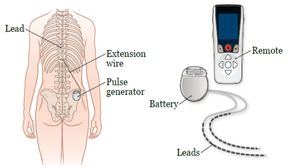
Assessing the Role of Urinalysis and Urine Culture Before Spinal Cord Stimulation Trials

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Introduction

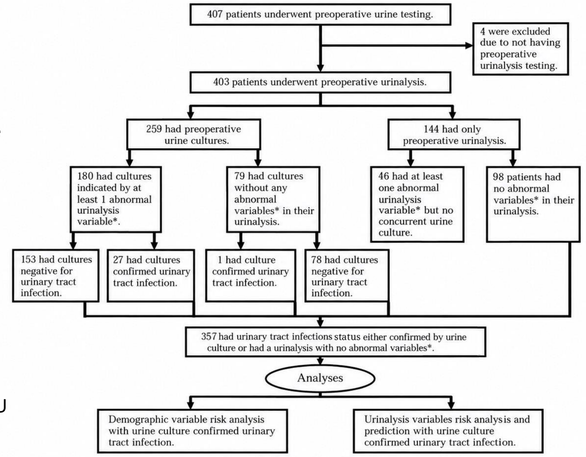
Spinal cord stimulation (SCS) is a surgical procedure that carries a risk of surgical site infection (SSI), increasing patient morbidity and healthcare costs [1]. The Neurostimulation Appropriateness Consensus Committee recommends identifying and treating remote infections before initiating an SCS procedure [2]. In some studies, urinary tract infections (UTIs) prior to surgery have been linked to increased likelihood of surgical site infections [3]. To test for UTIs, clinicians will often order a urinalysis screening test, followed by a urine culture when indicated. The goal of this study was to evaluate the prevalence of positive urinalyses (UAs) and urine cultures (UCs) before SCS trials, identify patient risk factors and common pathogens, and assess the value of preoperative urinary screening in SCS care.



Methods

After Robert Morris University Institutional Review Board approval (#20260527382), charts for patients considered for SCS trials between September 2013 and June 2026 who underwent preoperative urine testing were reviewed. Patients who underwent SCS trials were identified using CPT code 63650; those considering but not proceeding to trial were identified through preoperative UA orders.

Demographic variables included SCS trial status, treatment timeline, demographics, and neurological conditions (e.g., Parkinson's disease, multiple sclerosis, stroke). Preoperative UAs were reviewed for urinary tract infection (UTI) indicators, including nitrites, leukocytes, bacteria, red and white blood cells, pH, clarity, and mucus. UCs were evaluated for bacterial species and colony counts, with UTIs defined as $\geq 10^5$CFU and fewer than three bacterial species necessitating treatment [4]. UTI-negative status was defined as a negative UC or a UA without abnormalities in studied variables.



* Variables studied for urinalysis included clarity, nitrite positivity, leukocyte esterase positivity, white blood cell positivity (greater than 5 hpf), red blood cell positivity (greater than 4 hpf), bacteria presence, and mucous presence.

Conclusions

UTI Prevalence

- Culture-confirmed UTIs occurred in 7.8% of patients, with *Escherichia coli* appearing in more than 50% of the culture-confirmed UTIs. The second most common bacteria were Enterococcus species, followed by *Klebsiella*, Group B *Streptococcus*, and *Staphylococcus epidermidis*.

Association Between Urine Screening Results and Time to Treatment

- Longer time-to-trial was not associated with UTI status. Having an abnormal preoperative urine screening was not associated with delayed treatment.

Significant Predictors of UTI

- Increased UTI risk was associated with abnormal clarity, positive nitrites, leukocyte esterase, elevated white blood cell count, and bacteria. These findings suggest that a urine culture may be unnecessary unless at least one of these urinalysis variables is abnormal.
- Female sex, advanced age, and the presence of a neurological condition were all associated with increased risk of UTI. Based on the data, if only patients with at least one of these demographic factors were tested, no UTI-positive patients would have been missed.

Conclusion

- Culture-confirmed UTIs were present in approximately 8% of patients, and preoperative urine screening was not associated with delays in progression to spinal cord stimulation trial. These findings support screening as a practical strategy to identify infection risk without disrupting care; however, prospective studies are needed to determine whether testing and treatment reduce implant-related complications.

Results

Urinalysis factor	UTI Negative n (%)	UTI Positive n (%)	Risk Ratio (95% CI)	Fisher's p value
Nitrites	14/343 (4.1)	14/14 (100)	24.50 (14.67–40.92)	$< 0.001^*$
Leukocytes	6/281 (2.1)	22/76 (28.9)	13.56 (5.70–32.24)	$< 0.001^*$
Bacteria	9/275 (3.3)	19/82 (23.2)	7.08 (3.33–15.05)	$< 0.001^*$
WBCs	14/311 (4.5)	14/46 (30.4)	6.76 (3.45–13.25)	$< 0.001^*$
Clarity	14/297 (4.7)	14/60 (23.3)	4.95 (2.49–9.84)	$< 0.001^*$
Mucous	24/330 (7.3)	4/27 (14.8)	2.04 (0.76–5.44)	0.16
Blood	24/323 (7.4)	4/34 (11.8)	1.58 (0.58–4.29)	0.37
RBCs	26/335 (7.8)	2/22 (9.1)	1.17 (0.30–4.62)	0.82

Values are presented as the number of patients with a culture-confirmed UTI divided by the total number of patients in each comparison group (%). Risk ratios compare the second category (Abnormal) with the reference category (Normal).
* Values represent significantly higher risk of UTI for the yes groups.

