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ORIGINAL ARTICLE

Is there a place for indwelling transurethral catheterization in women with febrile urinary tract infection? A prospective randomized trial

Ingrid Schauer[1] · Badereddin Mohamad Al-Ali[1] · Werner Lüftenegger[1] · Stephan Madersbacher[1] · Klaus Eredics[1]

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Abstract

Purpose To assess the common practice to transiently place an indwelling transurethral catheter in case of hospitalization of women with febrile urinary tract infections. So far, this intervention has not been scientifically investigated.

Methods Inclusion criteria were female gender, a leucocyte esterase-positive urine dipstick analysis (≥ 250) from urine obtained with a catheter and fever > 38 °C. Patients were randomized 1:1 to either receive an indwelling catheter French 16 or not. The catheter was removed after 24 h without fever (< 37.5 °C). Principal exclusion criteria were a post void residual volume exceeding 50 mL or abnormalities of the urinary tract. Hospital stay and fever in days, the amount of analgetic medication needed and the laboratory parameters WBC and CRP—measured on the day of admission and in predefined intervals thereafter—were study endpoints.

Results 75 patients were included in the final analysis, 36 in the catheter group and 39 in the no-catheter group. Mean age was 39.4 ± 17.7 years and 39.8 ± 15.5 years, respectively ($p > 0.05$). The mean length of catheterisation was 3.6 ± 1.6 days in the catheter group. There were no differences between the two groups regarding duration of hospitalization and fever, or the amount of analgetic medication needed (all $p > 0.05$). Additionally, there was no difference in time to WBC < 10 G/L or CRP < 100 mg/L (all $p > 0.05$).

Conclusions This prospective, randomized trial provides no evidence to support routine insertion of an indwelling catheter in women with febrile urinary tract infection requiring hospital admission.

Keywords Indwelling transurethral catheterization · Catheterization as treatment · Febrile urinary tract infection · Women

Introduction

Almost 50% of women experience at least one urinary tract infection during their lifetime [1]. In the presence of unfavorable factors, this infection can ascend and affect the kidneys. In case of severe pain and/or reduced general condition, hospitalization may be indicated. An analysis on causes for admissions from emergency rooms between 2001 and 2011 in England reported the most prominent increase in hospitalization rates due to urinary tract infection and pyelonephritis, next to pneumonia, diseases of the lower respiratory tract and gastroenteritis [2]. In Austria, acute admission rates for urinary tract infection per 1000 inhabitants rose from 1.2 in 2003 to 1.4 in 2012 [3]. Notably, the ICD codes for febrile urinary tract infection and urosepsis are not reliably included in this numbers. Urosepsis has a lower mortality rate than sepsis originating from other organs and rates due to sepsis have been dropping suggesting improved disease management, but are still reach up to approximately 20% [4, 5].

According to an informal survey of urological departments in Austria, it is a widespread custom to place an indwelling transurethral catheter if female patients with urinary tract infection are admitted. However, the benefit of placement of an indwelling urinary catheter in this scenario has never been scientifically investigated. In fact, it may be argued that—apart from the discomfort caused by the foreign body—placement of a catheter itself may aggravate urinary tract infection [6, 7]. The objective of this study was, therefore, to evaluate the common practice of catheter placement as a therapeutic measure in women with febrile urinary tract infection in a prospective, randomized clinical trial.

✉ Stephan Madersbacher
stephan.madersbacher@wienkav.at

[1] Department of Urology, Kaiser-Franz-Josef Hospital, Kundratstraße 3, 1100 Vienna, Austria

Methods

The study population consisted of women admitted to our ward for treatment of a febrile urinary tract infection. Routine examination at the outpatient clinic included temperature measurement, ultrasound of the kidneys and bladder with residual urine quantification and dipstick analysis on disposable catheter urine. Inclusion criteria were fever > 38 °C on day of admission, leucocyturia (> 250/µL) on dipstick analysis with disposable catheter urine and a negative pregnancy test in women of childbearing potential. Exclusion criteria were hydronephrosis or residual urine > 50 mL on ultrasonography before admission, urolithiasis, urinary tract anomalies, strictures, urinary tract obstruction, and voiding dysfunction—all either known or diagnosed during the hospital stay—and pregnancy.

