https://doi.org/10.29309/TPMJ/2026.33.05.10255 www.theprofesional.com

ORIGINAL ARTICLE

Comparison of silver alloy coated latex catheters versus standard non-coated latex urinary catheters in terms of development of early catheter associated urinary tract infections.

Muhammad Imran Afzal[1], Syed Atif Hussain[2], Shafi Ghauri[3], M. Saddiq Haris[4], Shayan Rahim Kanjoo[5], Muhammad Zohaib Fazal[6]

ABSTRACT… Objective: To compare the use of silver-alloy coated latex catheters and uncoated latex catheters in the prevention of early CAUTI in patients with a short-term catheterization. **Study Design:** Randomized Controlled Trial. **Setting:** Department of Urology, Sheikh Zayed Hospital, Rahim Yar Khan. **Period:** 24 April 2025 to 24 Oct 2025. **Methods:** A randomized assignment was done on 66 adult patients who needed catheterization of at least three days, with 33 patients receiving silver-alloy coated and 33 non-coated catheters. Urine microscopy and culture were performed at baseline and on Day 5. Outcomes included significant pyuria (>10 WBC/HPF), positive urine culture (≥10^5 CFU/mL), and symptomatic CAUTI. Data were analyzed using SPSS 25, with $p \leq 0.05$. **Results:** By Day 5, the non-coated catheter group showed higher mean pus cell counts (17.8 ± 9.4 vs. 9.6 ± 6.5), more significant pyuria (57.6% vs. 27.3%), and more positive cultures (60.6% vs. 21.2%). Silver-coated catheters were associated with significantly fewer overall CAUTIs (21.2% vs. 60.6%, p=0.001) and lower rates of symptomatic UTI, fever, and dysuria. Age- and gender-based stratification showed consistently lower UTI rates in the silver-coated group. **Conclusion:** Silver-alloy coated urinary catheters effectively reduced early bacteriuria and CAUTI compared with non-coated catheters in short-term use. Their adoption may strengthen infection prevention strategies in hospitalized patients.

Key words: Bacteriuria, CAUTI, Randomized Trial, Silver-alloy Catheter, Urinary Infection.

Article Citation: Afzal MI, Hussain SA, Ghauri S, Haris MS, Kanjoo SR, Fazal MZ. Comparison of silver alloy coated latex catheters versus standard non-coated latex urinary catheters in terms of development of early catheter associated urinary tract infections. Professional Med J 2026; 33(05):883-887. https://doi.org/10.29309/TPMJ/2026.33.05.10255

INTRODUCTION

Urethral catheters have more than 3500 years of use and have been a thorn and a rose in the lives of both the patients and the urologist because they can be a source of danger to patients who have to be catheterized over a long period. UTI is the category of the most common healthcare-associated infections (HAIs) since they constitute 21-45 percent of all HAIs and bacteriuria up to 4 percent of cases.[1] Bacteremia is estimated at a rate of 3-10 percent. Per day in catheterization, 14 days of indwelling catheterization is linked to participation up to 70 percent. The catheter-associated UTIs are associated with the length of stay, morbidity, mortality and the cost of staying at the hospital. Some of the measures have been suggested to reduce the risk of catheter-associated UTIs. They include reduction of the catheterization time, the use of antiseptic procedure when inserting a catheter, prophylaxis in patients with high risk of catheterization, keeping of a tight sterile drainage system, and the creation of different types of catheters.[2,3] It deals with constructing special urethral catheters either coating the outer surface and /or lumen and/or impregnating the catheter material with antiseptics and/or antimicrobials. Silver has been the most popular agent that has been employed and it has been demonstrated to have antimicrobial effect against various uropathogens.[4] According to some systematic reviews, it was determined that the silver-alloy impregnated transurethral catheters are more effective in reducing the risk of pathogenic urine and/or/and catheter-associated UTIs, compared to the conventional catheters used in patients hospitalized and catheterized.[5] 3 and 7. Culture and sensitivity were carried out on days 1, 3, and 7. Though the initial results were similar in both groups, there was a significant reduction in the number of pus cells in urine and a decrease in positive cultures on day 7 (p=0.0277 and p=0.0497).

