Lesson S20: PreAnesthetic Assessment of the Patient Claiming Penicillin Allergy: Integrating SCIP Requirements

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REVIEW DATE: July, 2011

Read this article, reflect on the information presented, then go online and complete the lesson post-test and course evaluation before the termination date below. (CME credit is not valid past this date.) You must achieve a score of 80% or better to earn CME credit.

TIME TO COMPLETE ACTIVITY: 2 hours
RELEASE DATE: September 1, 2011
TERMINATION DATE: September 30, 2012

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Needs statement

Allergy to penicillin is commonly reported. However, most patients are found not to be allergic upon skin testing. Standard of care now requires that all patients receive preoperative antibiotic therapy, a task for which anesthesiologists are usually responsible. As such, anesthesiologists are required to possess the knowledge to choose an appropriate antibiotic, and avoid agents with higher cost and greater potential for adverse side effects.
Learning Objectives

At the end of this activity, the participant should be able to:

1. State the relationship between the incidence of self-reported penicillin allergy and severe reaction to antibiotic administration.
2. State the objectives of the Surgical Care Improvement Program (SCIP).
3. Describe the immunologic mechanism responsible for the hypersensitivity reaction observed in penicillin allergic individuals.
4. Differentiate between the commonly prescribed classes of antibiotics.
5. Be aware of current recommendations for antimicrobial prophylaxis.
6. Identify alternative antibiotic selection for an individual with a reported allergy to penicillin.
7. List the possible reactions to penicillin that a patient may interpret as allergic.
8. Identify the indications for skin testing in determining penicillin allergy.
9. Be able to discuss Tips for Safer Surgery with patients.
10. Safely administer an appropriate prophylactic antibiotic.

Case History

A 69-year-old female presented for left shoulder replacement. Past medical history was significant for mild seasonal allergies, well controlled by occasional use of an albuterol inhaler and hypertension treated with hydrochlorothiazide and amlodipine. She also had osteoarthritis for which she took a variety of non-steroidal anti-inflammatory agents. Surgical history included general anesthesia for tonsillectomy and placement of a myringotomy tube as a child. There were no known anesthetic related complications. She noted an allergy to penicillin based on an anecdotal report from her mother regarding a suspicious rash. She was 65 inches tall and weighed 174 lbs. Lung auscultation was clear bilaterally, with no evidence of rales, rhonchi or wheezing.

Introduction

Frequency of self-reported allergy to penicillin is generally accepted to be approximately 10%. One study found an incidence of 12.1%, with other reports showing that the number may actually be higher. The incidence of true allergy to penicillin, as confirmed by skin testing, is approximately 0.01%. Because an estimated 40% of patients with allergy to penicillin may also be allergic to cephalosporins, physicians often substitute vancomycin, a more expensive antibiotic which has the potential for more serious complications.

In the landmark document, Crossing the Quality Chasm, A New Health System for the 21st Century, the Institute of Medicine proposed an overhaul of American medical care aiming to make it “safe, effective, patient centered, timely, efficient and equitable”. Noting the large number of preventable deaths from infection annually in this country, major efforts have been directed at reducing perioperative infection. Antibiotic prophylaxis has been recommended to decrease infections related to surgery. One study showed a statistically significant reduction in surgical site infection when compliance with the Surgical Care Improvement Program (SCIP) increased from 38% to 92%. Most commonly, an agent related to penicillin is used for prophylaxis. Many hospitals have developed
protocols but controversy remains about selection of alternate agents when penicillin allergy is uncertain.