After assessment of the inclusion/exclusion criteria and informed consent patients were randomized 1:1 to receive a catheter French 16 or not. Urine cultures were taken from disposable catheter or the indwelling catheter right after placement. Laboratory parameters (white blood cells—WBC—4–10 G/L, C-reactive protein—CRP—< 6 mg/L, platelets, blood glucose, creatinine) and body temperature were assessed, and blood cultures taken in case of fever ≥ 38.5 °C. In case of ongoing antibiotic therapy, it was continued intravenously if possible. Otherwise, standard of care was intravenous Cefuroxime 1.5 g three times a day or Ciprofloxacin 400 mg two times a day in case of hypersensitivity to beta-lactam antibiotics. Acetaminophen was given as analgetic/antipyretic therapy in case of fever ≥ 38.5 °C up to four times daily, three times daily in patients with liver damage. Metamizol was used if additional analgetic therapy was needed. Laboratory analysis (WBC, platelets, CRP) is performed on the second day and every other day thereafter. The indwelling urinary catheter is removed and, without any other reason for prolonged hospital stay, such as the patients' wishes or concomitant problems, the patients are discharged after 24 h without fever (< 37.5 °C).

Study endpoints were the duration of hospitalization, time to no fever, time to WBC < 10 G/L, CRP < 100 mg/L, and the need for analgetic medication. Statistical analysis was performed with Excel and SPSS, in case of normal distribution of the data, which was tested for by Kolmogorow–Smirnow test, mean and standard deviation were given and student's *t* test applied. A two-sided *p* value of 0.05 was considered statistically significant. With an expected difference of 1.0 days between mean time to afebrility in both groups and a standard deviation of 1.5 and an expected drop out rate of 10% a number of 40 patients per group will be needed to be able to show a significant difference with a two-tailed α of 0.05 and a power of 0.8.

The study was approved by and registered with the ethics committee of the city of Vienna (EK 17-049-0617). Informed consent was obtained from all individual participants included in the study.

Results

After elimination of the drop-outs, 75 patients were included in the final analysis, 36 in the catheter group and 39 in the no-catheter group. In the catheter group, four patients dropped out because of early discharge or removal of the indwelling urinary catheter due to patients' wishes. In the no-catheter group, one patient got an indwelling urinary catheter in the course of treatment due to deterioration of general condition. Mean patient age was 39.4 ± 17.7 years in the catheter group and 39.8 ± 15.5 years in the no-catheter group ($p > 0.05$). Two patients in the catheter group suffered from diabetes, three patients in the no-catheter group. There was no difference in baseline values between the two groups (see Table 1).

The mean length of catheterisation in the catheter group was 3.6 ± 1.6 days. There were no significant differences between the two groups regarding duration of hospitalization (days) (5.2 ± 2.9 in the catheter group vs. 4.7 ± 2.0 days in the no-catheter group), duration of fever (days) (3.5 ± 1.7 in the catheter group vs. 2.9 ± 1.4 in the no-catheter group) and the amount of analgetic medication needed (mean doses of acetaminophen: 5.1 ± 3.2 in the catheter group vs. 5.2 ± 3.8 in the no-catheter group; other analgetics: 2.6 ± 4.1 in the catheter group vs. 2.2 ± 3.2 in the no-catheter group) (Table 2). Additionally, there was no difference in mean time (days) to WBC < 10G/L (2.1 ± 2.0 in the catheter group vs. 2.1 ± 1.6 in the no-catheter group) or CRP < 100 mg/L (3.8 ± 1.5 in the catheter group vs. 3.6 ± 2.1 in the no-catheter group, all $p > 0.05$; Table 2). The time course of WBC (Fig. 1) and CRP (Fig. 2) revealed no differences between the two study arms at all time points ($p > 0.05$).

