Nephrotoxic Medication Induced Acute Kidney Injury in Hospitalized Pediatric Patients

OAKLAND UNIVERSITY WILLIAM BEAUMONT®

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Introduction

Acute kidney injury (AKI) is a sudden decrease in kidney function that can lead to fluid imbalance and waste accumulation. AKI is a significant clinical challenge, particularly in pediatric patients, where AKI can lead to long-term consequences like chronic kidney disease. A key cause of AKI is exposure to nephrotoxic medications. The incidence of nephrotoxic-induced AKI is notably high in hospitalized children, with studies indicating that up to 86% of pediatric patients are exposed to at least one nephrotoxic medication during their stay.[1] Nephrotoxic-induced AKI can lead to increase length of stay, cost of care, and higher morbidity and mortality rates.[1,2] Given these risks, it is essential to understand the impact of nephrotoxic medications have on kidney function during hospitalization in the pediatric population. We hypothesize that nephrotoxic AKI is an underrecognized condition, with patients not being adequately evaluated for AKI following exposure to three or more nephrotoxic medications, despite the increased risk. Thus, we suspect that medication-induced AKI in hospitalized pediatric patients at Corewell Health is significant, yet underreported due to insufficient creatinine monitoring after medication exposure.

Objectives

Primary Objective: The primary aim of this retrospective study is to understand the incidence of nephrotoxic-induced AKI in the at risk pediatric population at Corewell Health

Secondary Objectives:

- To identify the at risk population, defined as patients less than 18 years of age, exposed to three or more nephrotoxic medications or intravenous (IV) aminoglycoside antibiotics during their hospital stay.
- To determine if creatinine is properly evaluated in the at-risk patient population
- To determine how often nephrology is consulted in patients that develop AKI during hospitalization
- To determine how often other methods of evaluating kidney function, such as urine studies and cystatin c values, are assessed in the at-risk population

Nephrotoxic Drug List

Acyclovir	Cisplatin	Ibuprofen	Lisinopril	Sulfasalazine
Ambisome	Colistimethate	Ifosfamide	Lithium	Tacrolimus
Amikacin	Cyclosporine	Indomethacin	Losartan	Tenofovir
Amphoteracin B	Dapsone	Iodixanol	Mesalamine	Ticarcillin/ Clavulanic Acid
Aspirin	Diatrizoate Meglumine	Iohexol	Methotrexate	Tobramycin
Captopril	Diatrizoate Sodium	Iopamidol	Mitomycin	Topiramate
Carboplatin	Enalapril	Iopromide	Nafcillin	Valacyclovir
Cefotaxime	Enalaprilat	Ioversol	Naproxen	Valganciclovir
Ceftazidime	Foscarnet	Ioxaglate Meglumine	Pamidronate Disodium	Valsartan
Cefuroxime	Gadoextate Disodium	Ioxaglate Sodium	Pentamidine	Vancomycin
Celexoxib	Ganciclovir	Ioxilan	Piperacillin	Zoledronic Acid
Cidofovir	Gentamicin	Ketorolac	Sirolimus	Zonisamide

Methods

This study was completed retrospectively, reviewing electronic health records of pediatric patients hospitalized at Corewell Health Royal Oak Hospital from May 1, 2020 to April 30, 2021. The exposed population includes pediatric patients who received three or more nephrotoxic medications or IV aminoglycosides during their hospital stay. Patient demographics (age, gender), length of hospitalization, medications, height, weight, creatinine and cystatin c trends, and urine studies were reviewed. Estimated glomerular filtration rate was calculated using the Schwartz CDKI-EPI 2021 formula. Using the KDIGO criteria for creatinine trends, patients were noted to have AKI or not, if creatinine was properly tracked during hospitalization. If the patient developed AKI during hospitalization, nephrology records were reviewed if applicable.