**Surgical Care Improvement Program**

The Surgical Care Improvement Program (SCIP), sponsored by the Centers for Medicare & Medicaid Services (CMS), is an extension of a previous CMS initiative, the Surgical Infection Prevention Project (SIPP). The initial goal was a 25% reduction in the incidence of surgical complications nationally by the year 2010. The SCIP focuses on improving the safety of surgical care through the reduction of postoperative complications. Initiated in 2003 by CMS and the CDC, the SCIP partnership is coordinated through a steering committee of 10 national organizations with a panel of more than 20 organizations providing additional technical expertise. The project's steering committee is composed of members from the following national organizations:

- Agency for Healthcare Research and Quality
- American College of Surgeons
- American Hospital Association
- American Society of Anesthesiologists
- Association of PeriOperative Registered Nurses
- Centers for Disease Control and Prevention
- Centers for Medicare & Medicaid Services
- Department of Veterans Affairs
- Institute for Healthcare Improvement
- The Joint Commission

The following are key features of the SCIP's plan:

1. Prophylactic antibodies should be received 1 hour prior to surgical incision.
2. Antibiotics should be selected for activity against the most probable antimicrobial contaminants.
3. Antibiotics should be discontinued within 48 hours after surgery end time.
4. Euglycemia should be maintained with well-controlled morning blood glucose concentrations for the first 2 postoperative days, especially in cardiac patients.
5. Hair at the surgical site should be removed with clippers or by a depilatory method.
6. Urinary catheters are to be removed within the first 2 postoperative days.
7. Normothermia should be maintained perioperatively.

SCIP publishes an informational packet for educating patients entitled “Tips for Safer Surgery”. This information is readily available online for consumers and may be used for patient education by health professionals.

**Penicillin Allergy**

Nearly 10% of the general population believe that they have suffered some kind of adverse reaction to penicillin, most commonly a minor rash or itching, though the severity depends on exposure history, route of administration, duration of treatment, time elapsed from reaction to repeat exposure, and type of initial reaction.
Types of allergic reactions

There are four types of hypersensitivity reactions involving the immune system and a foreign antigen:

**Type I (immediate hypersensitivity):** the immune system responds by immediately releasing vasoactive mediators that act on vessels and smooth muscle and pro-inflammatory cytokines, recruiting inflammatory cells, and resulting in the clinical appearance of anaphylaxis.

**Type II (antibody-mediated disorders):** secreted antibodies directly injure cells by promoting phagocytosis by macrophages or lysis by inflammatory mediators.

**Type III (immune complex-mediated disorders):** antibodies bind to antigens, inducing inflammation directly or through the activation of complement. Neutrophils and monocytes are attracted by the activation of damage tissue through the release of lysosomal enzymes and the generation of toxic free radicals.

**Type IV (cell-mediated immune disorders):** T lymphocytes are sensitized to cause cellular and tissue injury.

![Figure 1: Type I hypersensitivity reaction, mechanism of action.](image)

A type I reaction occurs when penicillin or its reactive metabolite binds to serum proteins and cross-links mast cells or basophils expressing preformed penicillin-specific immunoglobulin E antibodies, as shown in Figure 1. This cross-linking results in the release of mast cell mediators responsible for the clinical manifestations of anaphylaxis. Reactions occurring after 72 hours of drug administration are considered late reactions and are either of the type II, III, or IV variety. These reactions are less severe and not life threatening, and a history positive for a non-type I reaction is unlikely to result in cross-reactivity with related drugs. Immediate reactions showing systemic manifestations of anaphylaxis occur in only 0.004% to 0.15% of penicillin courses administered, but fear of these type I hypersensitivity reactions often results in the administration of an alternate, broad spectrum antibiotic such as vancomycin. Two older studies found that one-quarter to one-third of patients who died secondary to the administration of penicillin gave a history of penicillin allergy prior to the
administration of the antibiotic.\textsuperscript{7,8} These studies may not be applicable to the newer generation of antibiotics available today. Still, the anesthesiologist must determine when it is safe to administer a drug that has the potential to result in death in susceptible individuals.

It is common for patients presenting for surgery to report an allergy or “bad reaction” to penicillin based on personal experience or based on being told of the allergy by a caretaker. Occasionally, specifics of a rash, swelling, itchiness, or respiratory difficulty are recalled. Studies involving the use of skin testing to assess individuals reportedly allergic to penicillin have shown that less than 10\% of persons with a history of penicillin allergy are at risk for developing a type I reaction,\textsuperscript{9} and suggest that individuals who have both a history of penicillin allergy and positive skin tests could safely be given penicillin.

