

Morbidity and Significant Bacteriuria after Urodynamic Studies

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Abstract

Introduction: Urodynamic pressure flow studies (PFS) are increasingly utilised in assessing patients with lower urinary tract (LUT) dysfunction. Although minimally invasive, there is theoretical risk of morbidity and infection. This paper looks at the morbidity, the incidence and natural history of significant bacteriuria (SBU) occurring after PFS. **Materials and Methods:** Patients undergoing PFS in a General Hospital and meeting entry criteria were enrolled with informed consent. Each had urine culture specimens collected at the time of PFS (D0), 3 (D3) and 7 (D7) days after PFS and a 7-day symptom log. **Results:** Ninety-three patients (44 males and 49 females), with a mean age of 52.2 years (range, 17 to 89) were evaluated. Twenty-five per cent (23/93) developed irritative LUT symptoms after PFS, but only 2/23 had a positive urine culture. All symptoms in culture-negative patients resolved within 5 days and none had sought medical treatment. The overall incidence of SBU was 13.9% (13/93) of whom 11/13 (95.7%) were asymptomatic. Majority of SBUs were detected on D3 but 30% developed late (D7). All asymptomatic SBUs were treated expectantly and 70% (7/11) resolved spontaneously by D14. 81.8% of organisms cultured were coliforms, and 18.2% enterococcus. There was no statistically significant correlation between age, sex, post-void residual and bladder outlet obstruction (diagnosed by PFS) and post-PFS morbidity or SBU. **Conclusion:** Symptoms occurring after PFS are mild, transient and rarely associated with infection. SBU after PFS is largely asymptomatic and self-resolving. Given the extremely low rate of symptomatic infection, antibiotic prophylaxis is not necessary.

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Introduction

Urodynamics or pressure flow studies (PFS) are defined as a functional assessment of the lower urinary tract (LUT) to provide a pathophysiological basis for urinary symptoms and signs. Advocates of PFS deem it a necessary investigation if continence surgery is contemplated, stating that the “bladder is an unreliable witness” and that selecting patients on the basis of urological history alone will result in inappropriate surgery 10% of the time. As such, PFS are increasingly being performed on patients with LUT disorders, particularly in the realms of incontinence, female, geriatric and neuro-urology.

The morbidity of PFS has only been studied in the context of urinary tract infections. The actual morbidity in the form of LUT symptoms and haematuria, their relation to significant bacteriuria (SBU) and the natural history of SBU has not been widely analysed, while the choice to use

antibiotic prophylaxis prior to PFS is left to the physician and remains a moot point in the literature. This study looks at the incidence, symptomatology, microbiology and natural history of significant bacteriuria and the morbidity associated with PFS. This information will be useful in the pre-procedure counselling of patients and help to determine the need for antibiotic prophylaxis.

Materials and Methods

Between March 2000 and December 2000, all patients referred to the Urodynamics service of a general hospital meeting the entry criteria for this prospective study were enrolled after obtaining informed consent. Patients who were febrile, on antibiotics for any reason, had a positive urine culture within the last 3 months and who were unable or unwilling to comply with the study protocol were excluded. Patients subsequently found to have a positive urine culture on the day of the study (D0) were also

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excluded.

PFS were performed using Dantec Duet equipment with external transducers. A rectal balloon catheter (4.5F) with a perforated latex sheath was introduced into the rectum to measure the intra-abdominal pressure. Patients were then cleansed and draped for urethral catheterisation utilising chlorhexidine gluconate 0.015% w/v and centrimide 0.15% w/v.

An 8F bladder filling catheter and a 4.5F bladder pressure catheter were inserted side by side after lubrication with sterile lubricating gel and a urine culture specimen was collected at this point (D0 urine culture).

Both catheters were taped in place and connected to the pump and transducer respectively. Multichannel urodynamics at medium fill was performed with sterile normal saline at room temperature. New connecting drip sets and a fresh bottle of normal saline were used for each case.

