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Clinical Article

Association between Asymptomatic Urinary Tract Infection and Postoperative Spine Infection in Elderly Women : A Retrospective Analysis Study

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Objective : The purpose of this study is to identify the relationship between asymptomatic urinary tract infection (aUTI) and postoperative spine infection.
Methods : A retrospective review was done in 355 women more than 65 years old who had undergone laminectomy and/or discectomy, and spinal fusion, between January 2004 and December 2008. Previously postulated risk factors (i.e., instrumentation, diabetes, prior corticosteroid therapy, previous spinal surgery, and smoking) were investigated. Furthermore, we added aUTI that was not previously considered.
Results : Among 355 patients, 42 met the criteria for aUTI (Bacteriuria $\geq 10^5$ CFU/mL and no associated symptoms). A postoperative spine infection was evident in 15 of 355 patients. Of the previously described risk factors, multi-levels ($p < 0.05$), instrumentation ($p < 0.05$) and diabetes ($p < 0.05$) were proven risk factors, whereas aUTI ($p > 0.05$) was not statistically significant. However, aUTI with Foley catheterization was statistically significant when Foley catheterization was added as a variable to the all existing risk factors.
Conclusion : aUTI is not rare in elderly women admitted to the hospital for lumbar spine surgery. The results of this study suggest that aUTI with Foley catheterization may be considered a risk factor for postoperative spine infection in elderly women. Therefore, we would consider treating aUTI before operating on elderly women who will need Foley catheterization.

KEY WORDS : Asymptomatic UTI · Postoperative spine infection · Elderly women.

INTRODUCTION

Postoperative spine infection is a serious complication of spine surgery, resulting in increasing rates of morbidity and mortality, hospital length of stay, and economical difficulties[15,16]. Despite strict attention to operating room sterility and use of prophylactic antibiotics, postoperative spine infections continue to occur.

Previously identified risk factors include old age[17,38], obesity[6,39], diabetes[32,39], smoking[32,39], preoperative malnutrition[17,21], and previous spinal surgery[6,39]; surgery-related risk factors like placement of posterior instrumentation[18,39], multilevel surgery[31], and the presence of a wound hematoma[30]. Preoperative or perioperative steroid therapy[21,39] and massive intraoperative blood loss[21,39] have also been reported to increase the risk of postoperative spine infection. In particular, the high incidences of postoperative spine infections are known to increase in females and in old age[17,38]. This suggests that there might be more risk factors than are already known for elderly women.

Urinary tract infections (UTIs) account for approximately 7 million office visits annually, affecting men, women, and children[20]. Elderly women have the highest prevalence of this infection, which increases with increasing age[28], and they also have a relatively high proportion of asymptomatic UTI (aUTI). In previous studies, symptomatic UTI has been a reported risk factor of postoperative spine infection following spinal surgery[19]. However, the clinical significance of aUTI in elderly women is not clear. aUTI can be defined as isolation of a specified quantitative count of bacteria in an appropriately collected urine specimen obtained from a person without symptoms or signs referable to urin-

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ary infection[34]. The treatment of aUTI is not recommended in most cases, except for pregnant women and in traumatic urologic interventions such as urethroscopy[34].

There are some studies on the relationship between postoperative infection and UTI[8,13]. Even with other kinds of operations, it is generally known that symptomatic UTI in a patient with a prosthetic hip or knee can lead to hematogeneous joint seeding and therefore an increased risk for deep infection in that joint[8,13]. In contrast, aUTI has not been significantly correlated with the incidence of postoperative wound infection in hip/knee arthroplasty[12,33]. There has been no report of a relation between aUTI and postoperative spine infection. The purpose of this study is to identify the relationship between aUTI, Foley catheterization, and postoperative spine infection in elderly women.

MATERIALS AND METHODS

From January 2004 to December 2008, a total of 2,107 patients had lumbar spine surgery (laminectomy/discectomy, instrumentation), and the number of women over 65 years old was 386. All elderly women who were eligible for participation in the study fulfilled the following criteria : they had to be ambulatory; have no symptoms of UTI (incontinence, dysuria, frequency, urgency, suprapubic pain, flank pain); have no indwelling bladder catheter before the operation; have no infection source (pneumonia, spondylolitis, etc.); and be of normal mental state. We were able to analyze 355 elderly women patients except 31 patients in this study.