Salkind et al believe that history alone is an adequate method of determining penicillin allergy,\textsuperscript{10} concluding that, “taking a detailed history of a patient’s reaction to penicillin may allow clinicians to exclude true penicillin allergy, allowing these patients to receive penicillin without testing.” This recommendation is based on data suggesting that only 10\% to 20\% of patients who report a history of penicillin allergy are truly allergic when assessed by skin testing. The conclusion that a history of type I reaction to penicillin requires avoiding related antibiotics such as cephalosporins has not been validated in any prospective, random, double-blinded studies.\textsuperscript{1}

**Cross-reactivity between antibiotics**

The safety of administering a cephalosporin to a patient who reports a penicillin allergy remains controversial. Two studies performed in 1973 and 1978 suggest the cross-reactivity rate between cephalosporins and penicillins is as high as 50\%.\textsuperscript{12,13} Subsequent studies involving the second, third and fourth generation cephalosporins report a much lower cross-reactivity rate of 8\% to 12\%.\textsuperscript{21} Daulat et al reported a cross-reactivity rate of 0.17\% in patients with a reported penicillin allergy who were given a cephalosporin.\textsuperscript{14} This retrospective investigation identified 606 patients with a reported penicillin allergy who had received at least one course of treatment with a cephalosporin. There was one adverse reaction, reported as a mild worsening of an underlying eczema several days after cepazolin was commenced. In a letter to the editor addressing this study, Fine reported a series of 400 patients with a history of penicillin allergy that required penicillin administration.\textsuperscript{15} Each patient underwent skin testing with a positive result in only 2\% of cases. All patients with a negative skin test received penicillin without incident. Fine suggested the possibility that patients who reported a previous allergy to penicillin were simply no longer allergic to the antibiotic.

While it is not known if the allergic reactions observed in penicillin allergic patients who receive a cephalosporin are true cross reactions or merely independent reactions in susceptible individuals, it is likely that the patient with a penicillin allergy will experience more cephalosporin-induced allergic reactions than the patient who is not penicillin allergic.\textsuperscript{11,16} Cephalosporins are similar to penicillins immunochemically and the potential for cross-reactivity still exists in varying degrees despite the fact that third-generation cephalosporins are less likely to result in cross-allergic responses than first-generation cephalosporins. The penicillins and cephalosporins both share a bicyclic nucleus which is likely responsible for the appreciable but variable immunologic cross-reactivity in immune responses to these drugs.\textsuperscript{17}

The practice of administering a cephalosporin antibiotic to a patient with a known or suspected
penicillin allergy is common. A survey of 600 physicians, found that the type of penicillin allergic history influences antibiotic choice. The authors suggested that skin testing should be used to identify those patients not at risk for type I hypersensitivity reactions to decrease the use of broad-spectrum antibiotics in patients labeled "penicillin-allergic." While there exists some risk for cross-reactivity in patients with a history of penicillin allergy, the type of allergic reaction is not life threatening in those not at risk for a type I hypersensitivity reaction.

**Assessment of Risk**

Like penicillins, cephalosporins have a β-lactam ring, a six-membered dihydrothiazine ring similar enough to the five-membered thiazolidine ring found in penicillin to result in cross reactivity (Figures 2 and 3). The risk of cross-reactivity is highest with the first generation cephalosporins (5% to 16.5%) as compared to second generation (cefazolin, 4%) and the third or fourth generation agents (cefotaxime, cefetime, 1% to 3%).

