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Concise Communication

Optimizing utilization of beta-lactam surgical prophylaxis through implementation of a structured allergy assessment tool in a presurgical clinic

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Abstract

In patients with β-lactam allergies, administration of non–β-lactam surgical prophylaxis is associated with increased risk of infection. Although many patients self-report β-lactam allergies, most are unconfirmed or mislabeled. A quality improvement process, utilizing a structured β-lactam allergy tool, was implemented to improve the utilization of preferred β-lactam surgical prophylaxis.

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The administration of perioperative antibiotics is recommended to reduce the risk of surgical site infections (SSIs).[1] Current guidelines recommend β-lactam surgical prophylaxis given proven efficacy, safety, and tolerability over non–β-lactams.[1,2] For most procedures, cefazolin, or an equivalent cephalosporin, is the preferred, first-line surgical prophylaxis.[1] Administration of a non–β-lactam surgical prophylaxis (eg, vancomycin, clindamycin, etc) increases the subsequent risk for SSI by 50% or more.[2] Patients reporting an allergy to penicillin may not be prescribed cephalosporins due to fear of cross reactivity; however, a more comprehensive allergy history may lead to more optimal prescribing.[3]

Notably, β-lactams are the most common antibiotic class associated with allergic reactions. Approximately 10% of patients self-report a penicillin allergy; however, many reported allergies result from mild, cutaneous reactions, or from adverse effects (eg, diarrhea). Truly life-threatening, immunoglobin E (IgE)–mediated reactions are rare (<1%). Furthermore, IgE antibodies wane quickly within a 10-year period, and the cross reactivity of these antibodies to cephalosporins is ~2%. Collectively, these data indicate that >95% of penicillin-allergic patients are able to safely tolerate a cephalosporin.[4,5]

The Centers for Disease Control (CDC) and the American Nurses Association (ANA) designate high-quality allergy assessments as a major role for nurses within the antimicrobial stewardship program.[6] We implemented a quality improvement initiative using preoperative, nursing-driven, structured allergy assessments to improve the utilization of optimal surgical prophylaxis in elective surgery patients.

Methods

This quality improvement initiative was implemented at a quaternary-care academic medical center which performs >60,000 invasive procedures and admits ~55,000 patients annually. Patients with complex comorbidities may be referred to a pre-procedure outpatient clinic (PPOC), staffed by trained nurses under the supervision of an anesthesiologist. The PPOC evaluates ~26,000 patients annually for a wide variety of procedures. Prior to this intervention, allergy assessments were conducted by nurses without the use of a structured allergy assessment tool.

A simple, paper-based, 5-question, structured allergy assessment was developed by a multidisciplinary antimicrobial stewardship team to better characterize β-lactam reactions (Fig. 1). A job aid was included with the structured allergy assessment to help distinguish IgE-mediated reactions from non–IgE-mediated reactions, and nurses were trained to ask whether the patient had received other β-lactam antibiotics.

The structured allergy assessment was implemented on December 14, 2017. Roll-out of the tool followed the "Plan, Do, Study, Act" principle. Nurses utilized the assessment for all patients presenting to the PPOC who reported a β-lactam allergy. Concurrently, antimicrobial stewardship pharmacists provided a series of in-service education sessions to nursing staff on using the structured allergy assessments, importance of allergy assessments, and optimization of surgical prophylaxis. Allergy

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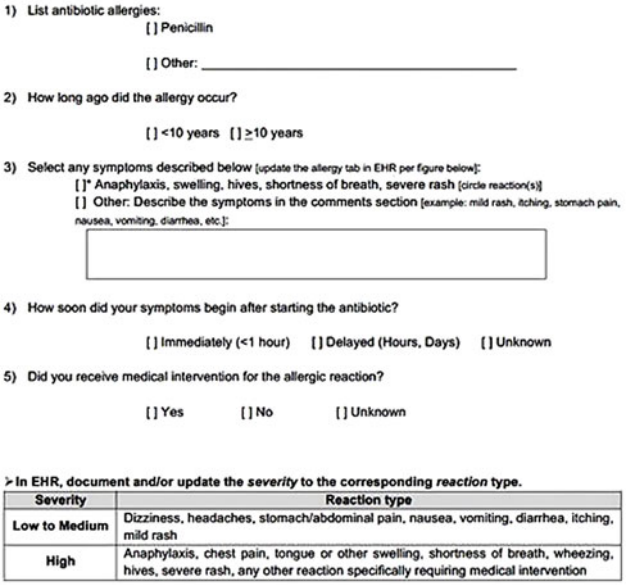
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Table 1. Clinical Characteristics of Patients Reporting a History of β-Lactam Reaction Presenting to the Presurgical Clinic and Who Underwent a Structured Allergy Assessment (n = 313)