Exposure and AKI Criteria

Exposure Criteria:

>= 3 NTMx medications

OR

IV Aminoglycoside use for >=3 days

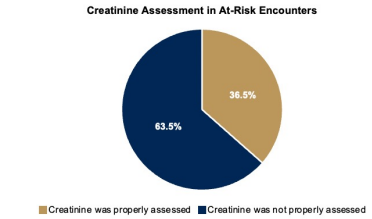
AKI Criteria:

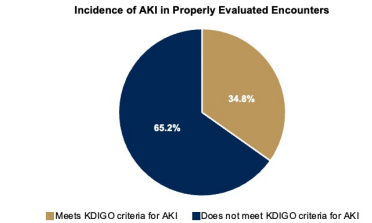
≥0.3 mg/dL (≥26.5 µmol/L) within 48 hours

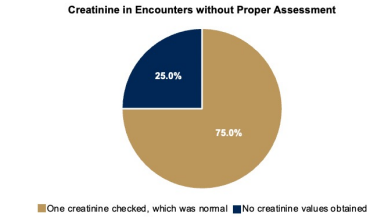
or 1.5 to 1.9 times baseline (within the prior 7 days)

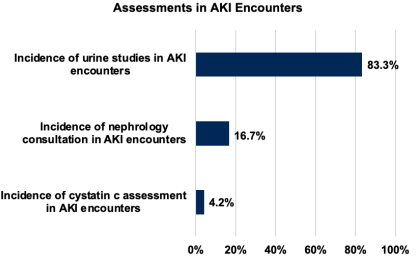
Incidence of Nephrotoxic-Induced AKI

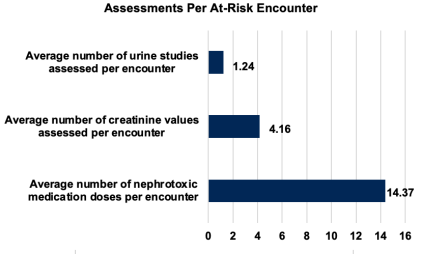
Results











Discussion

After evaluating pediatric admissions that occurred from May 1, 2020 to April 30, 2021, 189 encounters were at risk of AKI due to exposure to three or more nephrotoxic medications or IV aminoglycoside antibiotics during hospitalization. Among these 189 encounters, 69 encounters were properly evaluated for AKI (36.5%) and 120 encounters were not properly evaluated for AKI (63.5%) based on creatinine values. Of the 69 encounters with proper creatinine assessment, 24 encounters met KDIGO criteria for AKI (34.8%), while 45 encounters did not meet KDIGO criteria for AKI (65.2%). Among the 120 encounters that were not properly assessed for AKI, 90 encounters had only a single creatinine measurement, which were all normal, limiting the ability to assess trends (75.0%). 30 encounters had no creatinine labs checked despite nephrotoxic exposure, also preventing AKI evaluation (25.0%).

In the 24 encounters that were properly assessed and found to have known AKI, 20 encounters were evaluated with at least one urine study (83.3%). Nephrology was consulted in 4 patients (16.7%). Cystatin c was assessed in only one patient with AKI (4.2%).

In all 189 encounters exposed to nephrotoxic medication, the average number of urine studies per encounter was 1.24, the average number of creatinine values assessed was 4.16, and the average doses of nephrotoxic medication was 14.37.

Conclusion

Our study highlights a significant gap in the proper evaluation of nephrotoxic-induced AKI in hospitalized pediatric patients at Corewell Health. Despite the known risks associated with nephrotoxic medication exposure, only 36.5% of at-risk encounters had adequate creatinine monitoring, and a substantial proportion of patients with confirmed AKI did not receive nephrology consultation or further kidney function assessment, such as cystatin C measurement. These findings underscore the need for improved surveillance protocols and standardized nephrotoxic monitoring strategies to ensure early identification and management of AKI in pediatric patients. Increased awareness and adherence to AKI screening guidelines could lead to better outcomes and reduced long-term renal complications in this vulnerable population.

References

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