Antibiotic Prophylaxis for Gynecologic Procedures

Surgical site infection remains the most common surgical complication. Up to 5% of operative patients will develop a surgical site infection leading to a longer hospital stay and increased cost (1). One of the advances in infection control practices has been the selective use of antibiotic prophylaxis. However, antibiotic use, especially prophylactic antibiotic use, has been associated with the selection of antibiotic-resistant bacteria. Indiscriminate use of prophylactic antibiotics for institutions as well as for individual patients promotes this dangerous side effect. There are acknowledged consequences of prophylactic antibiotic use for institutions as well as for individual patients. It is important for clinicians to understand when antibiotic prophylaxis is indicated and when it is inappropriate. The purpose of this document is to review the evidence for surgical site infection prevention and appropriate antibiotic prophylaxis for gynecologic procedures.

Background

Pathophysiology and Microbiology of Gynecologic Infections

As the number and virulence of contaminating bacteria increase in a surgical site, so does the risk for postoperative infection. Surgery and the use of foreign material, such as sutures, further increase the risk of infection. At the same time, systemic and local host immune mechanisms function to contain inoculated bacteria and prevent infection. Antibiotics in the tissues provide a pharmacologic means of defense that augments the natural host immunity. Bacterial resistance mechanisms may contribute to the pathogenesis of surgical site
infection by enabling organisms to evade the prophylactically administered antibiotics (2).

For most surgical site infections, the source of pathogens is the endogenous flora of the patient’s skin or vagina. When skin is incised, the exposed tissues are at risk of contamination with endogenous flora. These organisms usually are aerobic gram-positive cocci (eg, Staphylococcus), but may include fecal flora (eg, anaerobic bacteria and gram-negative aerobes) when incisions are made near the perineum or groin (3). When the vagina is opened during surgery, the surgical site is exposed to a polymicrobial flora of aerobes and anaerobes (4). Bacterial vaginosis, a complex alteration of vaginal flora resulting in an increased concentration of potentially pathogenic anaerobic bacteria, is associated with an increased risk of posthysterectomy cuff cellulitis (5). These microorganisms also can be spread to the abdominal incision at the time of surgery. In addition, the skin microorganisms Staphylococcus epidermidis and Staphylococcus aureus may lead to an abdominal-incision infection. Gynecologic surgical procedures, such as laparotomies or laparoscopies, do not breach surfaces colonized with bacteria from the vagina, and infections following these procedures more commonly result from contaminating skin bacteria only.

Procedures breaching the endocervix, such as hysterosalpingogram, sonohysterography, intrauterine device (IUD) insertion, endometrial biopsy, and dilation and curettage, may seed the endometrium and the fallopian tubes with microorganisms found in the upper vagina and endocervix. Choosing prevention and treatment of these postprocedural infections, either endometritis or pelvic inflammatory disease (PID), should take into consideration the polymicrobial nature of these infections.

The risk of developing bacterial endocarditis is related to a procedure’s risk of inducing bacteremia and the significance of an underlying cardiac lesion. Most cases of infective endocarditis are caused by gram-positive cocci that originate from the mouth or the skin.

**Theory of Antimicrobial Prophylaxis**

State-of-the-art aseptic technique has been associated with a dramatic decrease in surgical site infections, but bacterial contamination of the surgical site is inevitable. The in vivo interaction between the inoculated bacteria and prophylactically administered antibiotic is one of the most important determinants of the state of the surgical site. Systemic antibiotic prophylaxis is based on the belief that antibiotics in the host tissues can augment natural immune-defense mechanisms and help to kill bacteria that are inoculated into the wound. Only a narrow window of antimicrobial efficacy is available, requiring the administration of antibiotics either shortly before or at the time of bacterial inoculation (eg, when the incision is made, the vagina is entered, or the pedicles are clamped). A delay of only 3–4 hours can result in ineffective prophylaxis (6).

The induction of anesthesia represents a convenient time (within an hour before the incision) for initiating antibiotic prophylaxis in major gynecologic procedures. Data indicate that for lengthy procedures, additional, intraoperative doses of an antibiotic, given at intervals of one or two times the half-life of the drug, maintain adequate levels throughout the operation (7). A second dose of the prophylactic antibiotic also may be appropriate in surgical cases with an increased blood loss (greater than 1,500 mL). Neither treatment for several days before a procedure nor subsequent doses are indicated for prophylaxis, with the above exception. The use of prophylaxis implies that the patient is presumed to be free of infection at the time of the procedure and, therefore, additional dosing is not indicated except in the above instances. During a procedure when a patient is found to be at greater risk for infection, use of therapeutic antibiotics should be considered.

