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Journal Policies

Insight Urology is the official journal of the Thai Urological Association under Royal Patronage. We accept submissions on interesting urological topics from physicians and all medical providers. The topics must not have been previously published.

Objectives

1. To enhance medical research in urology
2. To instigate academic discussions in urology
3. To distribute dedicated works and research in urology

Our experts and native English speakers will review all chosen topics. All of the content and opinions in this journal belong solely to the authors, and do not express the opinions of the editors or the Thai Urological Association under the Royal Patronage.

Owner The Thai Urological Association under the Royal Patronage (TUA)

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Date of Issue Semi-annually (June and December)

Editorial

The eleventh issue of *Insight Urology* (ISU) was published online in December 2025. It comprises seven original articles, one review article, and two case reports. It covers several fields of urology, such as oncologic urology, endourology, pediatric urology, and functional urology.

One review article was submitted by a renowned international author, namely **"Robotic urologic reconstruction: preservation of open principles and expansion of possibilities."** We are confident that you will enjoy reading and applying the knowledge in these articles to your present urological work, especially when treating reconstructive patients, and performing bladder neck reconstruction and urethroplasty.

The front cover of this issue features photographs of the 25th Asia-Pacific Association of Pediatric Urologist (APAPU) Annual Congress 2025 in conjunction with the 12th Thai Urological Association under the Royal Patronage (TUA) Refreshing Course 2025 in the main theme of **"The New Path of Collaboration and Urological Care for Children"** during October 2-4, 2025 in Eastin Grand Hotel Sathorn, Bangkok, Thailand. The meeting was very successful and warmly welcomed many participants across Asia-Pacific region.

Professor C.R. Huang (China), K. Terashima (Japan), D. Dator (Philippines), H. Choi (Korea), and C.K. Yeung (Hong Kong) discussed the founding of the APAPU at the Asia-Pacific Association of Pediatric Surgery (AAUS) meeting in China on September 29, 1998. The first logo of APAPU was illustrated by Professor D. Dator in January, 1999. The 1st Congress of APAPU was held in Beijing, China from May 7-9, 1999. In 2006, professor S. Tanikaze (Japan) became the first President of APAPU and APAPU had been managed by the president since then and the Thai Society for Pediatric Urology (TSPU) joined the APAPU in 2022.

The Editorial Board of ISU hopes that the cover of this issue represents the importance of international collaboration with our regional urological colleagues and societies to promote our communities in terms of clinical practice, education, and research, following a lovely quote of Winnie the Pooh **"A day without a friend is like a pot without a single drop of honey left inside."**

No reserve. No retreat. No regret.

Assoc. Prof. Phitsanu Mahawong, M.D.
Editor in Chief of Insight Urology

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Factors associated with successful clean intermittent catheterization in children with neurogenic lower urinary tract dysfunction

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Keywords:
Clean intermittent catheterization, neurogenic lower urinary tract dysfunction, urodynamic study

Abstract

Objective: Clean intermittent catheterization (CIC) is the standard treatment for children with neurogenic lower urinary tract dysfunction (NLUTD). Despite its effectiveness, many patients encounter obstacles such as the affordability of necessary instruments and finding a suitable location for CIC, which can impact treatment outcomes. This research aims to investigate factors associated with successful CIC in children with NLUTD.

Materials and Methods: This is an observational analytical study, focusing on patients under 18 diagnosed with NLUTD through urodynamic studies at our center from 2009 to 2020. Multivariate analyses were conducted to identify factors associated with successful CIC and prevalence of UTI in children with NLUTD.

Results: Between 2009 and 2020, 233 patients were recruited onto the study. Of these, CIC was successfully achieved in 148 (63.5%) cases. The effectiveness of performing CIC was high at 93.2%, with a cooperation rate of 94.6% in the unsuccessful group, numbering 85, 71 patients (83.5%) experienced UTI, with the mean occurring approximately 8 months after the diagnosis of neurologic bladder dysfunction. Multivariate analysis revealed that the ability to perform CIC effectively (OR 5.679; 95%CI 2.423-13.311) is an independent factor associated with successful outcomes. However, no significant differences were found between the successful and unsuccessful CIC groups regarding cooperation, socioeconomic status, caregiver, etiology of disease, medication use, number of CIC, school environment, healthcare provider access, and gender.

Conclusion: The ability to perform CIC effectively is the primary factor associated with successful CIC in children diagnosed with NLUTD. Improving the effectiveness of CIC is crucial for the achievement of success treatment of these patients.

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Introduction

Neurogenic lower urinary tract dysfunction represents a diverse group of conditions caused by issues in the central or peripheral nervous systems.[1-5] Treatment may not always be effective with either or both medication or surgery, and in some instances, lifelong catheterization may be necessary. This dysfunction can lead to a range of complications of varying severity, including urinary tract infections, urinary reflux, and kidney failure.[5] Clean intermittent catheterization (CIC), introduced by Lapides et al in 1972[3], is now considered the gold standard for the management of urinary retention in neurogenic bladders to minimize these complications.[1,2]

A recent study by Hentzen et al examined the predictors of success in learning clean intermittent self-catheterization (CISC) among patients over the age of 65. In that study, out of 202 patients, 169 (83.7%) over the age of 65 successfully learned CISC. The findings suggest that the ability to learn CISC is not limited by age but is influenced by factors such as mobility, access to the perineum, and possibly cognitive disorders.[6] Costa et al investigated factors that influence the procedure of CIC, focusing on 55 cases of infants with meningomyelocele. Their research identified several factors that positively affect the catheterization process, including the age of the child, caregivers who do not work outside the home, receipt of continued income benefits, and supplies of catheterization materials from the local or state governments.[7]

Given the limited data on factors associated with successful clean intermittent catheterization in children with neurogenic lower urinary tract dysfunction, we conducted a study to clarify these factors. The results may contribute to improving the management plan for neurogenic lower urinary tract dysfunction in children within Thailand's healthcare framework.