Upon discharge, all patients were advised to increase their fluid intake over the next few days and given an event log to record any fever, loin pain, LUT symptoms or medical treatment sought over the following 7 days. They were also asked to come in for a midstream urine culture 3 (D3) and 7 (D7) days after their PFS. Patients subsequently found to have positive D0 urine cultures were excluded from further study.

The incidence and natural history of significant bacteriuria (SBU), defined as 10,000 CFU/mL of a single organism from a midstream urine specimen, were then determined on D3, D7 and D14. The organisms cultured and antibiotic sensitivity were tabulated. Age, sex, final PFS diagnosis and residual volume were analysed as possible risk factors for SBU. Residual volume was determined by transabdominal ultrasonography. For statistical analysis, a Mann-Whitney U test was performed and $P < 0.05$ was considered statistically significant.

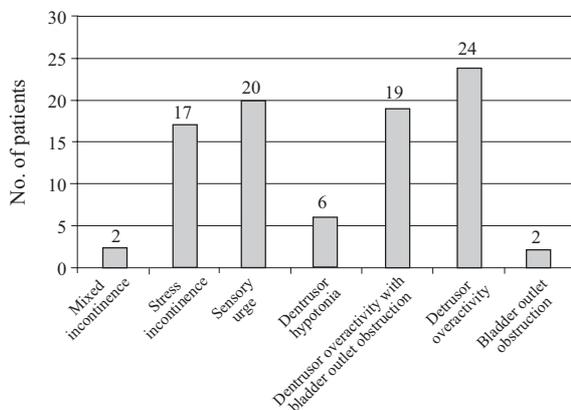


Fig. 1. Distribution of urodynamic diagnoses.

Only patients who were symptomatic i.e. febrile or experiencing irritative LUT symptoms were treated with antibiotics if urine cultures proved positive on D3 or D7.

Patients with asymptomatic significant bacteriuria were treated expectantly and cultures repeated on D7 and/or D14. Any patients with a second positive urine culture on D14 were treated with antibiotics regardless of symptomatology.

Results

Data from 93 patients (44 males and 49 females), with a mean age of 52.2 years (range, 17 to 89), were evaluated. Figure 1 shows the distribution of their urodynamic diagnoses.

Morbidity of Urodynamic Studies

Twenty-five per cent (23/93) of our patients developed irritative LUT symptoms after UDS. Figure 2 shows the distribution of symptoms of which mild dysuria and frequency were commonest. All symptoms resolved spontaneously with expectant management and liberal fluid intake within 5 days. Only 2/23 of these symptomatic patients had a positive urine culture (1 with gross haematuria and the other with pain and haematuria). Hence, overall rate of symptomatic urinary tract infection was 2.1% (2/93).

Incidence and Natural History of Significant Bacteriuria

Overall, 13.9% (13/93) developed significant bacteriuria after UDS of whom 85% (11/13) were asymptomatic. The majority of positive cultures were noted on D3. Thirty-one per cent (4/13) became culture-positive only on Day 7, all of whom were asymptomatic.

All asymptomatic culture-positive patients were treated expectantly with a liberal fluid intake and had repeat cultures on D7 and D14. Seventy per cent (7/11) of those with asymptomatic bacteriuria resolved spontaneously without treatment. None of them developed fever, sepsis or recurrent lower tract symptoms. The remaining 4 patients

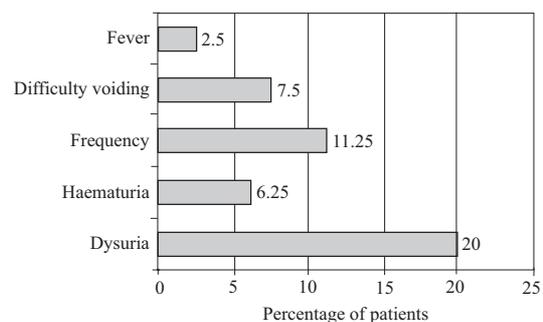


Fig. 2. Distribution of symptoms after pressure flow studies.

