Microbiological Analysis of Urine Cultures in Women after Pelvic Reconstructive Surgery

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Abstract

Background/Aims: The rate of urinary tract infection (UTI) after pelvic reconstructive surgery ranges from 9 to 48% and the most common uropathogen is Escherichia coli (E. coli). The aim of the study is to identify the predominant uropathogen from urine cultures in women undergoing pelvic reconstructive surgery. Methods: A retrospective review was conducted on women who underwent pelvic reconstructive surgery at a tertiary care center from July 2013 to June 2015. Data was collected from each postoperative visit to evaluate urinary tract symptoms, culture results and treatment in the 3-month postoperative interval. Results: There were 880 cases reviewed (mean age of 59.6 years) during the study period. The most common organism in positive cultures was E. coli after surgery. The total UTI rate was 11.3%. Patients discharged with a Foley catheter had a UTI rate of 65.6% (p = 0.003). Diabetes, neurologic disease, tobacco use, recurrent UTIs and breast or gynecologic cancers had no significant association with UTI after surgery. Conclusion: The most common organism identified is E. coli. Almost 12% of patients will develop a UTI after pelvic reconstructive surgery. The results of this study can influence management of lower urinary tract symptoms in the postoperative period.

Key Words
Urinary tract infection • Pelvic reconstructive surgery • Foley catheter

Introduction

Infection of the lower urinary tract is one of the most common reasons for use of antibiotics in the primary care setting [1]. One in 3 women will experience a urinary tract infection (UTI) by the age of 24 and half of all women will develop a UTI during their lifetime [2]. Complicated UTIs are mostly described as an infection associated with a structural or functional abnormality altering urine flow or in a patient with a decreased defense system [3]. Complicating factors include urological procedures, elderly patients, resistant uropathogens, neurologic disturbances or anatomical abnormalities [3]. Complicated UTIs are caused by gram-negative bacilli including Klebsiella, Pseudomonas, Enterobacter and Citrobacter and some gram-positive cocci such as Enterococci and Staphylococcus [4].

Diagnosis of a UTI includes particular urinary symptoms along with isolation of an uropathogen in culture. On urinalysis, when leukocyte esterase is used in combination with nitrates, the sensitivity is 45% and the specificity is 98%. If white blood cells are used as diagnostic criteria then the test will have a 74% sensitivity and an 86% specificity. The presence of bacteria in a urinalysis increases sensitivity to 88% with a specificity of 92% [5]. Although urinalysis results may warrant treatment in setting of clinical symptoms, the gold standard for diagnosis of UTI is urine culture for specific bacteria. Most laboratories define >100,000 colony forming units (CFU)/ml as
the number that represents clinically significant infection however, some studies have shown that clinical UTI can occur with <100,000 CFU/ml of bacteria [6]. Laboratories define uropathogens of 100,000 CFU/mL or more as a positive result although there are other recommendations that define diagnosis as low as 1,000 CFU/ml [6]. The most causative uropathogen isolated is *Escherichia coli* (E. coli) accounting for 70–95% of all UTIs [6].

UTIs are a common complication after urogynecologic surgery. The rate of UTI after pelvic reconstructive surgery ranges from 9 to 48% [7]. Bacteruria after gynecologic surgery has been estimated at 17–63% and increases up to 85% after anti-incontinence procedures [8]. In one study comparing outcomes of colporrhaphy versus polypropylene mesh repair, the most common postoperative adverse event in both groups was UTI with a rate of 15% [9].

There is little data describing causative uropathogens of UTIs in women undergoing pelvic organ prolapse surgery and midurethral sling procedures. The objective of this study is to identify the predominant uropathogen in women with UTIs undergoing surgery for pelvic organ prolapse and/or stress urinary incontinence. Furthermore, the second aim is to determine the incidence of UTI and assess potential risk factors pre and postoperatively.