Materials and Methods

Study design and subjects

This observational analytical study included patients under the age of 18 diagnosed with neurogenic lower urinary tract dysfunction by urodynamic studies at the Division of Urology, Department of Surgery, Faculty of Medicine Siriraj Hospital, from 2009 to 2020. Case record forms were collected for analysis. The follow-up schedule varied between three to six months and ultrasonography was routinely performed during each visit. Success in clean intermittent catheterization was evaluated after two years. Success was defined as the absence of urinary tract infections, no change in treatment mode, and no new occurrences of hydronephrosis.

All data were retrospectively collected from medical records. The initial data gathered included age, gender, etiology, medication (anticholinergic drugs), number of times CIC was performed, effectiveness of CIC, patient cooperation, caregiver identity (parent, grandparent, or relative), education level of the caregiver (primary, secondary, bachelor), socioeconomic status, school environment, and access to healthcare providers.

In this study, terms were defined as follows: performed CIC effectively: the patient or caregiver followed the CIC schedule correctly; cooperation: - the patient or caregiver was willing to perform CIC; school limitation: - there was no available space to perform CIC or the caregiver was unable to provide CIC to patient; healthcare provider access limitation: the caregiver was unable to follow hospital appointments or CIC instruments were not affordable or available.

Statistical analysis

Odds ratios (OR) with 95% confidence intervals (CI) were used to assess the association between potential risk factors and successful clean intermittent catheterization in children with neurogenic lower urinary tract dysfunction. An independent t-test was used to compare continuous variables, while the Chi-square or Fisher's exact test was used for analysis of discrete variables. Factors with a p-value less than 0.05 in univariate analysis were subsequently included in a logistic regression analysis. Data analysis was performed using the Statistical Package for Social Sciences (SPSS standard version 20.0; Chicago, Illinois, USA).

Study outcomes

The primary objective of this study was to investigate factors associated with successful clean intermittent catheterization in children with neurogenic lower urinary tract dysfunction. The secondary outcome was to determine the prevalence of urinary tract infections in children diagnosed with this condition.

Ethical approval

This study was approved by the Siriraj Institutional Review Board (SIRB protocol number 635/2565, COA number Si 114/2023). Data collection was authorized by the Medical Statistics Report Unit at the Faculty of Medicine, Siriraj Hospital.

Results

Between 2009 and 2020, 233 patients with NLUTD underwent urodynamic studies at our center. Of these, CIC was successfully achieved in 148 patients (63.5%). In this successful group, the effectiveness of performing CIC was high at 93.2%, and the cooperation rate was also high at 94.6%.

Table 1. Baseline characteristics and clinical outcomes of clean intermittent catheterization in children with neurogenic lower urinary tract dysfunction

Baseline characteristics	All (n=233)	Successful (n=148)	Unsuccessful (n=85)	P-value
Age (years); mean±SD	6.74±0.49	6.99±0.46	6.15±0.52	0.370
Gender; n (%)				
Male	111 (47.6)	67 (45.3)	44 (51.8)	0.413
Female	122 (52.4)	81 (54.7)	41 (48.2)	
Etiology; n (%)				
DESD	14 (6.0)	9 (6.1)	5 (5.9)	0.528
Meningomyelocele	141 (60.5)	92 (62.2)	49 (57.6)	
Kippel-Feil syndrome	2 (0.9)	2 (1.4)	0 (0.0)	
VACTREL	7 (3.0)	2 (1.4)	5 (5.9)	
Hydrocephalus	8 (3.4)	5 (3.4)	3 (3.5)	
Anorectal formation	17 (7.3)	11 (7.4)	6 (7.1)	
Other	44 (18.9)	27 (18.2)	17 (20.0)	
Medication (anticholinergic); n (%)				
No use	78 (33.5)	54 (36.5)	24 (28.2)	0.254
Use	155 (66.5)	94 (63.5)	61 (71.8)	
Number of CIC; mean±SD	3.55±0.144	3.56±0.132	3.75±0.156	0.252
Effective Performance of CIC				0.000
Effective	192 (82.4)	138 (93.2)	54 (63.5)	
Ineffective	41 (17.6)	10 (6.8)	31 (36.5)	
Co-operation; n (%)				
No	29 (12.4)	8 (5.4)	21 (24.7)	0.000
Yes	204 (87.6)	140 (94.6)	64 (75.3)	
Caregiver; n (%)				
Parent	218 (93.6)	137 (92.6)	81 (95.3)	0.207
Grand	14 (6.0)	11 (7.4)	3 (3.5)	
Relative	1 (0.4)	0 (0.0)	1 (1.2)	
Education of caregiver; n (%)				
Primary	102 (43.8)	62 (41.9)	40 (47.1)	0.114
Secondary	124 (53.2)	79 (53.4)	45 (52.9)	
Bachelor	7 (3.0)	7 (4.7)	0 (0.0)	
Socioeconomics (THB)				
< 10k	20 (8.6)	15 (10.1)	5 (5.9)	0.413
10-30k	199 (85.4)	123 (83.1)	76 (89.4)	
30-60k	14 (6)	10 (6.8)	4 (4.7)	
School limitations				
No	180 (77.3)	117 (79.1)	63 (74.1)	0.482
Yes	53 (22.7)	31 (20.9)	22 (25.9)	
Health care provider access limitations				
No	183 (78.5)	119 (80.4)	64 (75.3)	0.454
Yes	50 (21.5)	29 (19.6)	21 (24.7)	