**Pharmacology and Spectrum of Activity of Antibiotics Used in Prophylaxis**

The cephalosporins have emerged as the drugs of choice for most operative procedures because of their broad antimicrobial spectrum and the low incidence of allergic reactions and side effects. Cefazolin (1 g) is the most commonly used agent because of its reasonably long half-life (1.8 hours) and low cost. It is the frequent choice for clean procedures, and most clinical studies indicate that it is equivalent to other cephalosporins that have improved in vitro activity against anaerobic bacteria in clean-contaminated procedures such as a hysterectomy. Table 1 lists antibiotic regimens by procedure.

**Adverse Reactions to Antibiotics**

Adverse effects include allergic reactions ranging in severity from minor skin rashes to anaphylaxis. Anaphylaxis, the most immediate and most life-threatening risk of prophylaxis, is rare. Anaphylactic reactions to penicillin reportedly occur in 0.2% of courses of treatment, with a fatality rate of 0.0001% (8). Pseudomembranous colitis is an uncommon complication of prophylactic antibiotics (9). Overall, antibiotic-associated diarrhea rates in hospitals range from 3.2% to 29% (10, 11). Nearly 15% of hospitalized patients receiving β-lactam antibiotics develop diarrhea (11), and rates for those receiving clindamycin range from 10% to 25% (12). Predisposing host factors and circumstances affect-
ing the frequency and severity of disease include advanced age, underlying illness, recent surgery, and recent administration of bowel motility-altering drugs (13). The induction of bacterial resistance may be a consequence of prolonged prophylactic antibiotic use. Thus, use of repeated prophylactic doses is not recommended.

Clinical Considerations and Recommendations

What constitutes appropriate antibiotic prophylaxis for the following situations?

When choosing a prophylactic antimicrobial agent, the practitioner should consider the following factors. The agent selected must 1) be of low toxicity, 2) have an established safety record, 3) not be routinely used for the treatment of serious infections, 4) have a spectrum of activity that includes the microorganisms most likely to cause infection, 5) reach a useful concentration in relevant tissues during the procedure, 6) be administered for a short duration, and 7) be administered in a manner that will ensure it is present in surgical sites at the time of the incision (14).

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Antibiotic</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaginal/abdominal hysterectomy*</td>
<td>Cefazolin</td>
<td>1- or 2-g single dose IV</td>
</tr>
<tr>
<td></td>
<td>Cefoxitin</td>
<td>2-g single dose IV</td>
</tr>
<tr>
<td></td>
<td>Metronidazole(^1)</td>
<td>1-g single dose IV</td>
</tr>
<tr>
<td></td>
<td>Tinidazole(^2)</td>
<td>2-g single oral dose</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4–12 hours before surgery)</td>
</tr>
<tr>
<td>Laparoscopy</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Laparotomy</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Hysteroscopy</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Hysterosalpingogram</td>
<td>Doxycycline(^3)</td>
<td>100 mg orally, twice daily for 5 days</td>
</tr>
<tr>
<td>IUD insertion</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Endometrial biopsy</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Induced abortion/D&amp;C</td>
<td>Doxycycline</td>
<td>100 mg orally 1 hour before procedure and 200 mg orally after procedure</td>
</tr>
<tr>
<td></td>
<td>Metronidazole</td>
<td>500 mg orally twice daily for 5 days</td>
</tr>
<tr>
<td>Urodynamics</td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: IV, intravenously; IUD, intrauterine device; D&C, dilation and curettage.

\(^1\)Antimicrobial agents of choice in women with a history of immediate hypersensitivity to penicillin

\(^2\)If hysterosalpingogram demonstrates dilated fallopian tubes. No prophylaxis is indicated for a study without dilated tubes.

\(^3\)A convenient time to administer antibiotic prophylaxis is just before induction of anesthesia.

Vaginal, Abdominal, or Laparoscopically Assisted Hysterectomy

Patients undergoing vaginal or abdominal hysterectomy should receive single-dose antimicrobial prophylaxis (15). A recent report noted that as many as one half of women undergoing hysterectomy receive either inappropriately timed or no antibiotic prophylaxis (16). Hospital policies can significantly increase the appropriate use of prophylactic preoperative antibiotics (17).