Situations can be classified as high, moderate or low risk based on the history of the clinical presentation of the drug allergy. For high risk situations, the risk of severe reaction is estimated to range from 50% to 95%. High risk situations include the following:

1. The administration of a cephalosporin to a patient within 1 year of a known or suspected severe allergic reaction to penicillin.
2. The administration of a bolus infusion of a cephalosporin to a patient with positive penicillin skin test reactions.
3. The administration of imipenem (a β-lactam antibiotic) to a patient with a known cross-reactivity between penicillin and imipenem.
4. The administration of a cephalosporin to a patient with a history of allergy to both penicillin and cephalosporin.
In moderate risk situations, the risk of severe reaction is estimated to range from 30% to 50% and include:

- The administration of a cephalosporin to a patient within 5 years of a known or suspected severe allergic reaction to penicillin.\(^{21}\)

In low risk situations, the risk of severe reaction is estimated to range from 0% to 5% and include:

- The administration of a cephalosporin to a patient with a reported penicillin allergy but negative skin test reactions to major and minor penicillin determinants.\(^{22}\)
- The administration of a cephalosporin to a patient with a known or suspected history of a penicillin allergy 25 years prior. (Skin testing and test dosing may still be indicated.)\(^{17}\)

**The Test Dose**

The cascade of mast cell activation that causes symptoms of anaphylaxis can be triggered by a small amount of antigen (antibiotic). The administration of a “test dose” prior to beginning an infusion will likely have no effect but to trigger an anaphylactic reaction in truly sensitive individuals. In the rare case where a specific antibiotic is indicated and there is no acceptable alternative, rapid intravenous desensitization may be performed over a number of hours.\(^{23}\) The process involves administering the antibiotic in small bolus doses over an extended period of time, usually between 2.5 to 8 hours depending on the agent and the protocol. The initial bolus doses are equivalent to the dose absorbed during a skin test and doubled every 30 minutes. Once larger doses are reached, the time between doses is adjusted according to the tolerance of the patient.

**Current Recommendations for Antibiotic Prophylaxis**

The purpose of preoperative antibiotic prophylaxis is to reduce the quantity of bacterial contamination that may occur during surgery. It has been shown that the most effective prophylactic measure involves administration of systemic antibiotics immediately before surgery.\(^{24}\) Prophylactic doses are timed so that maximum antibiotic concentrations are achieved just prior to skin incision and maintained throughout the procedure.\(^{25}\) Current guidelines for antimicrobial prophylaxis are specific to the type of surgery. Because they do not share the β-lactam structure, vancomycin and clindamycin are accepted alternatives for patients who have a true type I β-lactam allergy (immediate urticaria, laryngeal edema, or bronchospasm) when cefazolin or cefuroxime are recommended.\(^{26}\)

The British National Formulary once issued broad warnings of 10% cross reactivity with penicillin and cephalazolin. The September 2008 edition now suggests that, in the absence of suitable alternatives, oral cefixime or cefuroxime and injectable cefotaxime, ceftazidine, and ceftriaxone can be used with caution; and cefaclor, cefadroxil, cefalexin, and cefradine should be avoided.\(^{27,28}\) Vancomycin (Figure 4) is a branched tricyclic glycosolated nonribosomal peptide. Clindamycin (Figure 5) is a substituted lincosamide. Gentamicin is an aminoglycoside, and metronidazole (Figure 6) has a nitroimidazole ring. All these structures differ enough from penicillins and cephalosporins to avoid cross-reactivity in penicillin allergic individuals. Although aztreonam (Figure 7) has a β-lactam structure, there is limited cross-reactivity with other β-lactam antibiotics, and it is generally considered safe for administration to patients with known hypersensitivity reactions to penicillins. Indications for specific antibiotic coverage are shown in Table 1.
<table>
<thead>
<tr>
<th>Figure 4: Vancomycin</th>
<th>Figure 5: Clindamycin</th>
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<tbody>
<tr>
<td><img src="image1" alt="Vancomycin Structure" /></td>
<td><img src="image2" alt="Clindamycin Structure" /></td>
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<thead>
<tr>
<th>Figure 6: Metronidazole</th>
<th>Figure 7: Aztreonam</th>
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<tbody>
<tr>
<td><img src="image3" alt="Metronidazole Structure" /></td>
<td><img src="image4" alt="Aztreonam Structure" /></td>
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Table 1: Antibiotic activity