SD = standard deviation, DESD = detrusor external sphincter dyssynergia, CIC = clean intermittent catheterization, OR = odds ratio

Table 2. Multivariate analysis of associated factors with successful clean intermittent catheter in children with neurogenic lower urinary tract dysfunction

Risk factors	All (n=233)	Successful (n=148)	Unsuccessful (n=85)	Adjusted OR (95%CI)	P-value
Perform CIC effectively					
Follow	192 (82.4)	138 (93.2)	54 (63.5)	5.679	< 0.001
Unfollow	41 (17.6)	10 (6.8)	31 (36.5)	(2.423-13.311)	
Co-operation; n (%)					
No	29 (12.4)	8 (5.4)	21 (24.7)	2.416	0.084
Yes	204 (87.6)	140 (94.6)	64 (75.3)	(0.887-6.583)	

OR = odds ratio, CI = confidential interval, CIC = clean intermittent catheterization

In the unsuccessful group, 71 patients (83.5%) experienced UTI, with the average onset of UTI occurring approximately 8 months after being diagnosed with neurologic bladder dysfunction (Table 1).

The multivariate analysis revealed that the ability to perform CIC effectively (OR 5.679; 95%CI 2.423-13.311) is an independent predictor of successful outcomes. However, there were no significant differences between successful and unsuccessful CIC groups in terms of cooperation (94.6% vs. 73.5%, p 0.084), socioeconomic status, caregiver, etiology of disease, medication use (66.5% vs. 71.8%, p 0.254), number of CIC (3.56 vs. 3.75, p 0.252), school environment (20.9% vs. 25.9%, p 0.482), access to healthcare providers (19.6% vs. 24.7%, p 0.454), and gender (54.7% vs. 48.2%, p 0.413) (Table 2).

Discussion

CIC is widely accepted as the cornerstone of conservative management of pediatric NLUTD, with the primary goal of preserving upper urinary tract function and reducing UTI, as emphasized by the EAU/ESPU guidelines.[1]

Previous studies have demonstrated that improper or inconsistent catheterization is strongly associated with increased risk of UTI, highlighting the importance of correct CIC technique rather than catheterization frequency alone.[8]

Therefore, this study focused on the identification of factors that may influence the outcome of CIC, such as age, gender, etiology, medication (anticholinergic drug), number of CICs performed, effectiveness in performing CIC, cooperation, caregiver identity (parent, grandparent, or other relative), caregiver education level (primary, secondary, or bachelor's degree), socioeconomic status, school environment, and access to healthcare providers.

The study revealed that performing CIC effectively and patient cooperation positively influenced the success rate of CIC. This correlation is reflected in the CIC training program, which is individualized by urologists for each patient.

Similar to findings in adult and elderly populations, Hentzen et al. reported that successful catheterization depends primarily on technical ability and physical feasibility rather than age alone, supporting our finding that effective CIC performance is the key of determinant of success.[6]

In the multivariate analysis, only the "accuracy of performing CIC" remained significant, with a confounding effect observed for cooperation. Notably, cooperation with the urologist's schedule of CIC could lead to excellent outcomes, particularly for patients requiring multiple numbers of CIC sessions when complete emptying of residual urine is not achieved. While cooperation initially showed significance, it no longer remained significantly associated with the main outcome when assessed in the multivariate model. A plausible explanation is that effective CIC performance may be considered a subset of cooperation.

No statistically significant differences related to age and gender were found in the univariate analysis, although accessing the perineum in girls appeared to be more challenging. This observation could be attributed to the fact that the majority of CIC procedures were performed by caregivers in patients under twelve years of age.

Environmental factors played a crucial role in the study. For instance, the home environment, including the presence of a sink in the bathroom and accessibility to toilets, can significantly influence the ease of performing CIC. Similarly, the school environment is also noteworthy, as it impacts the availability of space for CIC to

be performed in children or for them to receive help from teachers. Interview data revealed that many caregivers utilize their break time at noon to perform CIC at school.

Although caregiver characteristics and socioeconomic factors have been reported to influence CIC adherence in infants with myelomeningocele, particularly in resource-limited setting, our study did not demonstrate a statistically significant association between these factors and CIC success.[7]

From the background research, access to healthcare providers was identified as a potential factor influencing the success rate of CIC. Concerns arose from the possibility that patients might not have access to appropriate instruments for CIC due to appointment issues, However, interviews revealed that parents often visited local hospitals to obtain the necessary instruments, crucial for successful CIC.