**Materials and Methods**

A retrospective review was conducted on women who underwent reconstructive surgery to correct pelvic organ prolapse and/or a midurethral sling at a tertiary care center from July 2013 to June 2015. Data was collected from each postoperative visit (0–1 month after surgery and 1–3 months) to evaluate urinary tract symptoms, culture results and treatment in the 3-month postoperative interval. Inclusion criteria included women aged 18–90 years and any woman who has undergone pelvic reconstructive surgery within the hospital system. Standard postoperative procedure at office visits included urinalysis and if indicated, urine culture. The diagnosis of UTI was made using patient symptoms such as frequent voiding, dysuria, urgency and/or nocturia with either a positive urinalysis and/or urine culture. Urine samples were collected using a combination of clean catch and catheter samples dependent on each patient. Urine cultures with a colony count of > 10^5 CFU/ml and < 3 isolated uropathogens were classified as a UTI. Negative cultures included no growth, mixed urogenital flora, *Staphylococcus* species and group B *Streptococcus*.
Table 1. Organisms obtained in positive cultures

| Organism                        | 0–1 Month (n = 166) | 1–3 Months (n = 83) | 0–3 Months (n = 249) |
|---------------------------------|---------------------|---------------------|----------------------|
| Beta hemolytic streptococcus    | 2.41%               | 1.20%               | 2.01%                |
| group B                         |                     |                     |                      |
| Citrobacter freundii            | 1.81%               | 1.20%               | 1.61%                |
| E. coli                         | 22.89%              | 39.76%              | 28.51%               |
| Enterobacter aerogenes          | 1.20%               | 1.20%               | 1.20%                |
| Enterobacter cloacae            | 1.20%               | 3.61%               | 2.01%                |
| Enterococcus                    | 7.83%               | 1.20%               | 5.62%                |
| Klebsiella pneumoniae           | 2.41%               | 13.25%              | 6.02%                |
| Mixed gram positive growth      | 0.60%               | 0.00%               | 0.40%                |
| Mixed urogenital flora          | 13.25%              | 7.23%               | 11.24%               |
| MRSA                            | 0.60%               | 0.00%               | 0.40%                |
| No growth                       | 37.35%              | 24.10%              | 32.93%               |
| Proteus mirabilis               | 3.01%               | 3.61%               | 3.21%                |
| Pseudomonas                     | 0.60%               | 0.00%               | 0.40%                |
| Pseudomonas aeruginosa          | 1.20%               | 0.00%               | 0.80%                |
| Staphylococcus                  | 0.60%               | 1.20%               | 0.80%                |
| Streptococcus viridans          | 1.20%               | 0.00%               | 0.80%                |
| Unknown                         | 1.81%               | 2.41%               | 2.01%                |

MRSA = Methicillin-resistant Staphylococcus aureus.

All other pathogens isolated in urine cultures were considered a positive finding.

The primary objective investigated the uropathogen that is most prevalent in urine samples from women after pelvic organ prolapse reconstructive surgery and midurethral slings. Secondary outcomes included determining the incidence of UTIs, assessing the association between surgical procedures and rate of transurethral catheter at time of discharge.

Demographic data collected included age, medical history, cancer history, and tobacco use. Age was a continuous variable. Medical history included history of diabetes, recurrent UTIs, and neurologic disease. Cancer history included history of breast and gynecologic cancers. Tobacco use was defined as current smoker versus no history or former history of tobacco use.

Data was analyzed using descriptive statistics, chi square test and Fishers exact test using SAS 9.3 statistical software (SAS Institute, Cary NC).

Results

There were 880 cases reviewed (mean age of 59.6 years) during the study period. Two hundred patients (22.7%) had urine cultures performed after surgery. The total UTI rate proven by urine culture was 11.3% within the 3-month postoperative period. The most common organism found in positive cultures was E. coli 0–3 months postoperative described in table 1. Figure 1 displays uropathogens obtained in urine cultures at 0–1 month and 1–3 months during postoperative visits. Among women who had a culture performed 0–1 month after surgery (n = 154; 17.5%), 85 (55.2%) had a positive culture. Among women who had a culture performed 1–3 months after surgery (n = 73; 8.3%), 27 (37%) had a positive culture.