<table>
<thead>
<tr>
<th>ANTIBIOTIC</th>
<th>ACTIVITY</th>
<th>TOXICITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penicillin</td>
<td>Gram-positive organisms</td>
<td>Rash, urticaria, anaphylaxis</td>
</tr>
<tr>
<td>Cephalosporins</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; generation: Gram-positive organisms Subsequent generations: increased Gram-negative coverage, less Gram-positive coverage</td>
<td>Less toxicity, anaphylaxis possible</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>Gram-positive organisms (last resort)</td>
<td>Ears and kidneys Resistance common</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>Anaerobes, protozoa, MRSA</td>
<td>C. difficile diarrhea</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>Gram-negative organisms. Heat stable and can be used with orthopedic cement.</td>
<td>Ears and kidneys</td>
</tr>
<tr>
<td>Aztreonam</td>
<td>Gram-negative, especially P. aeruginosa</td>
<td>C. difficile overgrowth</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>Anaerobes and protozoa. Useful for colorectal surgery, Crohn’s Disease.</td>
<td>C. difficile overgrowth</td>
</tr>
</tbody>
</table>

Specific recommendations for antibiotic prophylaxis for selected types of surgery are as follows:

**Cardiac surgery and thoracic aortic surgery:**

1. Cefazolin 1 gram intravenously (IV) every four hours and vancomycin 1000 milligrams IV prior to surgery with 500 milligrams administered after coronary pulmonary bypass (CPB); or
2. Vancomycin 1000 milligrams IV prior to surgery with 500 milligrams after CPB only for immediate-type penicillin allergy.

**Thoracic surgery, and pacemaker or defibrillator placement:**

1. Cefazolin 1 gram IV every four hours intraoperatively; or
2. Vancomycin 1000 milligrams IV every twelve hours for immediate-type penicillin allergy.

**Esophageal surgery:**

1. Cefazolin 1 gram IV every four hours intraoperatively and metronidazole 500 milligrams IV every six hours; or
2. Clindamycin 600 milligrams IV every six hours and gentamicin 1.5 milligrams per kilogram of ideal body weight IV every eight hours for immediate-type penicillin allergy.

**Arterial surgery involving the abdominal aorta:**

1. Cefazolin 1 gram IV every four hours intraoperatively and metronidazole 500 milligrams IV every six hours; or
2. Clindamycin 600 milligrams IV every six hours and gentamicin 1.5 milligrams per kilogram of ideal body weight IV every eight hours for immediate-type penicillin allergy.
**Endovascular procedures:**

1. Cefazolin 1 gram IV every four hours intraoperatively; or
2. Clindamycin 600 milligrams IV every six hours for immediate-type penicillin allergy.

**Vascular procedures such as lower extremity bypass for ischemia, lower extremity amputation for ischemia, arteriovenous grafts for hemodialysis, and any vascular case involving a patient with Methicillin resistant S. aureus:**

1. Vancomycin 1000 milligrams IV every twelve hours.

**Craniotomy, cerebrospinal shunting procedures, spinal surgery and transphenoidal hypophysectomy:**

1. Cefuroxime 1.5 grams IV every six hours intraoperatively; or
2. Vancomycin 1000 milligrams IV every twelve hours and gentamicin 1.5 milligrams per kilogram of ideal body weight IV every eight hours for immediate-type penicillin allergy.

**Neurosurgery with entry into nasal sinuses:**

1. Cefuroxime 1.5 grams IV every six hours and ampicillin 1 gram IV every six hours intraoperatively; or
2. Vancomycin 1000 milligrams IV every twelve hours for immediate-type penicillin allergy.

**Orthopedic procedures with no implantable devices:**

1. Cefazolin 1 gram IV every four hours intraoperatively; or
2. Vancomycin 1000 milligrams IV x 1 dose for immediate-type penicillin allergy.