Association Between Urinalysis Findings and Urinary Tract Infection (n=357)

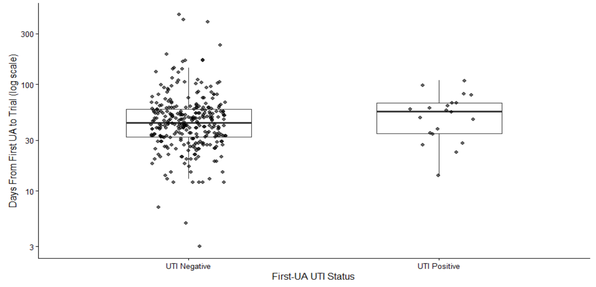
Pre-trial urinalysis variables independently associated with increased UTI risk included abnormal clarity, positive nitrites, leukocyte esterase, elevated white blood cell count, and bacteria. This association was calculated using Risk Ratios in R version 4.5.2. No correction methods were used to account for type I error rate inflation.

Characteristic	Comparison Group	UTI, n (%)	Risk Ratio(95% CI)	Fisher's p-value
Neurological condition	No	23/342 (6.7)	–	–
	Yes	5/15 (33.3)	4.96 (2.19–11.22)	$< 0.001^*$
Sex	Male	5/178 (2.8)	–	–
	Female	23/179 (12.8)	4.57 (1.78–11.76)	$< 0.001^*$
Advanced age	No	6/170 (3.5)	–	–
	Yes	22/187 (11.8)	3.33 (1.38–8.02)	0.004^*
Former smoker	No	22/266 (8.3)	–	–
	Yes	6/91 (6.6)	0.79 (0.33–1.90)	0.60
Current smoker	No	25/308 (8.1)	–	–
	Yes	3/49 (6.1)	0.75 (0.24–2.40)	0.63
Diabetes	No	21/278 (7.6)	–	–
	Yes	7/79 (8.9)	1.17 (0.52–2.66)	0.70
Obesity	No	12/162 (7.4)	–	–
	Yes	16/195 (8.2)	1.11 (0.54–2.27)	0.78

Values are presented as the number of patients with a culture-confirmed UTI divided by the total number of patients in each comparison group (%). Risk ratios compare the second category (Yes/Female) with the reference category (No/Male).
* Values represent significantly higher risk of UTI for the yes groups.

Association Between Demographic Factors and Urinary Tract Infection (n=357)

Demographic factors associated with increased UTI risk included sex, neurological condition, and those with advanced age (65 or older). This association was calculated using Risk Ratios in R version 4.5.2. No correction methods were used to account for type I error rate inflation.



Time From First UA to SCS Trial by First-UA UTI Status

Median time from first UA to SCS trial did not significantly differ (p = 0.19) between UTI-positive patients (56 days, IQR 35 – 67) and UTI-negative patients (43 days, IQR 32 – 59). The median time to trials was compared using a Mann-Whitney U test, a non-parametric test which was used as the data are not normally distributed. This was done in R version 4.5.2.

References

1. Spinal Cord Stimulation Infection Rate and Incremental Annual Expenditures: Results From a United States Payer Database Provenzano DA, et al. Neuromodulation. 2019;22(3):302–310. https://doi.org/10.1111/ner.12939

2. Deer TR, Provenzano DA, Hanes M, Pope JE, Thomson SJ, Russo MA, McJunkin T, Saulino M, Raso LJ, Lad SP, Narouze S, Falowski SM, Levy RM, Baranidharan G, Golovac S, Demesmin D, Witt WO, Simpson B, Krames E, Mekhail N. The Neurostimulation Appropriateness Consensus Committee (NACC) recommendations for infection prevention and management. Neuromodulation. 2017 Jan;20(1):31-50. doi: 10.1111/ner.12565

3. Pokrzywa CJ, Papageorge CM, Kennedy GD. Preoperative urinary tract infection increases postoperative morbidity. J Surg Res. 2016 Sep;205(1):213-20. doi: 10.1016/j.jss.2016.06.025

4 Karah N, Rafei R, Elamin W, Ghazy A, Abbara A, Hamze M, Uhlin BE. Guideline for urine culture and biochemical identification of bacterial urinary pathogens in low-resource settings. Diagnostics (Basel). 2020 Oct 16;10(10):832. doi: 10.3390/diagnostics10100832

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