Characteristics of microorganisms cultured from infected wounds post-hysterectomy

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Abstract

Objective: To characterize organisms causing wound infection following abdominal hysterectomy.

Study design: All patients who underwent an abdominal hysterectomy (December 2002-January 2006) and developed abdominal wall wound infection proven by a positive culture were included in the study. Patient information was collected from the computerized files. The isolated microorganisms were characterized for antibiotic susceptibility.

Results: Sixty-eight (68/620, 10.96%) patients had positive wound cultures. Of 100 isolated microorganisms, 44 were resistant to cefonicid (prophylactic treatment) and 15 were resistant to combined ampicillin, gentamicin and metronidazole (empirical treatment). Major co-morbidities (including diabetes mellitus, hypertension, past malignancies, renal, cardiovascular and pulmonary diseases, hypothyroidism or anemia), were found to be significantly associated with pseudomonal infection (P < .008).

Conclusion: A significant portion of pathogens causing post-hysterectomy abdominal wall wound infection are resistant to the prophylactic treatment, and some are resistant to the empirical treatment. Further studies are necessary to evaluate the effectiveness of various prophylactic regimens with better coverage of Enterococcus fecalis, as well as the effectiveness of empirical treatment active against the resistant Enterobacteriaceae group.

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1. Introduction

Hysterectomy is one of the most common gynecologic operations. Fibroids of uterus and gynecologic malignancies are frequent indications for this type of surgery. Infection at the surgical site after abdominal hysterectomy is still a common complication, with an incidence of 6–12% [1–9]. The major risk factors for developing surgical site infections after hysterectomy include older age, poor general health condition, prolonged hospitalization, extended surgery and extensive bleeding [1]. Several studies [5,7,9] have shown involvement of Staphylococcus aureus, Mycoplasma, Escherichia coli, Enterococci and anaerobic bacteria as being the causative pathogens. Antibiotic prophylaxis has been shown to reduce the risk of surgical site infection after hysterectomy [4,6,8] and has become common practice, usually involving an agent belonging to first- or second-generation cephalosporins (with or without an additional anaerobic coverage). It was also established that administering multiple doses has no benefit over a single pre-operative dose [2]. Despite the widespread administration of antibiotic prophylaxis, post-abdominal hysterectomy surgical site infections continue to occur, albeit at a lower rate. However, prophylaxis is likely to influence the causative pathogens, i.e., reducing the relative frequency of susceptible strains while increasing the relative proportion of resistant strains. Knowing which causative organisms are expected after prophylaxis, and their susceptibility...
pattern, is important in order to better direct empirical therapy. We hypothesized that in an era of antibiotic prophylaxis and increasing antibiotic resistance, many of the causative pathogens are resistant to the prophylactic antibiotics that are routinely used.

2. Study design

2.1. Setting

Tel Aviv Sourasky Medical Center is a 1200-bed tertiary care university affiliated hospital with 86,000 admissions annually, 24,000 of which are admissions to the obstetrics and gynecology department. Approximately 200 abdominal hysterectomies are performed yearly.

2.2. Microbiology

More than 87,500 clinical microbiological cultures are processed annually. Isolates are identified to species level from clinical specimens submitted to the microbiology laboratory using the Vitek-2 system. The Vitek-2 is a fully automated system that performs bacterial identification. The system also includes a highly advanced software system that then interprets the identified bacteria’s antibiotic resistance patterns. Antibiotic susceptibility testing is also performed using the Vitek-2, and supplemented as needed by either disc diffusion or E-test. All isolates are processed according to the Clinical and Laboratory Standards Institute (CLSI) criteria [11].

2.3. Antibiotic prophylaxis and treatment

The patient’s pre- and postoperative management consists of the following: admission to the gynecology department on the day before surgery, administration of prophylaxis medication consisting of a single dose of cefonicid 1 g one-half hour before surgery, no additional antibiotics postoperatively, and discharge from hospital 3–5 days after surgery. In case of suspected wound infection, the empirical treatment in our department consists of combined ampicillin, gentamicin and metronidazole.