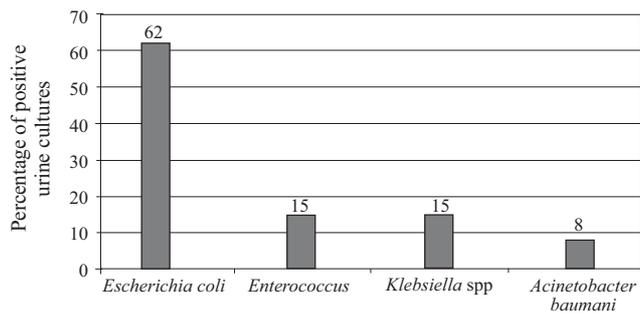


Fig. 3. Distribution of organisms cultured.

who had persistent bacteriuria on D14 were subsequently treated even though asymptomatic.

Microbiology

Figure 3 shows the breakdown of organisms cultured. *Escherichia coli* and *Klebsiella* spp accounted for 77% and *Enterococci* 18%. *E. coli* and *Klebsiella* spp cultures demonstrated resistance rates of 18% to 100%, respectively, to antibiotics commonly employed for genitourinary prophylaxis (Fig. 4).

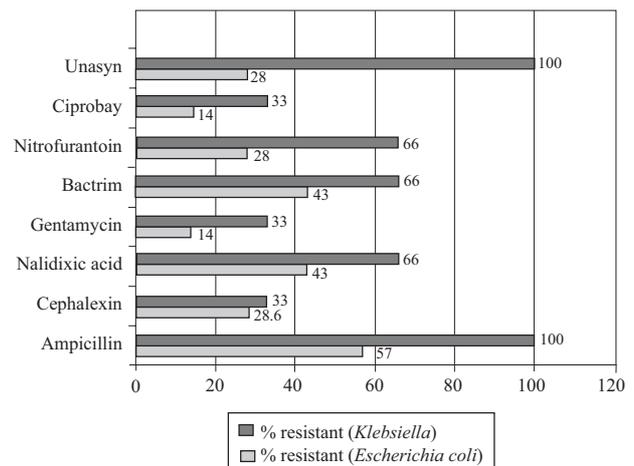
Risk of Developing Significant Bacteriuria Post-PFS

Age (greater than 60 years), sex, diagnosis of obstruction and high post-void residual (greater than 100 mL) did not show any statistically significant correlation with the development of SBU. However, 46.6% (6/13) of the culture-positive patients were more than 60 years of age (2.8 times relative risk) and 36% had a diagnosis of bladder outlet obstruction (1.5 times relative risk). 26.6% of patients with a diagnosis of bladder outlet obstruction developed significant bacteriuria. Patients with a post-void residual >100 mL had a 3 times relative risk of significant bacteriuria.

Discussion

Our study confirms that pressure flow studies have an acceptable morbidity rate. Although 25% of patients can be expected to develop irritative lower tract symptoms, these are often mild and resolve within 5 days. 95.7% of our symptomatic patients were culture-negative, proving that such symptoms are not necessarily specific to urinary tract infection and can be treated expectantly. The use of urinary alkalisers, such as sodium bicarbonate or potassium citrate, has been shown to be no more effective in preventing dysuria than placebo.¹

Although not statistically significant, elderly males and those with a urodynamic diagnosis of outlet obstruction appeared to have a greater propensity to develop LUT symptoms post-PFS. This has also been observed by Cutinha et al² who reported a significantly higher morbidity in men compared to women after pressure flow studies done with

Fig. 4. Antibiotic resistance profile of the *Escherichia coli* and *Klebsiella* spp.

the same 8F bilumen catheter, and by Klingler et al³ who reported a 20% higher morbidity in men who were obstructed compared to the unobstructed. The longer male urethra, particularly if distorted by an enlarged prostate or a stricture, may be more susceptible to mucosal trauma and oedema, leading to pain, dysuria and even urinary retention after catheterisation.