**Primary orthopedic procedures without implants:**

1. Cefazolin 1 gram IV every four hours intraoperatively and every eight hours postoperatively for 24 hours; or
2. Vancomycin 1000 milligrams IV x 2 doses for immediate-type penicillin allergy.

**Revision orthopedic procedures with implants (antibiotics should be withheld until cultures are obtained):**

1. Cefazolin 1 gram IV every four hours intraoperatively and every eight hours postoperatively for 48 hours; or
2. Vancomycin 1000 milligram IV x 4 doses for immediate-type penicillin allergy.

**Ophthalmic procedures:** topical therapy as ordered by the ophthalmologist.

**Head and neck procedures entering the oral cavity or pharynx:**

1. Cefazolin 1 gram IV every four hours intraoperatively and metronidazole 500 milligrams IV every six hours; or
2. Clindamycin 600 milligrams IV every six hours and gentamicin 1.5 milligrams per kilogram of ideal body weight IV every eight hours for immediate-type penicillin allergy.

**Gastroduodenal procedures:**

1. Cefazolin 1 gram IV every four hours intraoperatively; or
2. Clindamycin 600 milligrams IV every six hours and gentamicin 1.5 milligrams per kilogram of ideal body weight IV every eight hours for immediate-type penicillin allergy.

**Open procedures involving the biliary tract (no prophylactic antibiotics indicated for elective laparoscopic cholecystectomy):**

1. Cefazolin 1 gram IV every four hours intraoperatively and metronidazole 500 milligrams IV every six hours; or
2. Clindamycin 600 milligrams IV every six hours and gentamicin 1.5 milligrams per kilogram of ideal body weight IV every eight hours for immediate-type penicillin allergy.

**Colorectal surgery:**

1. Cefazolin 1 gram IV every four hours intraoperatively and metronidazole 500 milligrams IV every six hours; or
2. Clindamycin 600 milligrams IV every six hours and gentamicin 1.5 milligrams per kilogram of ideal body weight IV every eight hours for immediate-type penicillin allergy.

**Appendectomy:**

1. Cefazolin 1 gram IV every four hours intraoperatively and metronidazole 500 milligrams IV every six hours; or
2. Clindamycin 600 milligrams IV every six hours and gentamicin 1.5 milligrams per kilogram of ideal body weight IV every eight hours for immediate-type penicillin allergy.

**Hepatic transplant:**

1. Cefotaxime 1 gram IV every eight hours intraoperatively for adults and Unasyn® (ampicillin/sulbactam) 75 milligrams per kilogram ideal body weight IV every six hours and fluconazole 5 milligrams per kilogram ideal body weight IV every twenty-four hours for children; or
2. Vancomycin 1000 milligrams IV every twelve hours and aztreonam 1 gram IV every eight hours for immediate-type penicillin allergy.

**Open gynecological procedures including hysterectomy:**

1. Cefazolin 1 gram IV every four hours intraoperatively and metronidazole 500 milligrams IV every six hours; or
2. Clindamycin 600 milligrams IV every six hours and gentamicin 1.5 milligrams per kilogram of ideal body weight IV every eight hours for immediate-type penicillin allergy.
Cesarean section:

1. Cefazolin 1 gram IV every four hours intraoperatively; or
2. Clindamycin 600 milligrams IV every six hours and gentamicin 1.5 milligrams per kilogram of ideal body weight IV every eight hours for immediate-type penicillin allergy.

High risk genitourinary procedures:

1. Ciprofloxacin 500 milligrams PO 2 hours prior to surgery; or
2. Ciprofloxacin 400 milligrams IV 1 hour prior to surgery.

Notes Regarding Antibiotic Administration

Several precautions must be observed when administering antibiotics as severe reactions may occur, especially regarding interactions with anesthetic agents (Table 2).

