Risk Factors for Catheter Associated Urinary Tract Infections in a Pediatric Institution

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Abbreviations and Acronyms

CAUTI = catheter associated UTI

CDC = Centers for Disease Control and Prevention

ICU = intensive care unit

UTI = urinary tract infection

WBC = white blood cell

Accepted for publication March 30, 2015.

No direct or indirect commercial incentive associated with publishing this article.

The corresponding author certifies that, when applicable, a statement(s) has been included in the manuscript documenting institutional review board, ethics committee or ethical review board study approval; principles of Helsinki Declaration were followed in lieu of formal ethics committee approval; institutional animal care and use committee approval; all human subjects provided written informed consent with guarantees of confidentiality; IRB approved protocol number; animal approved project number.

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Purpose: Catheter associated urinary tract infections are an essential measure for health care quality improvement that affects reimbursement through hospital acquired condition reduction programs in adult patients. With the mounting importance of preventing such infections we evaluated risk factors for acquiring catheter associated urinary tract infections in pediatric patients.

Materials and Methods: All catheter associated urinary tract infections were identified at 1 pediatric institution from September 2010 to August 2014 from a prospective database maintained by the infection control office. To identify risk factors patients with a catheter associated urinary tract infection were individually matched to control patients with a urinary catheter but without infection by age, gender, date and the hospital location of the infection in 1:2 fashion.

Results: A total of 50 patients with catheter associated urinary tract infection were identified and matched to 100 control patients. Compared to controls the patients with infection were more likely to have a catheter in place for longer (2.9 days, OR 1.08, 95% CI 1.01, 1.15, p = 0.02). They were also more likely to be on contact precautions (OR 4.00, 95% CI 1.73, 9.26, p = 0.001), and have concurrent infections (OR 3.04, 95% CI 1.39, 6.28, p = 0.005) and a history of catheterization (OR 3.24, 95% CI 1.55, 6.77, p = 0.002). Using a conditional multivariate regression model the 3 most predictive variables were duration of catheter drainage, contact isolation status and history of catheterization.

Conclusions: Longer duration of urinary catheter drainage, positive contact precautions status and a history of catheterization appear to be associated with a higher risk of catheter associated urinary tract infection in hospitalized pediatric patients. Physicians should attempt to decrease the duration of catheterization, especially in patients who meet these criteria, to minimize the risk of catheter associated urinary tract infection.

Key Words: urinary tract infections, catheterization, risk, hospitals, cross infection

THE prevalence of CAUTIs in the adult population is well established, comprising 34% of health care associated infections in the United States with more than 500,000 CAUTIs reported annually.[1] In light of the significant morbidity and financial burden attributed to CAUTI the CMS (Centers for Medicare and Medicaid Services) amended its reimbursement policies in 2008 to omit coverage for certain health care associated

0022-5347/16/1954-1306/0
THE JOURNAL OF UROLOGY®

http://dx.doi.org/10.1016/j.juro.2015.03.121
Vol. 195, 1306-1311, April 2016
Printed in U.S.A.

infections, including CAUTIs, and a reduction in CAUTI has become one of the main targets for improving health care quality.[2] Despite the comparably high incidence of CAUTI reported in the pediatric population the true impact of these infections has only recently become recognized.[3] The Ohio Children's Hospitals' Solutions for Patient Safety revealed that CAUTI is the third most frequent cause of pediatric health care associated infections, outnumbered by central line associated blood stream infections and surgical site infections.[3] These data portray a profound discrepancy between the impact of pediatric CAUTI on the health care system and the paucity of data on the relevant characteristics and risk factors of CAUTI in the pediatric population.

Recognizing this important issue, pediatric institutions are beginning to implement quality improvement initiatives to combat pediatric CAUTI. Specifically a group at Children's Hospital of Philadelphia recently reported that initiating a CAUTI prevention bundle decreased the mean monthly CAUTI rate by 50%.[4] The prevention bundle primarily included using catheters only when indicated and using aseptic techniques. However, the group evaluated interventions as a bundle and could not discern which individual intervention was most effective.

Therefore, understanding pediatric CAUTI pathogenesis remains critically important, given the distinct pathological conditions and surgical interventions performed in pediatric patients. With this in mind we evaluated risk factors for CAUTI in the pediatric population.

METHODS

After receiving institutional board review approval we identified all CAUTIs at 1 pediatric institution from September 2010 to August 2014 from a prospectively collected database maintained by the office of infection control at a tertiary care pediatric hospital. CAUTI was defined according to the CDC definition of symptomatic UTI.[5] Patients were excluded from study if they did not meet the full CDC criteria for symptomatic UTI or they arrived at the hospital with a catheter in place due to baseline status.

To identify risk factors that may contribute to infection patients with CAUTI were individually matched 1:2 by gender and age (maximum 2-year difference) to those with a urinary catheter but without CAUTI. Patients were also matched by date of UTI hospitalization (maximum 18-month difference) and inpatient location of CAUTI since most CAUTIs occurred in an ICU setting and also to account for differences in health status. Control patients were likewise identified from a prospective database collected at the infection control office as part of hospital quality control standards.

Urine specimens for all suspected UTIs were collected according to hospital protocol through the needle-free port of the catheter drainage tubing located in close proximity to the Foley catheter. The collection process did not interrupt the integrity of the drainage system. In patients with CAUTI various parameters were evaluated, including hospital location of the UTI episode, fever, WBC count, urinalysis findings, urine culture organism with colony count and antibiotic resistance, duration of antibiotic therapy, intravenous vs oral antibiotics and UTI complications. For cases and controls additional measured parameters included duration of catheter drainage, concurrent infections, contact precautions status, hospital location, reason for catheter placement, surgical procedures performed with operative time, antibiotic use prior to UTI, history of hospitalization, catheterization or UTI and history of neuropathic bladder, constipation or genitourinary anomalies. For patients with CAUTI duration of catheter drainage was counted from the day of catheter placement to the day of the UTI. In control patients the duration of catheter drainage was considered the time of placement to the time of removal. Positive contact precautions status was defined as a patient flagged as having had a prior infection with methicillin resistant Staphylococcus aureus, vancomycin resistant Enterococcus, extended spectrum β-lactamase producing organisms, inducible β-lactamase producing organisms or Clostridium difficile before the UTI for cases or matched hospitalization for controls. If a patient was cleared from positive status before the hospitalization of interest, the patient was not considered positive for contact precautions status. Airborne precautions were not considered in our analysis. Prior catheterization was defined as hospitalization that was not necessarily during the hospitalization in question.

Statistical analysis was performed with SPSS®, version 22. The cohort and controls were paired as triplets (1:2) and compared by conditional logistic regression to preserve case-control matching. A conditional multivariate logistical regression model was created using significant variables identified by univariate analyses. A less conservative p value ($p < 0.1$) was applied for inclusion in multivariate analyses using forward selection. For all analyses $p < 0.05$ was considered significant.

RESULTS

A total of 56 patients were identified with CAUTI, of whom 6 were excluded from analysis. One patient presented to the hospital with a chronic indwelling Foley catheter in place and 5 did not meet full CDC criteria for symptomatic UTI since they lacked fever. The 50 patients with CAUTI were then matched to 100 control patients. Of the 50 patients 42 (84%) had a CAUTI in an ICU setting. All patients with CAUTI had fever greater than 38C except 1 younger than 1 year who had lethargy and tachycardia greater than 200 beats per minute. WBC count at the time of CAUTI diagnosis was in the hospital reference range for leukocytosis in 15 patients (30%) at a mean of $11.7 \times 10^3/\mu l$. Urinalysis findings were generally consistent with UTI, with