1. MBBS, PGR Urology, Sheikh Zayed Hospital Rahim Yar Khan.
2. MBBS, FCPS (Urology), Associate Professor and Head Urology, Sheikh Zayed Hospital Rahim Yar Khan.
3. MBBS, FCPS (Urology), Assistant Professor Urology, Sheikh Zayed Hospital Rahim Yar Khan.
4. MBBS, FCPS (Urology), Senior Registrar Urology, Sheikh Zayed Hospital Rahim Yar Khan.
5. MBBS FCPS (Urology), Senior Register Urology, Sheikh Zayed Hospital Rahim Yar khan.
6. MBBS, PGR Urology, Sheikh Zayed Hospital Rahim Yar Khan.

Correspondence Address:
Dr Muhammad Imran Afzal
Department of Urology, Sheikh Zayed Hospital Rahim Yar Khan.
imranafzal1163@gmail.com

Article received on:
06/11/2025
Accepted for publication:
13/01/2026

A randomized controlled trial conducted to compare incidence of UTI in patients using silver coated and non-coated urinary catheters has shown that, of the 343 UTI 70.8% occurred in patients in wards who had uncoated catheters in place at the time of infection, and 29.2% occurred in patients in wards who had silver-coated catheters in place.[6] Another comparative interventional study concluded that 33% patients in silver coated catheter group had positive urine culture and 10% had symptomatic urinary tract infection. Those in non-coated catheter group 39% patients had positive urine culture and 13% patients had symptomatic urinary tract infection[5]3, and 7. Culture and sensitivity were carried out on days 1, 3, and 7. Though the initial results were similar in both groups, there was a significant reduction in the number of pus cells in urine and a decrease in positive cultures on day 7 (P = 0.0277 and P = 0.0497 Another randomized controlled trial the patients who will receive placement of Suprapubic catheters (SPC) in pelvic organ prolapse surgery were enrolled and randomized to receive standard Suprapubic catheters (SPC) or silver-alloy Suprapubic catheters (SPC). Twenty-nine of 123 women undergoing standard Suprapubic catheters SPC (23.6%) and 24 of 131 Suprapubic catheters SPC were found to have UTI within the 6 weeks after the operation. Only diabetes was left as an independent risk factor on multivariate analysis.[2]

Despite partial evidence that shows positive outcomes indicating a reduction in the risk of UTI in the application of silver-alloy catheters, the research studies have been inconsistent with respect to the population of patients, clinical indication, and the outcomes. The lack of data on the studies which compare the effectiveness of the silver-alloy-impregnated catheters against non-coated catheters also exists. Thus, the following randomized controlled trial is planned in order to present some of the practical evidence among our local population.

METHODS

This randomized controlled trial was performed in the Department of Urology, Sheikh Zayed Hospital, Rahim Yar Khan, over a period of six months from 24 April 2025 to 24 Oct 2025. Following ethical approval (Ref.No.173/IRB/SZMC/SZH). The sample size was calculated by using Epitools online sample size calculator (https://epitools.ausvet.com.au/twomeansone) keeping 95% level of confidence and 90% power of study and taking expected incidence of UTI to be 29.2% and 70.8 % in patients with silver coated urinary catheters and non-coated urinary catheters[6] respectively. A total of 66 patients, aged 18–89 years and requiring urinary catheterization for three or more days, were selected through non-probability consecutive sampling. Eligible patients were randomized by lottery into two equal groups: Group I (silver alloy–coated latex catheter, n=33) and Group II (standard non-coated latex catheter, n=33). Catheterization was performed by a resident using standard aseptic technique, including cleansing with povidone-iodine. Immediately after catheter placement, a urine sample was collected for microscopy and culture, with a repeat sample obtained on day 5 through catheter aspiration. Patients were monitored for symptoms of urinary tract infection (dysuria, frequency, urgency, fever, suprapubic or flank pain), while laboratory confirmation was based on pyuria (>10 WBCs/HPF) and significant bacteriuria (≥10^5 CFU/mL). Demographic data, clinical findings, and laboratory results were recorded on a structured proforma. Data were analyzed using SPSS version 25.0. A chi-square test was used with A p-value ≤0.05.