Table 2: Precautions when administering antibiotics

- Antibiotic infusions should be completed 30-60 minutes prior to skin incision.
- Penicillins should not be given as rapid IV boluses as they may cause seizures.
- Gentamicin should be infused over 30 minutes to avoid ototoxicity.
- Vancomycin should be infused over 30-60 minutes in a monitored setting, one to two hour prior to the induction of anesthesia as adverse reactions have been reported when it is administered concurrent with anesthetic agents.
- Vancomycin tissue levels rise slowly, and rapid infusion has been associated with an anaphylactoid reaction, therefore the infusion should be completed 1 hour prior to skin incision.
- Standard adult doses may need to be increased in morbidly obese patients.

Also, antibiotic administration is required for children. Dosages and precautions are listed in Table 3.
Table 3: Pediatric Dosages of Antibiotics for IV Administration (Note, for pediatric patients <1 month of age, appropriate experts should be consulted. In no case should the pediatric dose exceed the standard adult dose):

<table>
<thead>
<tr>
<th>ANTIBIOTIC</th>
<th>DOSAGE</th>
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<tbody>
<tr>
<td>Cefazolin</td>
<td>25 mg/kg IV q4h</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>10 mg/kg IV q12h</td>
</tr>
<tr>
<td>Cefurozime</td>
<td>50 mg/kg IV q6h</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>1.5 mg/kg IV q8h (&gt;5 years old; ideal body weight)</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>2.5 mg/kg IV q8h (&lt;5 years old)</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>10 mg/kg IV q6h</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>100 mg/kg IV q8h</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>7.5 mg/kg IV q6h</td>
</tr>
<tr>
<td>Aztreonam</td>
<td>30 mg/kg q6h</td>
</tr>
</tbody>
</table>

Treatment for Type I hypersensitivity Reactions

It is not always possible to prevent a type I hypersensitivity reaction, even if care is taken to avoid triggering agents. Should such a reaction occur, the key is to recognize the complication and treat aggressively. Management of an acute allergic drug reaction involves identifying the causative agent and discontinuing its administration (if possible) while providing supportive therapy as indicated.

Physical findings may include any of the following: urticaria, pruritis, skin flushing, angioedema, weakness, dizziness, dyspnea, cough, malaise, difficulty swallowing wheezing, tachycardia, hypotension, and vascular collapse.

If anaphylaxis is suspected, the airway must be secured. If the patient’s trachea is not already intubated, consideration should be given to placing an endotracheal tube early as the success rate is improved when intubation is attempted before soft tissue swelling progresses. Intravenous access is imperative and two large bore lines should be placed at the earliest possible moment, allowing for aggressive fluid management as needed to maintain blood pressure. Pharmacologic therapy should be begun as early as possible, with aqueous epinephrine 1:1000 (0.01 milliliter per kilogram, maximum adult dose 0.3 to 0.5 milliliter) administered via intramuscular or subcutaneous route. This dose may be repeated approximately every 5–10 min if symptoms persist. Administration of H1- and H2-receptor antagonists is also indicated. Diphenhydramine (50 to 75 milligrams) may be administered either by the intravenous or intramuscular route and cimetidine (300 milligrams) or ranitidine (50 milligrams) may be given intravenously. Corticosteroids are not useful in the treatment of acute anaphylaxis due to the slow onset of action, but may be administered to prevent prolonged or recurrent anaphylaxis. Hydrocortisone sodium succinate (250 to 500 milligrams for adults, 4 to 8 milligrams per kilogram for children) may be given every 4 to 6 hours intravenously. Alternatively, a single dose of methylprednisolone (60 to 125 milligrams for adults, 1 to 2 milligrams per kilogram for children) may be administered intravenously. Aerosolized β-agonists, such as albuterol, control bronchospasm. For patients maintained on β-blocking agents, glucagon may be helpful for those who do not respond to epinephrine and antihistamines.
Management of the Case Presented

After placement of standard ASA monitors and cannulation of a vein with an 18-gauge needle, midazolam, 1.5 mg in divided doses, was given. A supraclavicular brachial plexus block was performed under sonographic guidance. Mepivacaine 20 milliliters, 1.5% and bupivacaine 20 ml, 0.5% with 1:200,000 epinephrine were administered. Cefazolin, 1 gm, was administered as antimicrobial prophylaxis prior to surgical incision and the patient received a propofol infusion at the rate of 50 micrograms per kilogram per minute for the duration of the case. Following a short stay in the post-anesthesia care unit, the patient was discharged home. Follow up at 24 and 72 hours post administration revealed no untoward reaction to the cephalosporin antibiotic.