More than 30 prospective randomized clinical trials and two meta-analyses support the use of prophylactic antibiotics to reduce postoperative infectious morbidity significantly and decrease length of hospitalization in women undergoing hysterectomy (18–20). Most studies show no particular antibiotic regimen to be superior to all others. Although no trials have been conducted in patients undergoing laparoscopically assisted hysterectomy, antibiotic prophylaxis seems reasonable for this procedure.

Bacterial vaginosis is a known risk factor for surgical site infection following hysterectomy. Preoperative and postoperative treatment of bacterial vaginosis with metronidazole for at least 4 days beginning just prior to surgery significantly reduces vaginal cuff infection among women with abnormal flora (21).
**Laparoscopy and Laparotomy**

No data are available to recommend antibiotic prophylaxis in clean abdominal surgery not involving vaginal or intestinal operations. A single placebo-controlled, randomized clinical trial failed to show benefit of cephalosporin prophylaxis in women undergoing laparoscopy (22). Antibiotic prophylaxis is not recommended in patients undergoing diagnostic laparoscopy or exploratory laparotomy.

**Hysterosalpingography, Sonohysterography, and Hysteroscopy**

Hysterosalpingography (HSG) is a commonly performed procedure to evaluate infertile couples for tubal factor infertility. Post-HSG PID is an uncommon (1.4–3.4%) but potentially serious complication in this patient population (23, 24). Patients with dilated fallopian tubes at the time of HSG have a higher rate (11%) of post-HSG PID (23). The possibility of lower genital tract infection with chlamydia should be considered before performing this procedure (24). In a retrospective review, investigators observed no cases of post-HSG PID in patients with nondilated fallopian tubes (0/398) (23).

In patients with no history of pelvic infection, HSG can be performed without prophylactic antibiotics. If HSG demonstrates dilated fallopian tubes, doxycycline, 100 mg twice daily for 5 days, can be considered to reduce the incidence of post-HSG PID (25). In patients with a history of pelvic infection, doxycycline can be administered before the procedure and continued if dilated fallopian tubes are found. Another option in patients with dilated fallopian tubes and a history of pelvic infection is to begin administering antibiotics. In patients thought to have an active pelvic infection, HSG should not be performed.

No data are available on which to base a recommendation for prophylaxis in patients undergoing sonohysterography, but reported rates of postprocedure infection are negligible (0/300 in one series) (26). Sonohysterography is a relatively new procedure, technically similar to HSG. The risks probably are similar to those of HSG, and the same considerations should be taken into account. Prophylaxis should be based on the individual patient’s risk of PID; routine use of antibiotic prophylaxis is not recommended.

Infectious complications following hysteroscopic surgery are uncommon and estimated to occur in 0.18–1.5% of cases (27). A single prospective study has evaluated the usefulness of amoxicillin and clavulanate antibiotic prophylaxis in preventing bacteremia associated with hysteroscopic endometrial laser ablation or endometrial resection (28). Although the incidence of bacteremia was lower in the antibiotic group than in the placebo group (2% versus 16%), most of the microorganisms isolated were of dubious clinical significance (anaerobic staphylococci) and may have resulted from contamination. Postoperative fever was noted twice as often in the patients receiving antimicrobial prophylaxis. Postoperative infection requiring antibiotic therapy was not significantly different between the two groups: 11.4% and 9% of patients required antibiotics in the placebo and antibiotic groups, respectively.

Other retrospective case series evaluating endometrial ablation reported similarly low rates of infection. In a series of 568 patients treated without antimicrobial prophylaxis, one woman (0.18%) developed endometritis (29). In a second series of 600 women, two (0.3%) developed mild pelvic infections, of whom one received antimicrobial prophylaxis and one did not (30). However, in a series of 200 women undergoing operative hysteroscopy without prophylactic antibiotics, investigators reported three cases of severe pelvic infection, although all three of these women had a history of PID (31). Given the low risk of infection and lack of evidence of efficacy, antibiotics are not of value for the general patient population undergoing these procedures.

**Intrauterine Device Insertion and Endometrial Biopsy**

The IUD is a highly effective contraceptive, but concern about the perceived risk of PID limits its use. Most of the risk of IUD-related infection occurs in the first few weeks to months after insertion, suggesting that contamination of the endometrial cavity at the time of insertion is the infecting mechanism rather than the IUD or string itself. Four randomized clinical trials have now been performed using doxycycline or azithromycin as antibiotic prophylaxis (32–35). Pelvic inflammatory disease occurred uncommonly with or without the use of antibiotic prophylaxis. A Cochrane Collaboration review concluded that either doxycycline or azithromycin before IUD insertion confers little benefit (36). When the results of the four studies were combined, a reduction in unscheduled visits to the health care provider was seen but not in the only trial performed in the United States. In the U.S. trial, however, all patients were screened for gonorrhea and chlamydia, and some with positive results were excluded from the study. The cost-effectiveness of screening for sexually transmitted diseases (STDs) before IUD insertion remains unclear because of limited data. The only randomized controlled trial performed in the United States concluded that in women screened for STDs before IUD insertion, prophylactic antibiotics provide no benefit (32).
No data are available on infectious complications of endometrial biopsy. The incidence is presumed to be negligible. It is recommended that this procedure be performed without the use of antimicrobial prophylaxis.