Several limitations hinder the interpretation of our study findings. First, it was a single-center retrospective study without a control group, which may limit the generalizability of the results. Second, the development of CIC skills is challenging within a day-hospital setting, despite these limitations, our study did not find a statistically significant difference in caregiver levels, and some patients had multiple caregivers performing CIC, which could have influenced the outcomes. The final limitation is the inability to comprehensively interpret urodynamic study data due to incomplete records from some patients. These limitations should be considered when interpreting the results of this study.

This study provides data to present to the authorities to facilitate recognition of difficulties in this situation and encourage provision of increased support for our patients by improving knowledge and awareness. The knowledge can be improved through education and guidance from doctors and nurses, while awareness can be raised by informing caregivers about the potential adverse events that may occur if patients or their care givers are unable to perform CIC effectively.

Conclusion

The ability to perform CIC effectively remains a challenge and is the primary factor associated with successful outcomes in children diagnosed with neurogenic lower urinary tract dysfunction. It is also important in reducing the risk of UTIs.

Other factors such as age, gender, etiology of NLUTD, anticholinergic use, number of CIC, cooperation, caregiver, caregiver education level, socioeconomic status, school environment and access to healthcare providers were found to be statistically insignificant in this study. This highlights the importance of focusing on achieving accurate CIC for improved outcomes in this patient population.

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Conflict of Interest

The authors have no conflicts of interest to declare.

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Original Article

Overall detection rate of prostate cancer using MRI/US fusion-guided prostate biopsy in Rajavithi Hospital

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Keywords:
Detection rate, prostate cancer, MRI, ultrasound (US), fusion-guided, prostate biopsy

Abstract

Objective: To study the detection rate of prostate cancer by using targeted MRI/US guided prostate biopsy in Rajavithi Hospital.

Materials and Methods: Patients with elevated PSA levels or abnormal digital rectal examinations who underwent prostate MRI with abnormal lesions (PIRADS ≥ 3) from January 2021 to October 2023 were enrolled onto the study. Patients underwent targeted MRI/US-guided biopsy, followed by a 12-core systematic transrectal ultrasound (TRUS) biopsy. The primary outcome was the overall detection rate of prostate cancer using MRI/US fusion-guided prostate biopsy. Secondary outcomes were the detection rate of prostate cancer in each PIRADS, detection of clinically significant prostate cancer in MRI/US-guided biopsy and complications.

Results: Patients 203 fulfilled the entry criteria and underwent both targeted MRI/US-guided biopsy and TRUS biopsy. The overall detection rate of prostate cancer from targeted MRI/US-guided biopsy was 32.50% which was significantly higher than detection by TRUS biopsy (25.60%, $p < 0.05$). In a subgroup analysis of each of PIRADS 3, 4 and 5, the detection rate was 8.8%, 40.50%, and 50.50%, respectively. MRI/US guided biopsy can more accurately detect clinically significant prostate cancer than TRUS biopsy (75.80% and 69.20%, respectively, OR1.39.95%CI 0.62-3.14, $p = 0.54$) with lower rates of insignificant prostate cancer (24.20% and 30.80%). However, the results did not reach statistical significance. The detection rate of prostate cancer when combining MRI/US fusion guided and TRUS biopsy was more successful than TRUS biopsy alone (38.90% vs. 25.60%, $p < 0.05$) or targeted MRI/US guide biopsy alone (38.90% vs. 32.50% $p < 0.05$). Complications included gross hematuria, fever, urinary retention and hematoma.

Conclusion: Targeted MRI/US-guided biopsy resulted in a higher detection rate of prostate cancer than systematic TRUS biopsy.

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Introduction

Cancer is the leading cause of death globally, and prostate cancer ranks as the second most common type of cancer in men. The mortality rate of prostate cancer can be significantly reduced by screening programs and early detection. The screening program[1] includes the use of prostate-specific antigen (PSA) tests and digital rectal examinations (DRE). While the current gold standard diagnostic procedure for patients suspected of prostate cancer is transrectal ultrasound (TRUS)-guided biopsy, which involves randomly sampling tissue from the entire prostate gland, multiparametric magnetic resonance imaging (mpMRI) of the prostate is now strongly recommended, if available, to improve the screening protocol and potentially reduce the number of men requiring prostate biopsies. Furthermore, in diagnosing prostate cancer, several studies advocate that multiparametric MRI-targeted biopsy can enhance the detection rate of clinically significant cancers and reduce the diagnosis of clinically insignificant prostate cancer. The aim of this study was to evaluate the detection rate of prostate cancer using targeted MRI/US-guided biopsy at Rajavithi Hospital.

Materials and Methods

Study design

This study is a retrospective observational study and was approved by the Ethics Committee of Rajavithi Hospital. Data were collected from the medical records of patients who met the inclusion criteria at Rajavithi Hospital between January 2021 and October 2023.

Adult men with elevated PSA levels or abnormal DRE who underwent prostate MRI and had abnormal lesions identified in the MRI prostate, and who consented to undergo a prostate biopsy, were eligible for enrollment onto the study. Exclusion criteria included the abnormal lesion with a PIRADS score of 2 or less and incomplete medical records.