2.4. Study design

This was designed as a retrospective study for describing the cultured organisms after abdominal hysterectomy. The study population included all patients who had an abdominal hysterectomy from December 2002 until January 2006 and developed a surgical wound infection as proven by a positive wound culture. The patients’ charts were reviewed and wound infection was defined according to the CDC (Centers for Disease Control) – superficial and deep incision criteria [3]. Electronic records of the clinical microbiology laboratory were searched for positive wound cultures and the characteristics of the microorganisms. To identify risk factors for wound infections by specific pathogens, we collected data from the patients’ files, including demographic details, medical background, and details concerning the operation and postoperative course.

2.5. Statistical analysis

All analysis were performed using STATA software version 9.0 (Stata version, Collegeville, TX). Univariate analysis included the Student t-test for continuous variables, and chi-square test or Fisher Exact test for two-by-two tables. Multivariate analysis using logistic regression was performed to identify risk factors, using a stepwise procedure. All tests were two sided and P values of <.05 were considered significant.

Table 1

<table>
<thead>
<tr>
<th>Patients’ characteristics</th>
<th>Mean</th>
<th>Median</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>56.79</td>
<td>52</td>
<td>28–90</td>
</tr>
<tr>
<td>Pre-operative stay (days)</td>
<td>1.91</td>
<td>1</td>
<td>28–90</td>
</tr>
<tr>
<td>Postoperative stay (days)</td>
<td>9.37</td>
<td>7</td>
<td>3–45</td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>Microorganism</th>
<th>Total</th>
<th>Prophylaxis</th>
<th>Gentamicin sensitive</th>
<th>Ampicillin sensitive</th>
<th>Resistant to empiric treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cefonicid sensitive</td>
<td>Resistant to prophylactic treatment</td>
<td>Gentamicin sensitive</td>
<td>Ampicillin sensitive</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>27</td>
<td>21</td>
<td>6</td>
<td>19</td>
<td>8</td>
</tr>
<tr>
<td>Enterococcus faecalis</td>
<td>15</td>
<td>NR</td>
<td>15</td>
<td>NR</td>
<td>0</td>
</tr>
<tr>
<td>Staphylococcus aureus (MSSA)</td>
<td>13</td>
<td>NR</td>
<td>0</td>
<td>13</td>
<td>NR</td>
</tr>
<tr>
<td>S. aureus (MRSA)</td>
<td>2</td>
<td>NR</td>
<td>2</td>
<td>1</td>
<td>NR</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>7</td>
<td>NR</td>
<td>7</td>
<td>6</td>
<td>NR</td>
</tr>
<tr>
<td>Streptococcus viridans</td>
<td>5</td>
<td>NR</td>
<td>0</td>
<td>NR</td>
<td>0</td>
</tr>
<tr>
<td>Klebsiella pneumoniae</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Morganella morganii</td>
<td>5</td>
<td>0</td>
<td>5</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Citrobacter koseri</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Yeast</td>
<td>3</td>
<td>NR</td>
<td>3</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Proteus mirabilis</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Enterobacter aerogenes</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>NR</td>
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<tr>
<td>Pseudomonas putida</td>
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<td>Klebsiella oxytoca</td>
<td>1</td>
<td>1</td>
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<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Hafnia alvei</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Enterobacter cloacae</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>NR</td>
</tr>
<tr>
<td>Other Streptococci</td>
<td>6</td>
<td>NR</td>
<td>0</td>
<td>NR</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>56</td>
<td>44</td>
<td>70</td>
<td>34</td>
</tr>
</tbody>
</table>

NR, not relevant.

a Intrinsic resistance (all isolates are resistant).
b Intrinsic sensitivity (all isolates are sensitive).
c Acquired resistance.

3. Results

During the 3-year study period, 620 women underwent an abdominal hysterectomy. Wound cultures taken within a month of surgery grew 135 microorganisms in 80 patients; 37 patients had multiple pathogens isolated from the incision site (range 2–6; mean 2.8). A review of the patients’ charts confirmed surgical wound infection according to the CDC criteria in 68 patients (an incidence of 10.96%). Isolates were considered as being colonizers rather than infecting organisms in 12 patients which had a total of 35 isolates (31 coagulase negative Staphylococci and 4 Diphtheroids).