Preoperatively, urine routine analysis was performed in each patient and urine culture was done if urine routine analysis was abnormal. aUTI was considered in two categories for asymptomatic patients : 1) UTI is defined as 2 consecutive voided urine specimens with isolation of the same bacterial strain in quantitative counts $\geq 10^5$ CFU/mL; 2) A single catheterized urine specimen with 1 bacterial species isolated in a quantitative count $\geq 10^2$ CFU/mL identifies bacteriuria in women[35].

Inclusion criteria for a spine infection case required : 1) constant fever over 38.5°C after the second postoperative day, detection of fluid collection by palpation, discharge or aspiration of pus from the wound[3]; 2) persistent elevation or second rise of CRP about a week after the surgery[22]; and 3) further imaging, especially with enhanced magnetic resonance image (MRI), indicating a diagnosis of postoperative spine infection. Spinal infections commonly demonstrate typical signal intensity on T1- and T2-weighted images and enhancement within the affected bone marrow after the administration of gadolinium-based contrast material[14].

Diabetes, prior corticosteroid therapy, previous spinal surgery, and smoking have been considered previously. Moreover, one of the intraoperative factors was classified into two subgroups based on surgical treatment. The subgroups were instrumentation (spinal fusion), and laminectomy and/or discectomy. The spinal fusion procedure was almost always a unilateral posterior transforaminal lumbar interbody fusion (TLIF) with artificial cage and pedicle screw fixation (PSF), with exposure of the lamina, facets, and transverse process[11]. In laminectomy and/or discectomy, the lamina was resected partially and/or a partial discectomy was done after retracting the nerve root medially. Another intraoperative factor involved spine surgery levels. Additionally, aUTI has been newly considered as risk factor.

A Foley catheter was inserted when the operation took over two hours, so most patients who underwent spinal fusion and some patients who underwent laminectomy and/or discectomy had a Foley catheterization. Two days postoperatively, the Foley catheter was removed.

All patients received preoperative antibiotics to cover commonly encountered organisms. A third generation cephalosporin was given. Antibiotics were continued for 7 days after the operative procedure. Closed suction drains were left routinely in posterior spinal wounds where laminectomy and fusions were performed, and removed 1-3 days after the operation.

When postoperative spine infection was suspected, broad spectrum antibiotics was initiated and every effort was given to find the source of the spinal infection as soon as possible. After wound culture result was confirmed, we changed broad spectrum antibiotics to proper antibiotics for its result. All 15 patients with suspected postoperative spine infection were taken to the operating room for open debridement or needle aspiration under fluorescence view. Debridement consisted of taking wound cultures and thoroughly irrigating the wound.

For statistical analysis, SPSS software (version 12.0, 2003; SPSS, Inc.; Chicago, IL, USA) was used. Multiple logistic regression analysis was performed. A probability value less than 0.05 was considered statistically significant.

RESULTS

During the 5-year period of the study, postoperative spinal infection occurred in 15 of 355 (4.2%) patients 65 years or older (mean 72.1 years), with no significant variation in postoperative spine infection rates during the 5 years of the study and no outbreaks identified. The incidence of aUTI was analyzed in 11.8% (42/355) patients.

The results of multivariate analysis for risk factors (operation level, operation type, diabetes, prior corticosteroid

therapy, previous spinal surgery, smoking and aUTI) are shown in Table 1. Among these factors, operation level (multi-level), operation type (instrumentation) and diabetes were statistically significant ($p < 0.05$).

More infections were found after instrumentation than after laminectomy and/or discectomy. The infection rates in the laminectomy/discectomy group and in the instrumentation group were 3.6% (8/220) and 5.2% (7/135), respectively. Also, multi-level operation was shown to confer an increased risk of postoperative spine infection in this study. Diabetes was associated with other important risk factors of postoperative spine infection. The infection rate in the diabetes group was 8.9% (6/67) and in other groups was 3.1% (9/288). However, the anticipated aUTI did not turn out to be an independent risk factor for postoperative infection. We added Foley catheterization as a variable to the all existing risk factors, because Foley catheterization in patient with aUTI might be synergistic in postoperative spine infection. Added results showed aUTI with Foley catheterization as well as operation level (multi-level), operation type (instrumentation) and diabetes to be statistically significant as a risk factor (Table 2).