Data collection included patient demographics, preoperative PSA levels, MRI findings, indications for biopsy, pathological reports, length of stay, and postoperative complications during admission.

Imaging

All patients underwent MRI of the prostate with T2-weighted, contrast-enhanced, and diffusion-weighted series, which were reviewed and targeted for lesions by one of two radiologists. MRI lesions were reported using the Prostate Imaging Reporting and Data System (PIRADS) score version 2.1[2] and were contoured using Symphony Dx-Lite software. Patients with a PI-RADS score of 3 or higher were scheduled for a prostate biopsy.

Prostate biopsy protocol

All patients due for pre-operative protocol were admitted to hospital 24 hours before surgery and received prophylactic antibiotics 30 minutes before surgery. Prostate MRI imaging with lesion contouring was integrated into the ultrasound (BK5000, BK medical).

During the biopsy procedure, either a urologist or a urology resident performed the procedure under general anesthesia. The prostate gland was identified using an ultrasound probe, employing a biplane transducer for transperineal biopsy and a triplane transducer for transrectal biopsy, guided by software provided by BK fusion. Biopsies were conducted using an 18-gauge biopsy gun. All patients underwent 12-core systematic TRUS biopsy followed by targeted MRI/US-guided biopsy.

For the postoperative protocol, all patients remained admitted to hospital for at least 24 hours for observation of any postoperative complications and were prescribed oral antibiotics for five days. Biopsy pathological results were reported by a pathologist.

Outcome

The primary outcome was the overall detection rate of prostate cancer using targeted MRI/US-guided biopsy. The secondary outcomes included the detection of prostate cancer in each PIRADS category, the detection of clinically significant prostate cancer in MRI/US-guided biopsy compared to TRUS-guided biopsy of the prostate, and complications.

Insignificant or very low-risk prostate cancer was as defined by Epstein and colleagues[3-5] as clinical stage T1c, biopsy Grade Group 1, the presence of disease in fewer than 3 biopsy cores, ≤ 50% prostate cancer involvement in any core, and PSA density.

Statistical analysis

The data in this study were analyzed using IBM SPSS software. A p-value of ≤ 0.05 was considered significant. Qualitative data are reported as percentages and numbers, while quantitative data are reported as mean, median, minimum-maximum range, and standard deviation (SD).

Comparisons of data between groups were made using Pearson Chi-square, Continuity correction, Likelihood ratio, Fisher's exact test, and Linear-by-linear association analyses.[6]

Results

A total of 208 men were enrolled in the study. After excluding patients who did not fulfil the criteria, 203 men were included. The mean age was 69.77 years, and the mean pre-operative PSA level was 14.07 ng/ml.

The majority (90.65%) of men in this study underwent targeted MRI/US-guided biopsy using a transperineal approach, while the remaining 9.35% underwent the procedure via a transrectal approach.

The mean length of stay was 3 days, with a minimum of 3 days and a maximum of 6 days, as depicted in Table 1.

The targeted MRI/US fusion-guided biopsy resulted in a cancer detection rate of 32.50% with a significantly higher detection rate than the systematic TRUS biopsy, with rates of 32.50% and 25.60%, respectively ($p < 0.05$), as indicated in Table 2. The sensitivity and specificity of the MRI/US fusion biopsy were found to be 75.00% and 82.00%, respectively.

Table 1. Patient characteristics

	Sample size (n=203)
Age, mean (SD), y	69.77 (7.078)
Pre-operative PSA, mean, ng/ml	14.05 (14.13)
Abnormal DRE, n (%)	37 (18.22)
Score on PIRADS, n (%)	
3	68 (33.50)
4	79 (38.90)
5	56 (27.60)
Approach	
Transperineal, n (%)	184 (90.65)
Transrectal, n (%)	19 (9.35)
Length of stay, mean (SD), day	3 (0.502)

SD = standard deviation, PSA = prostate specific antigen, DRE = digital rectal examination

Patients were categorized based on abnormal lesions in prostate MRI as PIRADS 3, 4, and 5, constituting 33.49%, 36.94%, and 27.60%, respectively. Subgroup analysis for PIRAD3, 4, and 5 revealed cancer detection rates of 8.80%, 40.50%, and 50.50%, respectively, demonstrating a trend of higher PIRADS scores correlating with higher detection rates, as illustrated in Table 3.

When combining MRI/US fusion-guided biopsy with systematic TRUS biopsy, the detection rate of cancer surpasses that of systematic TRUS biopsy alone (38.90% vs. 25.60%, $p < 0.05$) and MRI/US fusion-guided biopsy alone (38.90% vs. 32.50%, $p < 0.05$).

There were no patients with positive findings in either TRUS or MRI alone but negative findings when combined.