Patient Characteristics	No. (%)
Age, mean, y	59.7
Female gender, no. (%)	207 (66)
Ethnicity	
White	251 (80)
African-American	29 (9)
Other	33 (11)
Surgical service	
Orthopedic	99 (32)
General	47 (15)
Spine	26 (8)
Gynecologic	17 (5)
Cardiac	23 (7)
Neurosurgery	11 (4)
Other	90 (29)
Major medical comorbidities	
Diabetes	49 (16)
Chronic obstructive pulmonary disease	47 (15)
Congestive heart failure	21 (7)
Renal disease	24 (8)
Liver disease	9 (3)
Reported reaction to specific *β*-lactam agent	
Penicillin	295 (94)
Aminopenicillin	18 (6)
Cephalosporin	19 (6)
Self-reported nature of the reaction	
Possibly IgE-mediated	186 (59)
Anaphylaxis	32 (10)
Other severe reaction	154 (90)
Non–IgE-mediated	127 (41)
Mild rash	72 (23)
Itching without rash	8 (3)
Gastrointestinal symptoms	8 (3)
Nonspecific symptoms	39 (12)
Time since last reaction	
<10 y	42 (13)
≥10 y	237 (76)
Unknown	34 (11)
Timing of reaction	
Immediate (<1 h)	99 (32)
Delayed (>1 h)	25 (8)
Unknown	189 (60)
Medical intervention required?	
Yes	91 (29)
No	46 (15)
Unknown	176 (56)


1) List antibiotic allergies:
[ ] Penicillin
[ ] Other: _____
2) How long ago did the allergy occur?
[ ] <10 years [ ] ≥10 years
3) Select any symptoms described below [update the allergy tab in EHR per figure below]:
[ ]* Anaphylaxis, swelling, hives, shortness of breath, severe rash [circle reaction(s)]
[ ] Other: Describe the symptoms in the comments section [example: mild rash, itching, stomach pain, nausea, vomiting, diarrhea, etc.]:
4) How soon did your symptoms begin after starting the antibiotic?
[ ] Immediately (<1 hour) [ ] Delayed (Hours, Days) [ ] Unknown
5) Did you receive medical intervention for the allergic reaction?
[ ] Yes [ ] No [ ] Unknown
➢ In EHR, document and/or update the *severity* to the corresponding *reaction* type.

Severity	Reaction type
Low to Medium	Dizziness, headaches, stomach/abdominal pain, nausea, vomiting, diarrhea, itching, mild rash
High	Anaphylaxis, chest pain, tongue or other swelling, shortness of breath, wheezing, hives, severe rash, any other reaction specifically requiring medical intervention

Fig. 1. Structured screening tool.

information was documented in the electronic medical record (EMR) according to the normal routine during the PPOC visit, and nurses were encouraged to document relevant details from the structured allergy assessment in the EMR. Surgical prophylaxis was prescribed at the discretion of the surgeon.

The completed structured allergy assessments were collected and analyzed in aggregate after 5 months. Manual chart review evaluated allergy documentation in the EMR, surgical prophylaxis received, and any potential perioperative reaction to antibiotics. Only patients who subsequently received surgical prophylaxis after their PPOC visit were included in the analysis.

To assess the impact of the intervention on surgical prophylaxis administration, the EMRs of all patients who received surgical prophylaxis following PPOC evaluation from 2015 to 2016 were retrospectively reviewed for utilization of β-lactam surgical prophylaxis. Descriptive statistics were utilized to summarize the findings from the structured allergy assessments, and categorical variables were assessed using a 2-tailed Fisher exact test in SAS version 9.4 software (SAS Institute, Cary, NC).

Results

Between December 14, 2017, and May 17, 2018, the structured allergy assessment was conducted for 364 patients reporting a β-lactam allergy in the PPOC visit; 313 subsequently received surgical prophylaxis and were included in the analysis. Baseline characteristics are described in Table 1.