Summary

Though cross-reactivity between cephalosporins and penicillins does exist, most patients with a penicillin allergy tolerate cephalosporins without significant reaction. For the patient requiring a cephalosporin who reports a history of penicillin allergy, the anesthesiologist should determine the likelihood that the allergy represents a true type I hypersensitivity reaction. If it becomes clear from the history that the patient does not have this reaction, a cephalosporin can be safely administered.

Dr. Elizabeth A.M. Frost, who is the editor of this continuing medical education series, is clinical professor of anesthesiology at The Mount Sinai School of Medicine in New York City. She is the author of Clinical Anesthesia in Neurosurgery (Butterworth-Heinemann, Boston) and numerous articles. Dr. Frost is past president of the Anesthesia History Association and former editor of the journal of the New York State Society of Anesthesiologists, Sphere. She is also editor of the book series based on this CME program, Preanesthetic Assessment, Volumes 1 through 3 (Birkhäuser, Boston) and 4 through 6 (McMahon Publishing, New York City).
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Post-test

1. The incidence of self-reported penicillin allergy in the general population is approximately:
   a. 0.5-1%
   b. 10-15%
   c. Quite low
   d. Greater than 35%

2. Of the patients who report a penicillin allergy, the incidence of true allergy as confirmed by skin testing is approximately:
   a. 0.1%
   b. 0.01%
   c. 50%
   d. Almost 75%

3. The main focus of the SCIP program is:
   a. Reduction of postoperative complications
   b. Increase insurance reimbursement
   c. To improve compliance with Joint Commission standards
   d. Reduction in perioperative mortality rates

4. Administration of prophylactic antibiotics are timed to achieve maximum concentrations:
   a. Just prior to surgical incision
   b. One hour before surgical incision
   c. Just after incision is closed
   d. Two hours after surgical incision

5. The type of allergic reaction responsible for anaphylaxis in a patient with an immediate-type penicillin allergy is:
   a. A type I reaction
   b. A type II reaction
   c. A type III reaction
   d. A type IV reaction
6. If antibiotics are indicated for a given procedure but the patient is deemed truly allergic to the indicated antibiotic:
   a. The patient should not be given any antibiotics
   b. Antibiotics should be given only if the surgeon requests them
   c. The indicated antibiotic should be administered in smaller doses at a slower rate
   d. An alternate antibiotic should be administered

7. Regarding gentamicin:
   a. It is heat stable and may be used when an exothermic reaction from cement is anticipated
   b. It affects mainly Gram-positive organisms
   c. An appropriate dose in children is 5mg/kg/h
   d. There is little or no systemic toxicity

8. All of the following symptoms are suggestive of a true type I β-lactam allergy except
   a. Hypertension
   b. Immediate urticaria
   c. Laryngeal edema
   d. Bronchospasm

9. Which of the following statements is true?
   a. Current guidelines for antimicrobial prophylaxis are independent of the type of surgery
   b. Vancomycin should be infused over 15 minutes in a monitored setting
   c. Vancomycin tissue levels rise slowly so the infusion should be completed 1 hour prior to skin incision
   d. Penicillin may be administered as a rapid IV bolus in non-allergic patients.

10. If a patient reports an allergy to penicillin the best course of action is to:
    a. Administer penicillin anyway as the patient likely does not have a true allergy
    b. Cancel the case pending allergy work up, which includes skin testing
    c. Evaluate the patient’s history and choose an acceptable antibiotic
    d. Administer vancomycin