Table 2. Cancer detection rates

	Benign n (%)	Cancer n (%)	P-value
Systematic TRUS biopsy	151 (74.40)	52 (25.60)	< 0.05
Targeted MRI/US guided biopsy	137 (67.50)	66 (32.50)	

TRUS = transrectal ultrasound, MRI/US = magnetic resonance imaging/ultrasound

Table 3. Patient categorized base on PIRADS

		PIRADS n (%)			Total
		PIRADS3	PIRADS4	PIRADS5	
Count		68 (33.49)	79 (38.94)	56 (27.60)	203 (100.00)
Targeted MRI/US guided biopsy	Benign	62 (91.20)	47 (59.50)	28 (49.50)	137 (67.50)
	Prostate cancer	6 (8.80)	32 (40.50)	28 (50.50)	66 (32.50)

MRI/US = magnetic resonance imaging/ultrasound

Table 4. The detection of significant prostate cancer

Group	Targeted MRI/US guided biopsy positive (n) %	Systematic TRUS positive (n) %	P-value
Significant prostate cancer	50 (75.80)	36 (69.20)	0.54
Insignificant prostate cancer	16 (24.20)	16 (30.80)	

Group	Combined positive (n)	Systematic TRUS positive (n)	P-value
Significant prostate cancer	58 (73.40)	36 (69.20)	0.69
Insignificant prostate cancer	21 (26.60)	16 (30.80)	

TRUS = transrectal ultrasound, MRI/US = magnetic resonance imaging/ultrasound

Twenty-seven (13.30%) patients had positive findings on targeted MRI/US fusion-guided biopsy but negative findings on systematic TRUS biopsy. Conversely, thirteen (6.40%) patients had negative findings on targeted MRI/US fusion-guided biopsy but positive findings on systematic TRUS biopsy.

Table 4 shows that for the detection of significant prostate cancer, the targeted MRI/US-guided biopsy method identified more cases in comparison to systematic TRUS biopsy (75.80% vs. 69.20%, OR 1.399, 95%CI 0.62-3.14, p = 0.54), albeit with a lower detection rate of insignificant prostate cancer. Similarly, when comparing the combined technique with systematic TRUS biopsy alone, the results were not statistically significant (73.40% vs. 69.20%, OR 1.22, 95%CI 0.57-2.66, p = 0.69). With regard to insignificant prostate cancer, the detection rate using the combined technique was higher than that of systemic TRUS biopsy, although this difference was not statistically significant (26.60% vs. 30.80%).

The most common complication observed was gross hematuria, affecting 9.30% of patients, all patients showing spontaneous improvement before discharge from the hospital. Other complications were relatively insignificant and included fever (1.47%), urinary retention (0.98%), perineal hematoma (0.49%), and scrotal hematoma (0.49%). Notably, no cases of sepsis, severe infection, or complications related to general anesthesia were detected in this study, as outlined in Table 5.

Table 5. Complications from TRUS and MRI/US guided prostate biopsy

Complication	n (%)
Gross hematuria	19 (9.30)
Fever	3 (1.47)
Urinary retention	2 (0.98)
Perineal hematoma	1 (0.49)
Scrotal hematoma	1 (0.49)

Discussion

Systematic TRUS biopsy has traditionally been considered the gold standard for a diagnosis of prostate cancer, with a positive biopsy rate of approximately 60%. However, with the emergence of mpMRI of the prostate, which provides both anatomical and functional information, there has been a growing recognition of its utility in diagnosis.

In this study the overall detection rate of prostate cancer by targeted MRI/US fusion-guided higher than the systematic TRUS biopsy has been identified, moreover, results from the multicenter randomized noninferior trial, PRECISION[7,8], have shown that targeted MRI/US-guided biopsy detects more clinically significant cancer than systematic TRUS biopsy (38% vs. 26%, respectively). Our study yielded similar results, with detection rates of 75.80% and 69.20% for targeted MRI/US-guided biopsy and systematic TRUS biopsy, respectively, although the results were not statistically significant (p = 0.532). Additionally, the incidence of insignificant prostate cancer was lower in targeted MRI/US-guided biopsy compared to systematic TRUS

biopsy (24.20% vs. 30.90%, respectively). Our findings suggest that targeted MRI/US-guided biopsy is effective in the detection of prostate cancer and reduces the diagnosis of insignificant cancer.[9] Furthermore, when combining both techniques, there was a higher detection rate of prostate cancer compared to targeted MRI/US-guided biopsy or TRUS alone.[10-12] In the subgroup analysis of this study, we observed that higher PI-RADS scores were associated with higher detection rates, results consistent with findings from a prospective validation study by Hofbauer et al. in 2018.

From a systematic review of complications associated with prostate biopsy, it is evident that common complications[13] include bleeding (hematuria, hematospermia, rectal bleeding), fever, and urinary retention. Gross hematuria, as observed in our study, has been identified as the most common complication in several studies. All patients in our study underwent both targeted MRI/US-guided biopsy and systematic TRUS biopsy, leading to an increased number of biopsy cores and potentially, consequentially, more bleeding. All of the patients with hematoma were identified and were under observeationin the hospital; fifteen patients showed spontaneous improvement, while four patients were treated with continuous bladder irrigation without the need for surgical intervention. Postoperative fever was observed in three patients, all of whom were given antibiotics. No pathological organisms were isolated from urine cultures or blood cultures, despite compelling evidence of urinary tract infection. It is also noteworthy that no serious complications such as sepsis or readmission were observed.

Despite the valuable insights gained from our study, several limitations need be acknowledged. Firstly, the analysis was retrospective, which may introduce patient bias. Secondly, we included mpMRI of the prostate from external sources, utilizing both 1.5-Tesla and 3.0-Tesla mpMRI machines. However, all suspected lesions were reviewed by only two radiologists who were experts in prostate MRI before scheduling the biopsy. Thirdly, there is potential bias in the biopsy procedures as they were performed by different urologists which could impact the biopsy result. Lastly, while the data were corrected for complications during the hospital stay, there was no further follow-up conducted beyond this period. These limitations underscore the need for cautious interpretation of our findings and highlight areas for future research.