**Surgical Abortion**

Eleven of 15 randomized clinical trials support the use of antibiotic prophylaxis at the time of suction curettage abortion. In a meta-analysis of 11 placebo-controlled, blinded clinical trials, the overall summary relative risk (RR) estimate for developing postabortal infection of the upper genital tract in women receiving antibiotic therapy compared with those receiving placebo was 0.58 (95% confidence interval [CI], 0.47–0.71) (37). Of high-risk women, those with a history of PID had a summary RR of 0.56 (CI, 0.37–0.84); women with a positive chlamydial culture at abortion had a summary RR of 0.38 (CI, 0.15–0.92). Of low-risk women, those with no reported history of PID had a summary RR of 0.65 (CI, 0.47–0.90); in women with a negative chlamydial culture, the RR was 0.63 (CI, 0.42–0.97). The overall 42% decreased risk of infection in women given periabortal antibiotics confirms that prophylactic antibiotics are effective for these women, regardless of risk.

The optimal antibiotic and dosing regimens remain unclear. Both tetracyclines and nitroimidazoles provide significant and comparable protection against postabortal PID. One of the most effective and inexpensive regimens reported in a meta-analysis was doxycycline, 100 mg orally 1 hour before the abortion followed by 200 mg after the procedure. It is estimated that the cost of treating a single case of postabortal PID as an outpatient far exceeds the cost of doxycycline prophylaxis (37). In a prospective, randomized trial, antibiotic prophylaxis showed no benefit before treatment of incomplete abortion (38).

**Preoperative Bowel Preparation**

Occasionally, the gynecologic surgeon runs the risk of both small- and large-bowel injuries because of the presence of pelvic adhesions resulting from either previous surgery or an inflammatory process, such as PID or endometriosis. In these cases, it is reasonable to consider preparing the bowel for surgery with a mechanical bowel preparation and using a parenteral antibiotic regimen that is effective in preventing infection among patients undergoing elective bowel surgery. The addition of oral antibiotics to the mechanical bowel preparation is associated with increased nausea, vomiting, and abdominal pain and has shown no advantages in the prevention of postoperative infectious complications (39). Eight randomized clinical trials confirm the effectiveness of prophylactic parenteral antibiotics administered preoperatively with or without a prior oral antibiotic bowel preparation in decreasing the rate of postoperative infection, such as wound and intraabdominal infections (7). It is unclear whether any one regimen is superior, but broad-spectrum cephalosporins such as cefoxitin were commonly used.

**Endocarditis Prophylaxis**

As many as 75% of patients who develop endocarditis after undergoing a surgical procedure have preexisting cardiac abnormalities. To date, no randomized controlled trials have definitively established the efficacy of endocarditis prophylaxis, but most authorities agree that prophylaxis should be offered to susceptible patients. Patients with high- and moderate-risk structural cardiac defects may benefit from antimicrobial prophylaxis (see box, next page, column one). Because bacteremia is associated with certain surgical procedures (see box, next page, column two), antimicrobial prophylaxis is recommended in patients with underlying cardiac structural defects who are undergoing these procedures. Suggested regimens are listed in Table 2.

In the absence of obvious infection, prophylaxis is not indicated for cervical biopsy or IUD insertion or removal. In the presence of infection, removal of an IUD or other genitourinary procedures require endocarditis prophylaxis. Antibiotics administered for prevention of surgical site infection are not sufficient for endocarditis prophylaxis. However, most experts agree that prophylactic agents for endocarditis provide sufficient coverage against surgical site infection. For patients with significant heart disease being treated by a specialist, it may be helpful to consult the specialist for additional information if necessary.