RESULTS

A total of 66 patients were enrolled, with 33 in each group. Baseline characteristics, including age, gender, BMI, and indications for catheterization, were comparable between the two groups (Table-I). Laboratory findings showed no major difference on Day 1; however, by Day 5, the non-coated catheter group had significantly higher mean pus cell counts and a greater frequency of significant pyuria and positive urine cultures compared to the silver-coated group (Table-II). Clinical outcomes also favored the silver-coated catheters. Patients with silver-coated catheters had a significantly lower overall incidence of UTI, symptomatic UTI, fever, and dysuria than patients with non-coated catheters. (Table-III). Stratified analyses demonstrated consistent trends, with lower UTI rates in the silver-coated catheter group across both age categories and genders, confirming the protective effect of silver coating (Table-IV).

TABLE-I

Baseline characteristics of participants

Variable	Silver-Coated Catheter (n=33)	Non-Coated Catheter (n=33)
Age (years), Mean ± SD	52.4 ± 13.6	54.1 ± 14.2
Gender		
Male	21 (63.6%)	20 (60.6%)
Female	12 (36.4%)	13 (39.4%)
BMI (kg/m²), Mean ± SD	26.1 ± 3.8	26.7 ± 4.1
Indication for Catheterization		
Post-operative monitoring	18 (54.5%)	19 (57.6%)
Urinary retention	10 (30.3%)	9 (27.3%)
Severe illness requiring output charting	5 (15.2%)	5 (15.2%)

TABLE-II

Comparison of laboratory findings compared on Day 1 and Day 5.

Parameter	Silver-Coated Catheter (n=33)	Non-Coated Catheter (n=33)
Day 1 Pus Cells (Mean ± SD)	3.8 ± 2.1	4.1 ± 2.4
Day 5 Pus Cells (Mean ± SD)	9.6 ± 6.5	17.8 ± 9.4
Day 5 Significant Pyuria (>10/HPF)	9 (27.3%)	19 (57.6%)
Day 5 Positive Urine Culture (≥10⁵ CFU/mL)	7 (21.2%)	20 (60.6%)

TABLE-III

Comparison of outcomes-associated urinary tract infections between the two study groups.

Outcome	Silver-Coated Catheter (n=33)	Non-Coated Catheter (n=33)	P-Value
Incidence of UTI (overall)	7 (21.2%)	20 (60.6%)	0.001
Symptomatic UTI	6 (18.2%)	18 (54.5%)	0.002
Fever (>38°C)	4 (12.1%)	11 (33.3%)	0.03
Dysuria	5 (15.2%)	14 (42.4%)	0.01

TABLE-IV

Stratification of urinary tract infection incidence by age and gender among patients using silver-coated versus non-coated urinary catheters

Stratification for Age

Age Group	UTI in Silver-Coated	UTI in non-coated	p-value
18–50 years	2/15 (13.3%)	9/16 (56.3%)	0.01
>50 years	5/18 (27.8%)	11/17 (64.7%)	0.02

Stratification by Gender

Gender	UTI in Silver-Coated	UTI in non-coated	p-value
Male	4/21 (19.0%)	12/20 (60.0%)	0.004
Female	3/12 (25.0%)	8/13 (61.5%)	0.03

DISCUSSION

Silver-alloy catheters with latex were also linked to laboratory and clinical findings and clinical symptoms of catheter-associated urinary tract infection (CAUTI) which were significantly lower in the silver-alloy-coated group than in the standard non-coated latex catheters.[8-10] Day-5 pus cell counts, significant pyuria, and positive urine cultures along with rates of symptomatic UTI were all significantly lower in the silver-alloy-coated group as compared with the standard non-coated latex catheters. Findings that align with several recent clinical studies and systematic reviews showing a reduction in bacteriuria, and in some settings, CAUTI when antimicrobial or noble-metal coatings are used.[11] Mechanistically, silver and noble-metal coatings act through multiple antimicrobial pathways (release of metal ions, disruption of microbial membranes, and altered surface properties that reduce adhesion). Hydrogel-silver alloy coatings and noble metal alloy (silver/gold/palladium) surfaces also improve surface hydrophilicity and reduce biofilm formation, which likely explains the lower colonization and subsequent infection seen with coated devices in short-term catheterization. Recent laboratory and engineering studies support this anti-adhesive and bactericidal action and show promising reductions in biofilm formation with dual-layer or nanoengineered coatings.[12] Clinical evidence over the past five years, while mixed in quality and setting, generally supports a benefit in bacteriuria reduction and—in multiple trials—a clinically meaningful reduction in CAUTI. A large multicenter randomized study of a