In the catheter group, the antibiotic regimen had to be switched in three patients (8.3%) due to bacterial resistance in two and lacking clinical improvement in one. In the no-catheter group, seven patients (17.9%) received a

Table 1 Baseline parameters

Baseline at admission	Catheter ($n = 36$)	No catheter ($n = 39$)	p
Age	39.4 ± 17.7	39.8 ± 15.5	0.92
Temperature (°C)	38.8 ± 0.9	38.7 ± 0.7	0.86
Blood sugar (mg/dL)	119.3 ± 31.6	120.9 ± 43.5	0.86
WBC (G/L)	13.7 ± 4.5	14.2 ± 5.7	0.65
Platelets (G/L)	220.8 ± 60.6	227.5 ± 71.2	0.66
CRP (mg/L)	172.2 ± 73.6	151.8 ± 116.3	0.37

Table 2 Outcome parameters

	Catheter ($n=36$)	No catheter ($n=39$)	p
Hospitalization (days)	5.2 ± 2.9	4.7 ± 2.0	0.34
Fever (days)	3.5 ± 1.7	2.9 ± 1.4	0.09
Time to WBC < 10 (days)	2.1 ± 2.0	2.1 ± 1.6	0.96
Time to CRP < 100 (days)	3.8 ± 1.5	3.6 ± 2.1	0.73
Acetaminophen doses	5.1 ± 3.2	5.2 ± 3.8	0.88
Doses of other analgetics	2.6 ± 4.1	2.2 ± 3.2	0.71

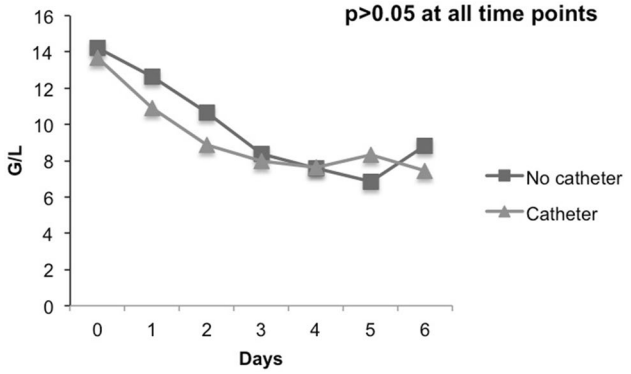

Fig. 1 Time course of WBC

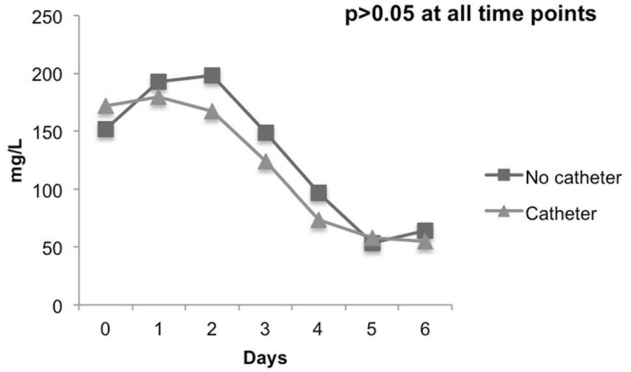

Fig. 2 Time course of CRP

change in antibiotic medication due to bacterial resistance in six and adjustment to a more narrow-spectrum antibiotic in one (Table 3). Urinary cultures revealed *E. coli* in 75% of patients in the catheter group (3 multidrug-resistant organism—3MDRO bacteria $n=2$) and 79.5% in the no-catheter group (3MDRO bacteria $n=5$). There was no bacterial growth in the remaining 25% in the catheter group and 20.5% in the no-catheter group. 21.4% in the catheter group and 33.3% in the no-catheter group had positive blood cultures. In the catheter group, three of six positive blood cultures showed 3MDRO bacteria, 11 in the no-catheter group (Table 3).