**Urodynamic Studies or Bladder Catheterization**

Several studies suggest that prophylactic antibiotics are not effective in preventing urinary tract infections resulting from urodynamic testing. One study identified 2 of 45 women (4%) not given antibiotics following urodynamic testing whose postprocedure urine cultures were positive, compared with 0 of 51 women given nitrofurantoin, 50 mg three times a day for 3 days after testing (40). A second study identified 10 of 49 women (18.9%) not given antibiotics after urodynamic testing whose urine cultures were positive, compared with 4 of 49 women (8.9%) who received prophylaxis and had positive urine cultures (41). The differences in both studies were not statistically significant. Because neither study reported on “symptomatic infection” or the microbiology of the
postprocedure bacteriuria, the site could have been contaminated with a nonuropathogen. However, given the prevalence of asymptomatic bacteriuria in women, approximately 8% of women had unsuspected bacteriuria at the time of urodynamic testing. Because bacteriuria and urinary tract infection can cause detrusor instability, pretest screening by urine culture or urinalysis, or both, is recommended.

Urinary tract infection after one-time bladder catheterization has been reported to be approximately 2% (42). No randomized trials have compared antibiotic prophylaxis with placebo in trying to further decrease the incidence of urinary tract infection. No data are available for adults, but a randomized clinical trial has shown that the use of antibiotic prophylaxis is not warranted in children undergoing clean, intermittent catheterization. In fact, the incidence of urinary tract infection was increased significantly in those continuing to use antibiotics (43). Therefore, given the low risk of infection, antibiotic prophylaxis is not indicated for bladder catheterization.

**Which antibiotics should be used in the patient with penicillin allergy?**

Allergic reactions occur in 0.7–4% of courses of treatment with penicillin (44). Four types of immunopatho-
logic reactions have been described, all of which have been seen with β-lactam antibiotics: 1) immediate hypersensitivity reactions, 2) cytotoxic antibodies, 3) immune complexes, and 4) cell-mediated hypersensitivity (45). From 5% to 20% of patients indicate a history of reactions to β-lactam antibiotics.

Like penicillins, cephalosporins possess a β-lactam ring; however, the five-membered thiazolidine ring is replaced by a six-membered dihydrothiazine ring. The overall incidence of adverse reactions from cephalosporins ranges from 1% to 10%, with rare anaphylaxis (less than 0.02%). In patients with histories of penicillin allergy, the incidence of cephalosporin reactions is increased minimally. Postmarketing studies of second- and third-generation cephalosporins showed no increase in allergic reactions to cephalosporins in patients with histories of penicillin allergy. One reaction occurred in 98 patients (1%) with positive penicillin skin test results, and six reactions occurred in 310 patients (2%) with negative test results (46). The incidence of clinically relevant cross-reactivity between the penicillins and cephalosporins is small, but rare anaphylactic reactions have occurred (47). Patients with a history of an immediate hypersensitivity reaction to penicillin should not receive cephalosporin antibiotics, given that alternative drugs are available for prophylaxis. Single-agent prophylaxis with metronidazole is probably the best choice in this situation (48). Alternative agents include tinidazole, doxycycline, clindamycin, and the quinolones. Cephalosporin prophylaxis is acceptable in those patients with a history of penicillin allergy not felt to be immunoglobulin E mediated (immediate hypersensitivity).

**How cost-effective is antibiotic prophylaxis?**

Prophylactic antibiotics add cost to the routine care of surgical patients, but the prevention of postoperative infection decreases overall hospital costs because of prevention of postoperative infection or febrile morbidity. This savings would be eroded by use of the more expensive cephalosporins unless they were considerably more effective than cefazolin. Likewise, the inexpensive prophylactic regimens used for the prevention of postabortal PID are cost-effective. It is estimated that more than $500,000 in direct treatment costs alone would be saved each year in the United States by providing antibiotic prophylaxis to women at average risk undergoing induced abortion (37).

### Table 2. Prophylactic Regimens for Prevention of Endocarditis in Susceptible Patients Undergoing Genitourinary or Gastrointestinal Procedures

<table>
<thead>
<tr>
<th>Situation</th>
<th>Agents</th>
<th>Regimen*</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-risk patients</td>
<td>Ampicillin plus gentamicin</td>
<td>Ampicillin, 2 g IM or IV, plus gentamicin, 1.5 mg/kg (not to exceed 120 mg) within 30 minutes of starting the procedure; 6 hours later, ampicillin, 1 g IM/IV, or amoxicillin, 1 g orally</td>
</tr>
<tr>
<td>High-risk patients allergic to ampicillin or amoxicillin</td>
<td>Vancomycin plus gentamicin</td>
<td>Vancomycin, 1 g IV over 1–2 hours, plus gentamicin, 1.5 mg/kg IV/IM (not to exceed 120 mg); complete injection or infusion within 30 minutes of starting the procedure</td>
</tr>
<tr>
<td>Moderate-risk patients</td>
<td>Amoxicillin or amoxicillin</td>
<td>Amoxicillin, 2 g orally 1 hour before procedure, or ampicillin, 2 g IM/IV within 30 minutes of starting the procedure</td>
</tr>
<tr>
<td>Moderate-risk patients allergic to ampicillin or amoxicillin</td>
<td>Vancomycin</td>
<td>Vancomycin, 1 g IV over 1–2 hours; complete infusion within 30 minutes of starting the procedure</td>
</tr>
</tbody>
</table>