One hundred and sixty-six patients were discharged with a Foley catheter, but only 64 of these patients had a culture obtained. Of these patients, 42 (65.6%) developed a UTI after surgery (p = 0.003). Patients discharged with a Foley catheter and received their first urine culture from 1–3 months after surgery although not found to be significant (n = 9; 60.0%; p = 0.6001). Of the patients that received treatment with antibiotics for UTI in the postoperative period (n = 161, 18.3%), 66 (46.8%) had a Foley catheter on discharge (p < 0.001). The organism found most is E. coli followed by Enterococcus sp and Klebsiella pneumoniae. Length of catheterization and age were found to be significantly associated with patients who received treatment seen in table 2. Risk factors such as smoking, neurologic disease, history of breast cancer, and history of gynecologic cancer did not have a significant impact on UTIs.

Patients treated with antibiotics showed an association with specific surgical procedures including anterior defect repairs (p < 0.001), vaginal vault suspensions (p < 0.0001), vaginal paravaginal repairs (p = 0.023) and...
laparoscopic colpopexy (p = 0.021) described in table 3. Patients discharged with a Foley catheter and postoperative UTI were found to have a significant correlation with type of surgical procedure including vaginal paravaginal repairs and midurethral slings described in table 4.

### Discussion

*E. coli* is the most common organism in our study population. Interestingly, the next largest cohort of patients had no growth cultures. The second and third most common uropathogens seen in our study were *Klebsiella pneumonia* and *Enterococcus sp*, respectively. *E. coli* is responsible for 50–60% of complicated UTIs and is frequently seen in the first UTI episode [10]. A retrospective review estimated risk factors and frequency of UTIs in women undergoing pelvic reconstructive surgery and midurethral slings and found the most common organism was *E. coli* (n = 14) followed by *Proteus mirabilis* (n = 4) [7]. In a retrospective study by Kow et al. [4] assessing uropathogen speciation in women with pelvic floor disorders, *E. coli* was again the most commonly isolated uropathogen followed by *Klebsiella pneumoniae* and *Enterococcus*, respectively.

Our study demonstrated a UTI rate of 11.3% within the first 3 months after surgery in women who underwent pelvic reconstructive surgery and/or a midurethral sling. The rate of UTI found in our study is consistent with the 9–48% rate after pelvic reconstructive surgery using mesh or graft [7, 9, 11, 12]. Multiple studies have reported varying UTI rates after pelvic reconstructive surgery. The stress incontinence surgical treatment efficacy trial of Burch versus autologous sling found a UTI rate of 48% in the sling cohort and 32% in the Burch cohort during 2 year follow-up [13]. Sutkin et al. [7] described a UTI rate in women undergoing surgery for pelvic organ prolapse and stress urinary incontinence of 9%. In 2007, Anger et al. [14] conducted an analysis of 1,356 sling procedures using the Medicare Public Use Files and found a 33.6% rate of UTIs during a 3-month postoperative period.

### Table 3. Surgical procedure for patients receiving treatment (n = 880)

| Procedure                              | Cultures Negative | Cultures Positive | Total | p       |
|----------------------------------------|-------------------|-------------------|-------|---------|
| Anterior defect repair                 | 690               | 143               | 833   | 0.0003  |
| Vaginal vault suspension               | 544               | 99                | 643   | 0.0002  |
| Vaginal paravaginal repair             | 611               | 125               | 736   | 0.0229  |
| All mesh revisions                     | 682               | 152               | 834   | 0.819   |
| Laparoscopic colpopexy                 | 537               | 134               | 671   | 0.0213  |
| Laparoscopic supracervical hysterectomy| 616               | 147               | 763   | 0.0572  |
| Total hysterectomy                     | 631               | 143               | 774   | 0.709   |
| Midurethral sling                      | 259               | 57                | 316   | 0.8824  |
| Midurethral sling revision             | 716               | 161               | 877   | 0.545   |