While catheterisation technique, experience and method of lubrication are contributory, catheter size and consistency is possibly another important factor in post-cystometry morbidity. This may explain our overall morbidity of 25% when utilising 8F Lofric catheters compared to Klingler et al³ who reported a 56.2% to 76.1% morbidity using 15F tandem catheters.

The prevalence of unsuspected asymptomatic bacteriuria in patients prior to PFS ranges from 1.9%⁴ to 10.3%.¹⁻⁶ A significant association has been demonstrated between age and the presence of bacteriuria before cystometry.⁴ There are concerns that this may influence the urodynamic findings or lead to symptomatic UTIs post-cystometry. A statistically significant association between sensory urgency and pre-cystometry asymptomatic bacteriuria has been reported.⁴ Screening of urine for bacteria prior to PFS has thus been recommended in order to reduce potential errors in interpretation.⁷

However, Okorochoa et al⁴ and Shekhariz et al⁸ have noted no increased morbidity nor false abnormal cystometries in the gynaecological and paediatric populations respectively. Incidentally, none of our patients with positive D0 urine cultures (subsequently excluded from analysis) developed UTI symptoms in the 3 days following UDS. While it may be prudent to screen for bacteriuria in high-risk patients and those with vesical irritability, these reports do not support the practice of routine universal screening or prophylaxis

for the primary purpose of eliminating unsuspected SBU.

The incidence of *de novo* bacteriuria (asymptomatic or symptomatic) after PFS varies from 1.5% to 36%.^{4,7} Controlled studies have demonstrated no significant difference in the rate of infection after urodynamic testing between those who received antibiotic prophylaxis and those who received placebos. Darouiche et al⁷ noted a 14% difference in post-cystometry infections in the spinal population between those given ciprofloxacin prophylaxis and those given placebo, but this was not statistically significant. Moreover, none of the organisms causing symptomatic UTIs post-cystometry were grown in corresponding cultures prior to the procedure. Furthermore, the organisms cultured in our patients suggest an iatrogenic source with resistance rates of 15.4% to 61.5% for antibiotics commonly utilised in genito-urinary prophylaxis. The 15.4% (2/13) resistance rate for ciprofloxacin suggests a particularly worrying level of quinolone resistance at the outpatient level. Routine use of prophylaxis may merely result in further emergence of bacterial resistance.

The 13.9% rate of significant bacteriuria developing without antibiotic prophylaxis in our study is comparable to those quoted in the literature.^{1,2,4,6} Only 4.3% (2/13) of culture-positive patients were symptomatic and 70% of the asymptomatic bacteriuria resolved within 7 days. Therefore, despite the lack of antibiotic prophylaxis, the risk of symptomatic infections after urodynamic studies appears to be very low (2/93) and the majority of post-cystometry bacteriuria appears to be transient.

In addition to the bactericidal activity of the bladder, urine and bacterial adhesion to host cells, bacterial persistence in the LUT has been shown to be affected by bladder kinetics as well.^{9,10} Wullt et al¹⁰ were able to establish bacteriuria in a fraction of dysfunctional voiders on intermittent catheterisation or high post-void residuals but not in those with normal emptying. Based on calculations in an artificial bladder model, O'Grady and Cattell calculated that the critical bladder volume for bacterial persistence is 70 mL, with a bacterial doubling time of 50 minutes, a urine flow rate of 1 mL/minute and bladder voiding every hour.¹⁰ In their series, Cutinha et al² noted that the mean post-void residual of patients who developed urinary tract infections after PFS was 110 mL compared to 55 mL for those who did not, but this difference was not statistically significant. Elderly males with a diagnosis of bladder outlet obstruction

and patients with high post-void residuals in our series also appeared to have a greater propensity for significant bacteriuria: however, no statistically significant correlation was again noted. This could be due to the small number of culture-positive cases in our series.

Conclusion

PFS result in mild and transient LUT symptoms in a quarter of patients and have an extremely low risk of symptomatic urinary tract infection. This information is pertinent when counselling patients before a PFS. The use of prophylactic antibiotics is neither necessary nor a substitute for good aseptic technique.

Acknowledgement

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