKI group	Control group
Pre-op creatine, Mean (SD)	0.99 (0.26)	0.83 (0.22)
Pre-op GFR, Mean (SD)	75.4 (23.9)	89.2 (19.1)
Pre-op Hemoglobin, Mean (SD)	12.1 (1.8)	11.2 (2.2)
Pre-op BUN, Mean (SD)	20.7 (6.7)	15.6 (6.9)

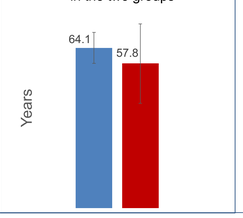
Patient Characteristics

■ AKI group (n=15) ■ Control group (n=42)

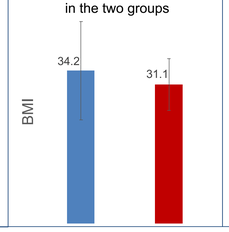
1 86.7% of patients who developed AKI were male



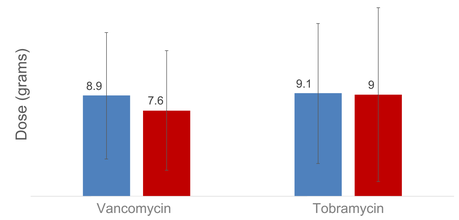
2 There was no significant difference in the age of patients in the two groups



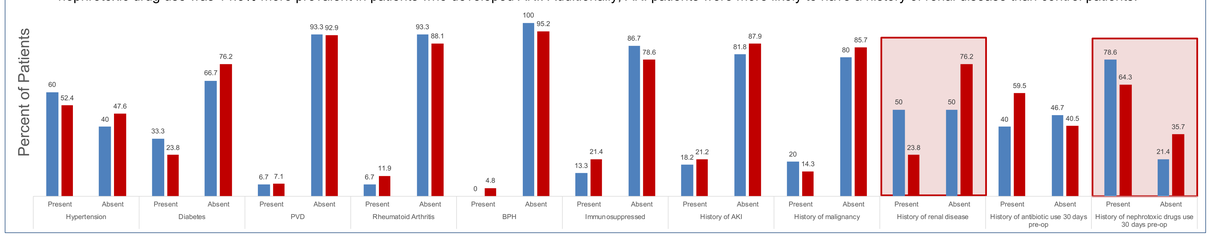
3 There was no significant difference in the BMI of patients in the two groups



4 Despite a very wide range of doses used, the doses of vancomycin and tobramycin in ALBC were similar between the two groups



5 When comparing the presence of comorbidities and past medical history in AKI and control group patients, there was no significant difference in any of the factors examined. History of nephrotoxic drug use was 14.3% more prevalent in patients who developed AKI. Additionally, AKI patients were more likely to have a history of renal disease than control patients.



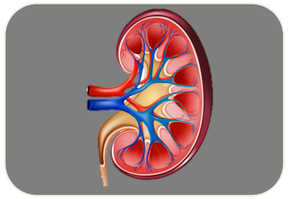
Univariate Data Analysis

	OR	95% CI	P
Male gender	5.9	1.18 – 29.5	**0.03**
PVD	0.9	0.1 – 9.7	0.95
Diabetes	1.6	0.44 – 5.8	0.47
History of AKI	1.6	0.25 – 10.3	0.61
Immunosuppression	0.6	0.11 – 3.0	0.50
Rheumatoid Arthritis	0.5	0.1 – 4.9	0.58
History of malignancy	1.5	0.32 – 6.9	0.60
Hypertension	1.4	0.41 – 4.5	0.61
History of antibiotic use	0.6	0.17 – 2.04	0.40
Current use of nephrotoxic drugs	2.0	0.50 – 8.5	0.33

All categorical data were analyzed as percentages and compared using Fisher's exact tests. Numerical data such as age and lab-values such as creatine were summarized as mean plus standard deviation and compared using two-sample student t-tests. We used logistical regression models to predict factors of AKI. We did not conduct a multivariate analysis due to our study sample restrictions. All p-values ≤ 0.05 were considered statistically significant. We used version 16 of STATA statistical software for all analysis (StataCorp. 2019. Stata Statistical Software: Release 16. College Station, TX: StataCorp LLC).

Conclusions

Male gender



History of elevated serum creatinine within 30 days post-op

Potential Limitations

- Highly variable amounts of tobramycin (0.1g to 43.6g) and vancomycin (2g to 28g) used in ALBC
- Single center study with a small sample size
- Concurrent use of systemic antibiotics

References

[1] Centers for Disease Control and Prevention. Number of all-listed procedures for discharges from short-stay hospitals, by procedure category and age: United States, 2010. Accessed October 12, 2020. https://www.cdc.gov/nchs/data/nhds/4procedures/2010pro4_numberprocedureage.pdf

[2] Kurtz S, Ong K, Lau E, et al. Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030. *J Bone Joint Surg Am*. 2007;89(4):780-5. doi: 10.2106/JBJS.F.00222

[3] Kurtz S, Lau E, Watson H, et al. Economic burden of periprosthetic joint infection in the United States. *J Arthroplasty*. 2012;27(8 Suppl):61-5.e1. doi: 10.1016/j.arth.2012.02.022

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