Table 1. Clinical predictive of postoperative infection using multivariate analysis

	Infected patient Group (n = 15)	Non-infected patient Group (n = 340)	*p*-value
OP levels (multi-levels : Single-level)	14 : 1	184 : 156	0.012*
OP type (Instrumentation : laminectomy/discectomy)	7 : 8	128 : 212	0.031*
DM (+) : (-)	6 : 9	61 : 279	0.039*
Prior OP (+) : (-)	4 : 11	34 : 306	0.167
Smoking (+) : (-)	2 : 13	16 : 324	0.374
Prior Steroid Tx (+) : (-)	4 : 11	20 : 320	0.061
aUTI (+) : (-)	9 : 6	33 : 307	0.054

*$p < 0.05$. OP : operation, DM : diabetes mellitus, Tx : treatment, aUTI : asymptomatic urinary tract infection.

Table 2. Risk factors related to postoperative spine infection after new statistical analysis with Foley catheter insertion as new variable

	Infected patient Group (n = 15)	Non-infected patient Group (n = 340)	*p*-value
Multi-levels with Foley cath. (+) : (-)	13 : 2	172 : 168	0.027*
Instrumentation with Foley cath. (+) : (-)	7 : 8	128 : 212	0.047*
DM with Foley cath. (+) : (-)	4 : 11	49 : 291	0.039*
Prior OP with Foley cath. (+) : (-)	3 : 12	31 : 309	0.117
Smoking with Foley cath. (+) : (-)	1 : 14	10 : 330	0.391
Prior Steroid Tx with Foley cath. (+) : (-)	1 : 14	15 : 325	0.097
aUTI with Foley cath. (+) : (-)	4 : 11	17 : 323	0.021*

*$p < 0.05$. OP : operation, DM : diabetes mellitus, Tx : treatment, aUTI : asymptomatic urinary tract infection, Foley cath.: Foley catheterization

Of 42 asymptomatic bacteria, *Escherichia coli* was the offending organism in 50.0% of the cases and *Staphylococcus epidermidis* was the organism in 19.0% of the cases (Table 3).

Table 3. Types of organisms cultured inpatient with aUTI

Infected organisms	No. of patient
Enterobacteriacease	
Escherichia coli	21
Klebsiella Pneumoniae	9
Gram (+) bacterias	
Staphylococcus epidermidis	8
Staphylococcus aureus	3
Nonenterococcus Streptococcus	1

aUTI : asymptomatic urinary tract infection

All 15 patients with postoperative spine infection underwent operation site culture with surgical open debridement or needle aspiration. The results of the culture showed that 9 patients were culture positive and 6 patients were "no growth". Of the nine patients who had positive culture results, *Staphylococcus aureus* was found in six and *Staphylococcus epidermidis* was found in three. Culture results of postoperative spine infection in patients with aUTI are shown in Table 4. One of these patients had "no growth" and three patients had the same organism in postoperative spine infection and aUTI.

DISCUSSION

Asymptomatic bacteriuria, also referred to aUTI, is not rare[23,26]. There has been considerable controversy about the appropriate management of bacteriuria. Evidence reported in clinical trials undertaken over the past three decades, however, is sufficient to support recommendations for management in most populations.

The incidence rate of aUTI in healthy premenopausal women is 2-5%[23]. Even though there were reports on a cohort study of bacteriuria that lasted for several months to several years in some women, it is temporary in most cases. However, elderly women have higher likelihood for bacteriuria. A prospective, randomized study reported that the treatment of aUTI using nitrofurantoin or placebo was not effective[2]. When the patients who underwent antimicrobial treatment and those who did not were compared using prospective, randomized, comparative trials, the benefits for these two groups did not show significant difference[5,25,29].

