Variation in Surgical Antibiotic Prophylaxis for Outpatient Pediatric Urological Procedures at United States Children's Hospitals

Katherine H. Chan,* Teresa Bell, Mark Cain, Aaron Carroll and Brian D. Benneyworth

From the Division of Pediatric Urology, Riley Hospital for Children at Indiana University Health (KHC, MC) and Department of Surgery, Center for Outcomes Research in Surgery (TB), Department of Pediatrics, Center for Pediatric and Adolescent Comparative Effectiveness Research (KHC, AC), Section of Pediatric Critical Care Medicine (BDB) and Children's Health Services Research (BDB), Indiana University School of Medicine, Indianapolis, Indiana

Purpose: Guidelines recommend surgical antibiotic prophylaxis for clean-contaminated procedures but none for clean procedures. The purpose of this study was to describe variations in surgical antibiotic prophylaxis for outpatient urological procedures at United States children's hospitals.

Materials and Methods: Using the PHIS (Pediatric Health Information System®) database we performed a retrospective cohort study of patients younger than 18 years who underwent clean and/or clean-contaminated outpatient urological procedures from 2012 to 2014. We excluded those with concurrent nonurological procedures or an abscess/infected wound. We compared perioperative antibiotic charges for clean vs clean-contaminated procedures using a multilevel logistic regression model with a random effect for hospital. We also examined whether hospitals that were guideline compliant for clean procedures, defined as no surgical antibiotic prophylaxis, were also compliant for clean-contaminated procedures using the Pearson correlation coefficient. We examined hospital level variation in antibiotic rates using the coefficient of variation.

Results: A total of 131,256 patients with a median age of 34 months at 39 hospitals met study inclusion criteria. Patients undergoing clean procedures were 14% less likely to receive guideline compliant surgical antibiotic prophylaxis than patients undergoing clean-contaminated procedures (OR 0.86, 95% CI 0.84–0.88, p <0.0001). Hospitals that used antibiotics appropriately for clean-contaminated procedures were more likely to use antibiotics inappropriately for clean procedures ($r = 0.7$, $p = 0.01$). Greater variation was seen for hospital level compliance with surgical antibiotic prophylaxis for clean-contaminated procedures (range 9.8% to 97.8%, coefficient of variation 0.36) than for clean procedures (range 35.0% to 98.2%, coefficient of variation 0.20).

Conclusions: Hospitals that used surgical antibiotic prophylaxis appropriately for clean-contaminated procedures were likely to use surgical antibiotic prophylaxis inappropriately for clean procedures. More variation was seen in hospital level guideline compliance for clean-contaminated procedures.

Key Words: urology; practice patterns, physician's; antibiotic prophylaxis; pediatrics; outpatients

Abbreviations and Acronyms

CTC = clinical transaction classification

CV = coefficient of variation

SAP = surgical antibiotic prophylaxis

SSI = surgical site infection

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* Correspondence: Division of Pediatric Urology, Riley Outpatient Center, 4230, 705 Riley Hospital Dr., Indianapolis, Indiana 46202 (telephone: 216-269-7878; FAX: 317-944-7481; e-mail: kchubert@iupui.edu).

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POSTOPERATIVE SSIs are a source of potentially preventable morbidity in children. Negative consequences of a SSI include increased costs due to additional postoperative visits, antibiotic treatment, infection related diagnostic testing and even surgical drainage of an infected wound. Strategies to reduce SSI have focused on infection surveillance programs, postoperative care and operative factors such as antibiotic prophylaxis.[1]

Limited data exist on the efficacy of SAP in children, leading to uncertainty about its benefit and the widely variable rates of its administration.[2] We hypothesized that there would be significant variation in SAP for pediatric urological procedures due to uncertainty about benefits, differences in physician beliefs about indications and a lack of patient/parental involvement in decisions about use. The purpose of this study was to describe variation in the use of SAP for clean and clean-contaminated outpatient pediatric urological procedures at United States children's hospitals and examine how wound class and location impact compliance with SAP guidelines.

MATERIALS AND METHODS

Study Population

We performed a retrospective cross-sectional study of patients younger than 18 years undergoing outpatient clean or clean-contaminated pediatric urological procedures, as identified by CPT codes and using the PHIS database, from January 2012 to December 2014 at United States children's hospitals. We excluded inpatients, patients with an observation status, those with a discharge date different from the admittance date and those with a length of stay of greater than 1 day. We also excluded patients younger than 30 days, and those who underwent concurrent nonurological procedures and procedures including drainage of an abscess or infected wound. We excluded hospitals that did not report antibiotic charges separately from operating room charges and those that did not report billing data. Finally, we excluded hospitals that did not report any ambulatory surgery data and years with incomplete ambulatory surgery data on the hospital level.

Data Source

PHIS is an administrative database that contains inpatient, emergency department, ambulatory surgery and observation encounter level data from more than 45 not-for-profit tertiary care pediatric hospitals in the United States. These hospitals are affiliated with the Children's Hospital Association, Overland Park, Kansas. Data quality and reliability are assured through a joint effort between the Children's Hospital Association and participating hospitals. For the purposes of external benchmarking, participating hospitals provide discharge/encounter data including demographics, diagnoses and procedures. Nearly all of these hospitals also submit resource utilization data (eg charge codes for pharmaceuticals, imaging and laboratory) to PHIS using the CTC system. Data are de-identified at the time of data submission. Data are also subjected to a number of reliability and validity checks before being included in the database.

We included data from 39 hospitals in this study. Four of the 39 hospitals were included but did not have complete data for the entire 3-year study period. For those hospitals only years with complete data were included in analysis.

Wound Class and Location, and Surgical Antibiotic Prophylaxis Definitions

Clean procedures included penile (nonhypospadias), inguinal and scrotal procedures, and open/laparoscopic abdominal procedures (supplementary Appendix, http://jurology.com/). Clean-contaminated procedures included hypospadias repair and endoscopic procedures (supplementary Appendix, http://jurology.com/). We classified all hypospadias repairs as clean-contaminated procedures due to the difficulty using administrative data of determining whether a urethral catheter was placed. Patients who underwent concomitant clean and clean-contaminated procedures were classified as having undergone a clean-contaminated procedure for the purpose of determining whether they should receive SAP in accordance with the guidelines.

SAP was defined as a CTC code for an intravenous antibiotic on the date of surgery. Guideline compliance was defined as 100% SAP utilization for clean-contaminated procedures and no SAP utilization for clean procedures.

Statistical Analysis

We performed the Kolmogorov-Smirnov test for normality for the rates of patient-level antibiotic compliance for clean and clean-contaminated procedures. For clean and clean-contaminated procedures $p = 0.1$ and 0.09, respectively, indicating that both rates were normally distributed. Next, we compared patient level antibiotic compliance for clean vs clean-contaminated procedures using the chi-square test. We examined the association between wound class and patient level antibiotic compliance using a multilevel logistic regression model with a random effect for hospital to account for clustering of similar patients by hospital. We also examined whether hospitals that were compliant with SAP recommendations for clean procedures were also compliant for clean-contaminated procedures using the Pearson correlation coefficient.

We determined the hospital level variation in antibiotic compliance rates using the CV, which is defined as the SD of the antibiotic rate divided by the mean. The CV is a unit-free statistic that provides a standardized measure of variability across a set of outcomes with higher values indicating greater variation.[3,4] In addition, we compared patient level antibiotic compliance for clean procedures among the different wound locations (ie penile, inguinal/scrotal and abdominal) using the chi-square test. SAS®, version 9.4 was used for data analysis with $p < 0.05$ considered significant.