noble metal alloy (NMA)–coated Folleys catheter reported a ~60–70% relative reduction in bacteriuria and CAUTI incidence compared with uncoated catheters, particularly for short to medium term use.[13] Smaller randomized and controlled observational studies across critical care, spinal cord injury, and general surgical populations have reported consistent reductions in microbiological markers and symptomatic infection in favor of silver or noble metal coated devices.[14] A recent trial of a silver alloy hydrogel (SAH) catheter in critically ill patients showed reduced colonization and suggested lower infection rates, though heterogeneity in patient populations and endpoints remains an issue.[15] However, not all contemporary studies show a clear clinical benefit, and some real-world evaluations have found no statistically significant difference in CAUTI rates-especially in heterogeneous or long-term catheterized cohorts highlighting the importance of patient selection, catheter dwell time, and infection surveillance definitions.[16] Systematic reviews and meta-analyses published in the last five years conclude that noble-metal and silver-alloy coatings reduce bacteriuria during short term catheterization, but the evidence for reducing symptomatic CAUTI is less consistent and sometimes downgraded because of study heterogeneity, small sample sizes, and varying outcome definitions.[17] Our results showing both microbiological and symptomatic reductions-therefore add valuable RCT evidence supporting a protective effect of silver-coated catheters in the short term. Cost and antimicrobial resistance considerations are important. Coated catheters typically cost more than standard catheters, and economic evaluations have produced varied results depending on baseline CAUTI rates, device price difference, and downstream costs of UTI management. Some analyses have found that in high-risk settings (e.g., neurosurgical or spinal cord injury units, critically ill populations) the reduction in infections can offset the higher device cost.[18] Regarding resistance, current evidence does not show clinically important selection of silver-resistant pathogens from short-term catheter use, but surveillance and stewardship are prudent as usage expands; laboratory data show complexity in microbial responses and biofilm adaptation that merit monitoring.[19]

Strengths of this study include randomized allocation, predefined microbiological endpoints (pyuria and ≥10^5 CFU/mL), and parallel assessment of both laboratory and clinical outcomes. These features make the findings robust and directly comparable to many modern trials. Limitations include modest sample size and single-center conduct. Additionally, exclusion of diabetics and neurogenic bladder patients while improving internal validity means results may not apply to these high-risk groups.

CONCLUSION

Silver-alloy coated urinary catheters effectively reduced early bacteriuria and CAUTI compared with non-coated catheters in short term use. Their adoption may strengthen infection prevention strategies in hospitalized patients. This trial adds to a growing body of evidence that silver alloy coated urinary catheters reduce microbial colonization and were associated with lower symptomatic CAUTI in short-term use. While not a substitute for strict aseptic technique and catheter-care protocols, coated catheters are a valuable additional tool especially in high-risk short-term catheterized populations and should be further evaluated in larger, cost-aware clinical trials

CONFLICT OF INTEREST

The authors declare no conflict of interest.

SOURCE OF FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

REFERENCES

1. Oumer Y, Dadi BR, Seid M, Biresaw G, Manilal A. **Catheter-associated urinary tract infection: Incidence, associated factors and drug resistance patterns of bacterial isolates in southern Ethiopia.** Infect Drug Resist. 2021; 14:2883-94.
2. Singh R, Hokenstad ED, Wiest SR, Kim-Fine S, Weaver AL, McGree ME, et al. **Randomized controlled trial of silver-alloy-impregnated suprapubic catheters versus standard suprapubic catheters in assessing urinary tract infection rates in urogynecology patients.** Int Urogynecol J. 2019; 30:779-87.
3. Vaitkus S, Simoes-Torigoe R, Wong N, Morris K, Spada FE, Alagiri M, et al. **A comparative study of experimental urinary catheters containing silver and zinc for biofilm inhibition.** J Biomater Appl. 2021; 35:1071-81.