Abbreviations: IM, intramuscularly; IV, intravenously.

*No second dose of vancomycin or gentamicin is recommended.

Summary of Recommendations and Conclusions

The following recommendations and conclusions are based on good and consistent scientific evidence (Level A):

- Patients undergoing abdominal or vaginal hysterectomy should receive single-dose antimicrobial prophylaxis.
- Pelvic inflammatory disease complicating IUD insertion is uncommon. The cost-effectiveness of screening for gonorrhea and chlamydia before insertion is unclear; in women screened and found to be negative, prophylactic antibiotics appear to provide no benefit.
- Antibiotic prophylaxis is indicated for suction curette abortion.
- Appropriate prophylaxis for women undergoing surgery that may involve the bowel includes a mechanical bowel preparation without oral antibiotics and the use of a broad-spectrum parenteral antibiotic, given immediately preoperatively.
- Antibiotic prophylaxis is not recommended in patients undergoing diagnostic laparoscopy.

The following recommendations and conclusions are based on limited or inconsistent scientific evidence (Level B):

- In patients with no history of pelvic infection, HSG can be performed without prophylactic antibiotics. If HSG demonstrates dilated fallopian tubes, antibiotic prophylaxis should be given to reduce the incidence of post-HSG PID.
- Routine antibiotic prophylaxis is not recommended in patients undergoing hysteroscopic surgery.
- Cephalosporin antibiotics may be used for antimicrobial prophylaxis in women with a history of penicillin allergy not manifested by an immediate hypersensitivity reaction.
- Patients found to have preoperative bacterial vaginosis should be treated before surgery.

The following recommendations and conclusions are based primarily on consensus and expert opinion (Level C):

- Antibiotic prophylaxis is not recommended in patients undergoing exploratory laparotomy.
- Use of antibiotic prophylaxis with saline infusion ultrasonography should be based on clinical considerations, including individual risk factors.
- Patients with high- and moderate-risk structural cardiac defects undergoing certain surgical procedures may benefit from endocarditis antimicrobial prophylaxis.
- Patients with a history of anaphylactic reaction to penicillin should not receive cephalosporins.
- Pretest screening for bacteriuria or urinary tract infection by urine culture or urinalysis, or both, is recommended in women undergoing urodynamic testing. Those with positive results should be given antibiotic treatment.

Proposed Performance Measure

The percentage of women undergoing vaginal or abdominal hysterectomy who received antibiotic prophylaxis

References


The MEDLINE database, the Cochrane Library, and the American College of Obstetricians and Gynecologists’ own internal resources and documents were used to conduct a literature search to locate relevant articles published between January 1961 and April 2006. The search was restricted to articles published in the English language. Priority was given to articles reporting results of original research, although review articles and commentaries also were consulted. Abstracts of research presented at symposia and scientific conferences were not considered adequate for inclusion in this document. Guidelines published by organizations or institutions such as the National Institutes of Health and ACOG were reviewed, and additional studies were located by reviewing bibliographies of identified articles. When reliable research was not available, expert opinions from obstetrician–gynecologists were used.

Studies were reviewed and evaluated for quality according to the method outlined by the U.S. Preventive Services Task Force:

- **I** Evidence obtained from at least one properly designed randomized controlled trial.
- **II-1** Evidence obtained from well-designed controlled trials without randomization.
- **II-2** Evidence obtained from well-designed cohort or case–control analytic studies, preferably from more than one center or research group.
- **II-3** Evidence obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled experiments also could be regarded as this type of evidence.
- **III** Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

Based on the highest level of evidence found in the data, recommendations are provided and graded according to the following categories:

- **Level A**—Recommendations are based on good and consistent scientific evidence.
- **Level B**—Recommendations are based on limited or inconsistent scientific evidence.
- **Level C**—Recommendations are based primarily on consensus and expert opinion.

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