The 68 patients with confirmed culture-positive wound infection comprised our study cohort. Their characteristics are summarized in Table 1. The mean age was 56 years and 60 of them (88%) were hospitalized for 1–2 days before undergoing surgery. Their postoperative hospitalization was 9 days, as opposed to 3–4 days in patients who did not have a surgical site infection ($P < .001$). The most common co-morbidity condition among the 68 women was hypertension ($n = 24$), followed by history of malignant disorder ($n = 11$) and diabetes mellitus ($n = 9$). Indications for hysterectomy were fibroid uterus ($n = 37, 54.4$%), endometrial carcinoma ($n = 22, 32.3$%) and cervical carcinoma ($n = 5, 7.3$%). The great majority of the patients ($n = 66, 97$%) underwent total abdominal hysterectomy with/without bilateral salpingo-oophorectomy and two underwent radical hysterectomy.

Of the 100 microorganisms from the patients with confirmed wound infections, the most frequently detected isolates were $E. coli$ ($n = 27$), Enterococcus faecalis ($n = 15$), $S. aureus$ ($n = 15$), and Pseudomonas aeruginosa ($n = 7$). Forty-four were resistant to the prophylactic treatment, and 15 were resistant to the given empirical treatment (Table 2). Of note, $P. aeruginosa$ was isolated from 7 patients, an organism often not covered by the routine prophylactic or empiric therapy. Having a major co-morbidity (including diabetes mellitus, hypertension, past malignancies, renal, cardiovascular and pulmonary diseases, hypothyroidism or anemia), was found to be significantly associated with pseudomonal infection ($P < .008$). No significant association was found between culture-positive wound infection and the patient’s age, past surgical procedures, exposure to the health care system in the 30 days preceding the operation, the indication for the operation, the duration of the pre-operative hospitalization, the presence of intra- or postoperative complications, blood transfusions or the presence and size of scar hematoma as viewed on ultrasonography.

4. Discussion

Hysterectomy is a common gynecologic procedure and wound infections are not rare occurrences. The use of prophylactic antibiotics is successful in decreasing the incidence of wound infections in women undergoing abdominal hysterectomy. A meta-analysis of 25 randomized controlled trials of antibiotic prophylaxis that used rigorous protocols revealed that antibiotic prophylaxis can reduce wound infection rates in abdominal procedures from 21.2% to 5.0% [12]. The recommended antibiotic prophylaxis for abdominal hysterectomy includes an agent belonging to first- or second-generation cephalosporins, preferably with an additional anaerobic coverage [13,14]. Ampicillin–sulbactam is considered an acceptable alternative [15].

In spite of the use of prophylactic antibiotics in the present study, our wound infection rate was 10.96%, which is similar to other studies where antibiotic prophylaxis was given less consistently [6,8]. Therefore we attempted to characterize the microbiological factors of these wound infections.

The majority of our study group had only one isolate recovered from the wound. This monomicrobial predominance is different from the polymicrobial etiology of wound infection previously described by Hemsell et al. [16]. They recovered 295 bacterial isolates from infection sites in 43 women given cefotetan or cefazolin prophylaxis for elective abdominal hysterectomy (mean number of almost 7 isolates per patient). Anaerobes, which were the predominate isolates recovered from women with pelvic abscesses/cellulites in that study, and were not included in our microbiological database, are an important variable that differed between the two studies. Our microbiological results represent only abdominal wall wound infections and not the vaginal cuff infections. Most ($n = 56$) of the pathogens were found to be sensitive to the commonly administered prophylactic treatment, while 44 pathogens were resistant. The two major groups of resistant pathogens were $E. faecalis$ (15 isolates) and $P. aeruginosa$ (7 isolates), and resistance was intrinsic in at least 27 pathogens (e.g., $E. faecalis$, MRSA, $P. aeruginosa$ and yeasts). A minority ($n = 17$) of the pathogens, mostly gram-negative Enterobacteriaceae, had an acquired resistance.