Table 4. Culture positive results of postoperative infections in patient with asymptomatic urinary tract infection

Cases	Organism of postoperative spine infection	Organism of urinary tract infection	Foley catheterization
Case 1	No growth	E. coli	(+)
Case 2	S. aureus	E. coli	(-)
Case 3	S. epidermidis	S. epidermidis	(+)
Case 4	S. epidermidis	S. epidermidis	(+)
Case 5	S. aureus	S. aureus	(+)

The optimal approach varies among different patient groups. Recently, the Infectious Diseases Society of America (IDSA) developed and published guidelines for screening for, and treatment of, aUTI. Screening and treatment of asymptomatic bacteriuria is recommended only for pregnant women, or for patients prior to selected invasive genitourinary procedures[26]. However, we think that this recommended protocol should include additional preoperative management in elderly women.

Because the treatment of postoperative spine infection is difficult, prophylaxis is most important, but significant knowledge about risk factors is still debatable. Multiple factors have been related to the incidence of infection in spine surgery.

In our study, prior corticosteroid therapy, previous spinal surgery, and smoking as predisposing factors were not related to postoperative spine infection. But, instrumentation and operation levels had been reported to be associated with postoperative spine infection[18,31,39] and our study also showed an increased correlation with the occurrence of postoperative spine infection. In our study, as in other studies, the risk of postoperative spine infection was significantly increased in patients who had diabetes[32,39]. However, against our expectation, aUTI was not an independent risk factor for postoperative infection. Also, these findings were relevant with other research studies[12,33]. But, we noticed that Foley catheterization could induce urethral mucosa injury[34] and might induce hematogenous bacterial spread in aUTI condition. David and Vrahas[9] reported that Foley catheterization before or after total joint arthroplasty surgery could cause UTI which might affect postoperative infections and its risk should increase in patient with aUTI. Therefore, another statistical analysis was done with Foley catheterization as a new added variable. The added results showed aUTI with Foley catheterization as well as operation level (multi-level), operation type (instrumentation) and diabetes were statistically significant. From these results, even though aUTI alone does not affect postoperative spine infection, we should suspect that to a certain degree, aUTI with Foley catheterization is related to postoperative spine infection.

Escherichia coli is the most common pathogen in bacteriuric elderly women, and it is isolated in 85.7-87.0%[4,5,24,27,28]. Other studies have isolated gram-positive bacteria ranging from 7-21% and *Staphylococcus epidermidis* in 9.5%[4,5]. On the other hand, in postoperative spine infection, *Staphylococcus aureus* was the most common organism[36]. In our study, *Staphylococcus aureus* was the most common in postoperative spine infection, as shown in other studies. But *Staphylococcus epidermidis* is more common than *Staphylococcus aureus* in spine infection patients who have aUTI with Foley catheterization. Although the number of infected cases was small, the result was that the bacteria in urine and postoperative spine infection were identical in three cases. Of course, even if this result were considered a coincidence, it would still be significant that it occurred in patients who had aUTI with Foley catheterization. We may infer from this result that hematogeneous spread by Foley catheterization in patients with aUTI caused the infection at the operation site. After surgery, elderly patients in particular experience lower systemic immunity and the operated site becomes vulnerable to infection. The most common source of general infection in the present study was the genito-urinary system[1,7,10]. We suspected the hematogeneous spread of bacteria in aUTI inoculated perioperatively. It is possible the infection may be caused by hematogeneous spread from mucosal injury of a distant urinary tract after an invasive procedure like Foley catheterization[37]. So, the results of this study suggest that aUTI with Foley catheterization would be considered a risk factor for postoperative spine infection in women 65 years of age or older. However, the number of patients with spine infection and aUTI with Foley catheterization is small, so we need further studies. Also, further studies will be needed to find the biological mechanism of bacterial hematogeneous spread.

CONCLUSION

According to our data, instrumentation, multi-level operation, diabetes, and aUTI with Foley catheterization are independent risk factors of postoperative spine infection. It is significant that aUTI with Foley catheterization, which has not been identified previously, is risk factor of postoperative spine infection. Only few cases of aUTI in elderly women have been treated, and not much attention has been paid to hospital cases for lumbar spine operation. However, since lumbar spine operation takes a long time, Foley

catheterization is often performed. According to this study, a higher risk of postoperative spine infection is incurred in this case. It is therefore, recommended that Foley catheterization in elderly women with aUTI be restricted and that aUTI should be treated first if Foley catheterization is needed.

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