Conclusion

In men with suspected prostate cancer detected via mpMRI and undergoing biopsy, targeted MRI/US-guided biopsy yielded a higher detection rate of prostate cancer in compareison to systematic TRUS biopsy alone. Additionally, acombination of the techniques of targeted MRI/US-guided biopsy and systematic TRUS biopsy demonstrated an improved detection rate over TRUS biopsy and mpMRI alone. These findings suggest that the combined approach enhances the accuracy of the detection of prostate cancer, highlighting the complementary nature of these diagnostic methods in clinical practice.

Conflict of Interest

The authors wish to affirm that there are no conflicts of interest associated with this study with regard to academic or funding sources

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Original Article

Impact of the position of the distal end of the ureteral stent and stent-related symptoms in patients with indwelling ureteric stent

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Keywords:
Position of ureteral stent, ureteral stent-related symptoms, questionnaires

Abstract

Objective: A ureteral stent is extensively employed to treat various urologic conditions including ureteral obstruction from external compression, stone, or post-urological procedures. Ureteral stent-related symptoms, such as lower urinary tract symptoms (LUTS), hematuria, and pain, have frequently been found in patients with indwelling ureteral stents. The impact of the position of the distal end of the ureteral stent on stent-related symptoms remains controversial.

Materials and Methods: Twenty-five patients with indwelling ureteral stents undergoing ureteral stent replacement or removal were recruited onto the study. A Thai USSQ was completed before stent replacement or removal. The position of the distal end of the ureteral stent was categorized into 2 groups by Fluoroscopic study or X-ray before stent replacement or removal. The relationship between the position of the distal ureteral stent and the USSQ score was analyzed.

Results: The mean USSQ score was 59 (range 28-112). The majority (60%) of participants had a distal ureteral stent that crossed the midline. The mean stent indwelling time was 2.18+/-1.14 months (range 0.5-4 months). The urinary tract symptoms did not differ significantly between the two groups (OR 1.05, 95%CI 0.92-1.2, p = 0.492). There were also no significant differences between the two groups with regard to the USSQ sub-scores for urinary symptoms (p = 0.509), pain (p = 0.957), general health (p = 0.443), working performance (p = 0.770), sexual symptoms (p = 0.716), and additional problems (p = 0.272). In the case of other factors, the female sex was significantly related to hematuria symptoms (IRR 1.90, 95%CI 1.09-3.73, p = 0.026). The cross-midline group also had significantly higher lower abdominal pain (p = 0.041). Patients with stents that did not cross the midline had significantly fewer symptoms of urinary tract infection (p = 0.035), but there was no significant difference in antibiotic use (p = 0.574) between the two groups.

Conclusion: The position of the distal end of the ureteral stent does not affect urinary symptoms. Discussion with the patient about stent placement, procedure, and related symptoms before and after stent placement remains crucial.

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Introduction

A ureteral stent placement is a common urologic procedure.[1,2] This procedure has been frequently employed to treat ureteral obstruction of any cause that leads to renal function deterioration, infection, and uncontrollable pain.[3] Other indications occur after surgical procedure and ureteral operation.[3] The most commonly used design has been a double pigtail design, enabling the stent to be maintained in its position in the upper and lower urinary tract system.[4] However, a ureteral stent may lead to some undesirable symptoms, including flank pain, hematuria, and lower urinary tract symptoms (LUTS), causing discomfort to patients.[1,5] These symptoms are usually treated by anti-cholinergic, alpha receptor blocker, or PDE inhibitor medication.[2,5,6]

In 2003, to objectively assess these symptoms, Joshi et. al. developed questionnaires known as Ureteral Stent Symptom Questionnaires (USSQ).[1] This questionnaire analyzed the effect of stent-related symptoms on multiple domains, including urinary tract symptoms, pain, general health, working performance, and sexual health. Recently, this questionnaire has been translated into multiple languages[2,7], including Thai.

The effect of the position of the distal end of the ureteral stent and stent-related symptoms remains controversial. In 2011, Giannarini et al. published a study that showed a significant relationship between the position of the ureteral stent and ureteral stent-related symptoms. The position of a distal ureteral stent that crossed the midline of the urinary bladder had a significant effect on urinary symptoms, pain, general health, working performance, and sexual symptoms.[8] The results of other studies have shown the same finding.[8-10] However, in 2009, Lingeman et. al. reported that the position of the distal ureteral stent does not affect ureteral stent-related symptoms.[5] Other studies also showed that the position of a distal ureteral stent that crosses the midline of the urinary bladder significantly affects urinary symptoms.[2]

In 2022, the Thai version of USSQ was developed and validated. This version of USSQ is now waiting for publication.

In this study, we hypothesized that the position of the distal ureteral stent that did not cross the midline of the urinary bladder did not significantly affect urinary symptoms. The aim of the study was to assess the effects of distal ureteral stent position on ureteral stent-related symptoms using the Thai version of the USSQ.

Materials and Methods

The study was conducted in line with the guidance of The Declaration of Helsinki and was reviewed and approved by the Institutional Review Board (IRB) of King Chulalongkorn Memorial Hospital (IRB No.105/65).