### Table 4. Significance of surgical procedure for patients discharged with a Foley catheter and obtained urine culture (n = 64)

| Procedure                              | Cultures Negative | Cultures Positive | Total | p       |
|----------------------------------------|-------------------|-------------------|-------|---------|
| Anterior defect repair                 | 20                | 37                | 57    | 0.3163  |
| Vaginal vault suspension               | 14                | 19                | 33    | 0.1619  |
| Vaginal paravaginal repair             | 19                | 23                | 42    | 0.0115  |
| All mesh revisions                     | 22                | 40                | 62    | 0.4271  |
| Laparoscopic colpopexy                 | 18                | 35                | 53    | 0.2654  |
| Laparoscopic supracervical hysterectomy| 19                | 39                | 58    | 0.2358  |
| Total hysterectomy                     | 16                | 34                | 50    | 0.0184  |
| Midurethral sling                      | 3                 | 17                | 20    | 0.0278  |
| Midurethral sling revision             | 19                | 25                | 44    | 0.0034  |

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The diagnosis of UTI in our study was made using patient symptoms such as frequent voiding, dysuria, urgency and/or nocturia with either a positive urinalysis and/or urine culture. Although urinalysis results may warrant treatment in setting of clinical symptoms, the gold standard for diagnosis of UTI is urine culture for specific bacteria. The UTI rate was calculated using positive urine cultures. In our study, many patients received a urine culture for symptoms and/or a clean catch urinalysis positive for nitrites and/or leukocyte esterase. Many patients also received treatment for a UTI without a culture performed. Positive urine cultures in our study included isolation of an uropathogen in urine cultures excluding no growth, mixed urogenital flora, *Staphylococcus* species or group B *Streptococcus*.

Our study demonstrated patients who were discharged home with a transurethral catheter were significantly more likely to develop a UTI in the first 3 months after surgery. The organism found most is *E. coli* followed by *Enterococcus* sp and *Klebsiella pneumoniae*. Hakvoort et al. [15] demonstrated that patients with transurethral catheters greater than 72 hours were more likely to develop a UTI postoperative after vaginal surgery. Indwelling Foley catheter use may play a role in non-*E. coli* cultures and may provide an environment that allows growth of certain microorganisms to concentrate [4, 16]. Rates of non-*E.coli* uropathogens have been reported in catheterized patients between 61 and 65% [16]. In a retrospective cohort of patients undergoing vaginal reconstructive surgery, prophylactic antibiotics decreased the risk of postoperative UTI in women requiring use of Foley catheterization at time of discharge [17]. This concept is further supported by Ghezzi et al. [18] who reported prophylactic single-dose antibiotic therapy may help reduce the rate of UTIs after short-term urethral catheterization in women undergoing tension-free vaginal tape procedure.

There is little literature correlating specific pelvic reconstructive surgical procedure to rate of UTI. In a recent study with patients after colpocleisis for uterovaginal and vaginal vault prolapse, a UTI rate of 34.7% was found in the postoperative period [19]. Doganay et al. [20] found that women who underwent a sling procedure had a UTI rate of 10.4% in an 8-week postoperative period. Women were more likely to have UTIs after midurethral sling and concomitant hysterectomy and cystocele repair among other risk factors.

The retrospective nature of this study allowed us to analyze a small population of patients with limited resources. Limitations include difficulty standardizing UTI definitions and treatment. A small proportion of patients did not return postoperative therefore unknown if they had UTIs and/or treatment. It is possible that the rate of UTI in this study is underestimated due to lack of postoperative follow-up and urine culture testing in the setting of symptoms. In many instances patients were empirically treated for UTIs although either no cultures were conducted or urine cultures were negative. Patients receiving empiric antibiotics with a negative culture were advised to stop. There was difficulty following patient’s outcomes after antibiotic therapy as this was not documented. Although the exact number of patients that received empiric antibiotics was not calculated, it is difficult to truly report UTI rate and organism type.

**Conclusion**

The most common organism is *E. coli* identified 0–3 months after surgery. Almost 12% of patients will develop a UTI after pelvic reconstructive surgery that is lower than most recent literature. Transurethral catheters on discharge are associated with an increased risk of developing a UTI after surgery. Apical and anterior compartment procedures with concomitant cystoscopy may increase UTI symptoms resulting in more urine cultures and antibiotic treatment. The results of this study inspire a prospective design to further investigate management of lower urinary tract symptoms in the postoperative period and antibiotic choice.
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