Of 313 patients for whom a β-lactam allergy was reported, 295 (94.2%) reported an allergy to penicillin, 18 (5.7%) reported an allergy to an aminopenicillin, and 19 (6.1%) reported an allergy to a cephalosporin (18 patients reported allergies to multiple antibiotic classes). Overall, 271 patients (86.6%) described remote reactions (>10 years prior or could not recall). Symptoms possibly consistent with an IgE-mediated reaction were reported by 186 patients (59%). Mild or nonallergic reactions were described by the remaining 127 patients (41%), most often involving mild rash.

A β-lactam was ultimately administered in 245 of 313 patients (78.3%) who previously reported a β-lactam allergy, without any clinically significant reactions. Patients describing a mild or

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non-IgE type reaction were more likely to receive β-lactam prophylaxis (110 of 127, 86.6%) compared to those who reported a possible severe or IgE-type reaction (135 of 186, 72.6%) (odds ratio [OR], 2.44; 95% confidence interval [CI], 1.34–4.47; $P = .0033$).

We observed 135 patients who safely tolerated β-lactam prophylaxis (cefazolin in 131 of 135, 97.0%) despite initially reported symptoms consistent with a possible severe or IgE-type β-lactam reaction. Nearly all of these patients (131 of 135, 97.0%) described β-lactam reactions only to penicillin or aminopenicillins. The most common reactions described were hives (79 of 135, 58.5%) and swelling (34 of 135, 25.2%). Among these patients, most reported a remote reaction history (113 of 135, 83.7%), lack of immediate onset (77 of 135, 57.0%), and/or could not recall requiring medical intervention for the reaction (83 of 135, 61.5%).

In the preimplementation group, 1,182 patients with reported β-lactam allergies were evaluated at the same PPOC visit from January 2015 to December 2016 and subsequently received surgical prophylaxis. Among them, 857 patients (72.5%) received β-lactam surgical prophylaxis, which was significantly fewer than our postimplementation cohort (OR, 1.37; 95% CI, 1.01–1.87; $P = .04$). These patients had demographics (ie, age, gender, ethnicity, medical comorbidities, and surgical service) similar to those of our postimplementation group.

Discussion

Implementing a brief structured allergy assessment in a PPOC is a simple and effective way to increase the use of preferred β-lactam surgical prophylaxis in patients reporting prior β-lactam reactions. Our findings are consistent with those of Vaisman et al,[7] who reported that the use of alternative surgical prophylaxis decreased after implementing structured allergy histories. Importantly, this approach demonstrates the profound value of engaging nurses in antimicrobial stewardship programs to optimize antibiotic use. Nurses are often the first medical provider patients encounter in both inpatient and outpatient settings; thusly, their expertise in patient assessment is paramount in elucidating an accurate allergy history.

Our findings support the notion that most patients reporting a prior reaction to penicillin can safely receive alternative β-lactams (eg, cefazolin) and that historically reported β-lactam reactions are not a contraindication for future use of β-lactams. This finding is particularly exemplified by the substantial number of patients reporting a possible IgE-mediated β-lactam reaction yet safely tolerating β-lactam surgical prophylaxis. This finding is likely explained by waning antibody response, low rates of penicillin-cephalosporin allergy cross reactivity, and adverse drug reactions mistaken for allergies.[4,5]

Our study has several limitations. First, this study was a nonrandomized quality improvement project, and our results may have been confounded by other factors, such as an increasing awareness among prescribers of the safety of cephalosporins in patients with a reported allergy to penicillin. Second, evaluation of surgical prophylaxis was limited to patients encountered in the PPOC, which does not encompass the entire presurgical patient population of the medical center. Third, in patients with a primary penicillin allergy, receipt and tolerance of a cephalosporin does not rule out the primary penicillin allergy. Lastly, we acknowledge the relatively small sample size and limited time frame of the study.

In summary, we observed that the implementation of a simple structured allergy assessment by nurses in a PPOC was associated with a modest increase in patients receiving first-line β-lactam surgical prophylaxis. Expanding the role of structured allergy assessments across the spectrum of patient care has the potential to optimize the use of first-line antimicrobial therapy.

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