4. Ardehali SH, Sedaghatmanesh M, Fatemi A. **The role of Foley catheter coated with gold, silver, and palladium in decreasing urinary tract infections in the intensive care unit; a letter to editor.** Arch Acad Emerg Med. 2019; 7:e40.
5. Vallabha T, Ammanna H, Sindgikar V, Kullolli G, Saha A**. Non-randomized clinical trial of in-house silver-coated Foley's catheter reduces urinary tract infections—a low-cost innovation.** Indian J Surg. 2022; 84:818-23.
6. Karchmer TB, Giannetta ET, Muto CA, Strain BA, Farr BM. **A randomized crossover study of silver-coated urinary catheters in hospitalized patients.** Arch Intern Med. 2000; 160:3294-8.
7. Roberts KB, Wald ER. **The diagnosis of UTI: Colony count criteria revisited.** Pediatrics. 2018; 141:e20173239.
8. Stoffel JT, Yu L. **Urinary catheters.** Urol Clin North Am. 2024; 51(2):253.
9. So B, Kim J, Jo JK, So H. **Recent developments in preventing catheter-related infections based on biofilms: A comprehensive review.** Biomicrofluidics. 2024; 18(5):051506.
10. Duque-Sanchez L, Qu Y, Voelcker NH, Thissen H. **Tackling catheter-associated urinary tract infections with next-generation antimicrobial technologies.** J Biomed Mater Res A. 2024; 112(3):312-35.
11. Kai-Larsen Y, Grass S, Mody B, Upadhayay S, Trivedi HL, Pal DK, et al. **Foley catheter with noble metal alloy coating for preventing catheter-associated urinary tract infections: A large, multi-center clinical trial.** Antimicrob Resist Infect Control. 2021; 10:40.
12. Gauhar V, Castellani D, Teoh JY, Nedbal C, Chiacchio G, Gabrielson AT, et al. **Catheter-associated urinary infections and consequences of using coated versus non-coated urethral catheters—outcomes of a systematic review and meta-analysis of randomized trials.** J Clin Med. 2022; 11(15):4463.
13. Wang H, Chediak JA, Belmont JP Jr, Saylor DM, Phillips KS. **Preclinical performance testing of medical devices with antimicrobial effects.** Nat Rev Bioeng. 2023; 1(8):589-605.
14. Banaszek D, Inglis T, Ritchie L, Belanger L, Ailon T, Charest-Morin R, et al. **Effectiveness of silver alloy–coated silicone urinary catheters in patients with acute traumatic cervical spinal cord injury: Results of a quality improvement initiative.** J Clin Neurosci. 2020; 78:135-8.
15. Zhao M, Geng S, Zhang L, Fan X, Tong F, Meng X, et al. **Prevention of urinary tract infection using a silver alloy hydrogel-coated catheter in critically ill patients: A single-center prospective randomized controlled study.** J Intensive Med. 2023; 4(1):118-24.
16. Hassan FM, Yusof AM, Cheah S, Kader MNA, Mat WRW, Mokhtar MN. **Catheter-associated urinary tract infection in critically ill patients: A comparative evaluation between latex urinary catheter and metal alloy-coated urinary catheter.** Cureus. 2025; 17(2):e79689.
17. Sun Y, Ren P, Long X. **Role of noble metal-coated catheters for short-term urinary catheterization of adults: A meta-analysis.** PLoS One. 2020; 15(6):e0233215.
18. Ronin D, Felix RB, Williams CM, Mannuel SA, Goeres D, Summers J, et al. **Prevention of biofilms in catheter-associated urinary tract infections (CAUTIs): A review.** In: Antibiofilm Strategies: Current and Future Applications to Prevent, Control and Eradicate Biofilms. 2022 Sep 29:61-97.
19. Andersen MJ, Flores-Mireles AL. **Urinary catheter coating modifications: The race against catheter-associated infections.** Coatings. 2019; 10(1):23.

AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Muhammad Imran Afzal:** Data collection, manuscript writing.
2	**Syed Atif Hussain:** Methodology.
3	**Shafi Ghauri:** Data analysis.
4	**M. Saddiq Haris:** Data interpretation.
5	**Shayan Rahim Kanjoo:** Drafting.
6	**Muhammad Zohaib Fazal:** Data entry.