Table 3 Antibiotic/antimicrobial data

	Catheter	No catheter	p
Antibiotics before admission	14 (38.9%)	10 (25.6%)	0.22
Switch in antibiotics	3 (8.3%)	7 (17.9%)	0.31
Additional gentamicin	2 (5.6%)	3 (7.7%)	1.0
E. coli in urine culture	27/36 (75%)	31/39 (79.5%)	0.50
3MDRO in urine culture	2/36 (5.6%)	5/39 (12.8%)	0.45
Positive blood culture	6/28 (21.4%)	11/33 (33.3%)	0.28
3MDRO in blood culture	3/28 (10.7%)	3/33 (9.1%)	1.0
Diabetes	2 (5.6%)	3 (7.7%)	1.0

Discussion

The objective of this study was to determine if placement of an indwelling urinary catheter in women admitted for a febrile urinary tract infection leads to faster recovery. The rationale behind this measure is to guarantee immediate and continuous drainage of the urinary tract. It is hypothesized that catheter placement leads to shorter exposure and faster elimination of bacteria, which could accelerate convalescence. Additionally, it might prevent potential vesicoureteral reflux with a full bladder, which could contribute to development and maintenance of an upper urinary tract infection [8]. To the authors' knowledge, this common practice in many urological departments has not yet been scientifically evaluated.

The major limitations of this study are the small sample size, the lack of demographic information, that the data, e.g., on hospitalization refer to a public, highly socialized health care system and that some inclusion criteria (i.e., post void residual volume) were arbitrarily chosen. Furthermore, this analysis did not exclude patients who had already started antibiotic therapy at the time of admission. This might be a source of bias, but the prior intake of antibiotics is evenly distributed over both groups. Furthermore, patients were not always discharged on the day of catheter removal, which may introduce bias in the length of hospitalization analysis. Another confounding factor may be the inclusion of diabetic patients, which was small in both groups. Another limitation is that the exclusion criteria urolithiasis was also diagnosed after inclusion in the study. To strictly rule out the presence of stones before enrolment, a CT scan in every eligible patient would be needed. This, in a predominantly young female population, seemed disproportional and ethically questionable.

This prospective randomized comparison failed to demonstrate any advantage of placing an indwelling catheter

regarding length of hospital stay, course of laboratory parameters or need for analgetic medication. On the contrary, the duration of fever was slightly longer in the catheter group (3.5 ± 1.7 days vs. 2.9 ± 1.4 days) indicating a rather negative impact on the course of the disease, although not reaching statistical significance ($p = 0.09$). Based on these data, we have given up to routinely insert catheters in women with febrile urinary tract infection requiring hospital admission.

This study focused on uncomplicated upper urinary tract infection, excluding patients with any urinary tract anomalies, obstruction, urolithiasis, and/or voiding dysfunctions. The cut-off of 50 mL for residual urine was set this low to be sure to exclude any voiding dysfunction. Diabetes was present in two of 36 patients in the catheter group and three of 39 patients in the no-catheter group. Due to the small number of patients, a subgroup analysis was refrained from, but diabetes did not seem to be associated with a longer hospital stay, longer duration of fever or higher rate of antimicrobial resistance. Still, it has to be considered as a possible confounding factor in the analysis. However, further studies are needed to evaluate if diabetes is a risk factor for more severe course of disease.

The theory behind placement of an indwelling urinary catheter in patients with febrile urinary tract infections is immediate drainage to shorten exposure time to bacteria. In our patient collective, however, there was no indication that this measure is beneficial: either there is indeed no benefit from continuous drainage or the negative effects of a foreign object in the urinary tract outbalance a possible positive effect. Generally, indwelling urinary catheters are mostly associated with iatrogenic bacteraemia and urinary tract infections, and a higher rate of polymicrobial infections and multiple-drug-resistant uropathogens [8, 9]. In this patient collective, there was no sign of a higher rate of ESBL or 3MDRO in the catheter group. The data have to be interpreted in the light of the Austrian health care system, which is public, free of charge and quite permissive regarding admission and prolonged hospital stay.

Conclusions

The data of this prospective, randomized trial provide no support for the routine insertion of an indwelling catheter in women with febrile urinary tract infection requiring hospital admission. There was no evidence for quicker normalization of laboratory parameters or faster recovery from fever. However, this conclusion is only valid for women with uncomplicated febrile urinary tract infection meeting the inclusion/exclusion criteria of this randomized trial.

Author contributions IS: protocol/project development, data collection or management, data analysis, manuscript writing/editing. BMA-A: data collection or management, manuscript writing/editing. WL: data collection or management, manuscript writing/editing. SM: protocol/project development, data collection or management, manuscript writing/editing. KE: data collection or management data analysis, manuscript writing/editing.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethics statement All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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