Enterococcus fecalis is commonly recovered from pelvic or abdominal wound infection sites after hysterectomy, usually as part of a mixed aerobic and anaerobic flora [16]. Nevertheless, the role of this pathogen in these settings has been questioned. Treatment with antimicrobial regimens devoid of activity against Enterococcus can cure such infections, and no prophylactic coverage is usually indicated. Indeed, antibiotic prophylaxis by ampicillin was found to be no better than placebo, and significantly worse than cefazolin, in reducing infectious morbidity (including surgical wound infections) after elective abdominal hysterectomy [17]. Ampicillin–sulbactam (a single dose IV ampicillin 2 g/subcutant 1 g 30–60 min before operation), which includes broader gram-negative and anaerobic coverage than ampicillin alone and was recently added to the list of acceptable antibiotics before hysterectomy and colorectal surgery (particularly if the clinician decides to provide endocarditis prophylaxis), may give better results [15].

Post-hysterectomy wound infection by $P. aeruginosa$ was often considered a rare event. In the study by Hemsell et al. [16] only one out of 147 aerobic species recovered grew $P. aeruginosa$, and it is noteworthy that prophylactic treatment for $P. aeruginosa$ is not accepted as a common practice. In the present study $P. aeruginosa$ was isolated from 7 women (10.3% of all microbiologically documented infections). Several parameters were found to be significantly associated with pseudomonal infection: the presence of major co-morbidities, pulmonary diseases, prolonged postoperative hospitalization, short operation–to-infection time, and additional procedures done during the index operation. Thus, in patients who develop postoperative surgical site infections, who fit this profile, anti-pseudomonal treatment like cefazidine, piperacillin–tazobactam, or ciprofloxacin should be considered. A better characterization of these women is needed so that broad-spectrum anti-pseudomonal drugs can be used judiciously. We believe that anti-pseudomonal prophylaxis is not indicated, as these infections occur rarely (1% of all operations) and all anti-pseudomonal agents are broad-spectrum agents which may contribute to emergence of resistance.

Resistant gram-negative Enterobacteriaceae (mostly $E. coli$) were the main default of our conventional empirical treatment by the combination of gentamicin, ampicillin and metronidazole. Among a total of 15 pathogens (15/100, 15%) that were found resistant to the empirical treatment, $E. coli$ comprised more than one-half (8/15, 53.3%). We therefore raise a question of changing our empirical protocol and treating empirically with broad-

spectrum antibiotics (like ertapenem or piperacillin–tazobactam) in order to cover resistant gram-negative Enterobacteriaceae. While choosing a correct empirical treatment is desirable, factors such as cost and emergence of resistance to broad-spectrum drugs should be considered seriously. The clinical outcome of women who were treated empirically with an ineffective antibiotic should also be investigated. On the basis of the present data we cannot recommend of changing the empirical treatment for post-hysterectomy surgical site infection. We believe that conducting a randomized trial to evaluate the effectiveness of various prophylactic antibiotics with better coverage of E. faecalis group, as well as the effectiveness of empirical treatment for the resistant E. coli group is warranted. A similar study in colon surgery prophylaxis has shown the superiority of ertapenem as compared to cefotetan [18].

Our study has several limitations; anaerobic organisms are not routinely isolated and worked-up in our laboratory. However, this is the practice in wound cultures in most clinical microbiology laboratories, and only specialized laboratories mostly under research conditions perform these tests. Indeed it is accepted that specimen collection for anaerobic bacteria culture is very difficult to perform and has a high error rate. Another limitation of the present study is that the clinical diagnosis of wound infection by clinical symptoms and signs and/or culture may be sub-optimal. The group of patients with vaginal cuff infections, which were mostly anaerobic bacteria in nature may have been missed.

We conclude that a significant portion of the pathogens causing wound infection after abdominal hysterectomy are resistant to the conventional prophylactic treatment, and that some are resistant to conventional empirical treatment. A more comprehensive prospective multi-center study should be conducted including anaerobic cultures for vaginal cuff infections.

Conflict of interest

None.

References