Between February 2023 and December 2023, patients with an indwelled ureteral catheter, were aged 18-80 years, and able to communicate and read Thai at King Chulalongkorn Memorial Hospital were recruited. By reviewing medical records, patients with LUTS (lower urinary tract symptoms) or alpha receptor blocker or anti-cholinergic medication, or had incomplete USSQ, were excluded from the study.

The baseline data was obtained by reviewing medical records. This data included sex, weight, height, cause of ureteral stent placement, type, size, and length of ureteral stent, underlying diseases, underlying LUTS and medications.

The ureteral stent of choice, including Percuflex Plus (Boston Scientific, Natick, MA, USA), Universa (COOK Medical, Bloomington, IN, USA), and Inlay Optima (BD, Franklin Lake, NJ, USA), was determined by the surgeon. The size, ranging from 4.7 Fr to 7 Fr, the length of the ureteral stent, ranging from 14 cm, 24 cm, 26 cm, and the multi-length ureteral stent (22-32 cm), were all determined by the surgeon (Diagram 1).

Before ureteral stent replacement or removal, the participants were asked to complete a Thai USSQ questionnaire. Intravesical stent position was determined by X-ray or fluoroscopy before stent replacement or removal. Participants were divided into two groups, based on the position of the intravesical stent as shown in Fig. 1 and 2.

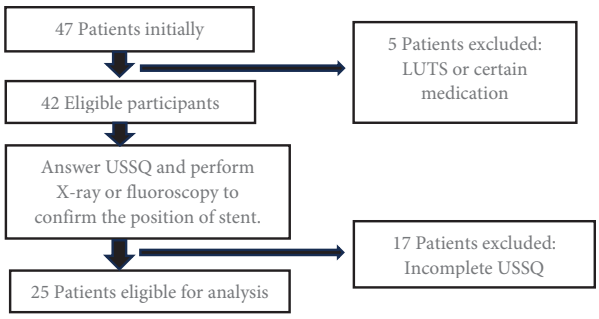

Diagram 1. Study protocol

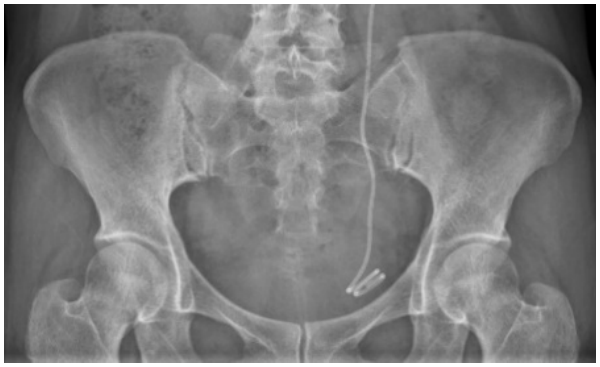

Figure 1. Position of ureteral stent considered not crossing the bladder midline.

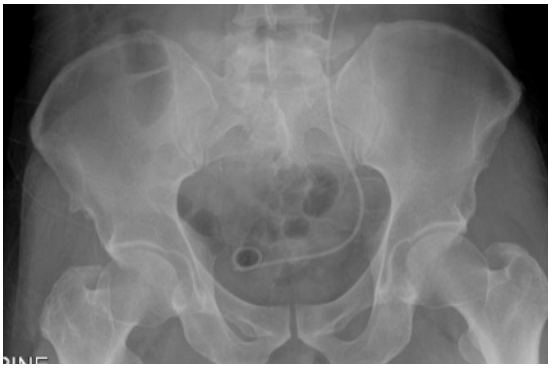

Figure 2. Position of ureteral stent considered to crossing the bladder midline.

If part or a complete loop of distal ureteral stent crossed a straight imaginary line at the pubic symphysis, it was considered to cross the midline (Fig. 2).

Categorial variables were reported as numbers and percentages. Continuous variables were reported as mean, SD. Variables were analyzed using Independent T-test and Univariate logistic regression. A significance level of 0.05 was applied. Data analysis was carried out using SPSS 29.0.1 (IBM SPSS, Chicago, IL USA).

Results

47 patients were initially enrolled onto this study. Five patients were excluded due to having underlying LUTS or were taking specific medications (three patients were taking alpha-blockers due to stent-related symptoms, and two patients alpha-blockers due to underlying LUTS). Seventeen patients were also excluded due to incomplete questionnaires. In total, 25 patients were eligible for analysis. During the study, no stent displacement or malposition was reported.

Demographic data and position of distal end of ureteral stent

72% (n = 18) of participants were female, while 28% (n = 7) were male. The most common cause of ureteral stent placement was external compression from tumor (40%, n = 10), followed by ureteral calculi (36%, n = 9), ureteral stricture (20%, n = 5), and post-kidney transplantation (4%, n = 1). The mean duration of stent indwelling time was 2.68±1.14 months (range 0.5-4 months). There was no difference between the two groups with regard to demographic data and stent indwelling time before replacement or removal. The most common type of stent used was Percuflex Plus (6 Fr, 26 cm) (56%, n = 14). Proportion employed was 60% (n = 15) with 40% (n = 10) being unemployed or retired. 9 (36%) of the patients had a history of previous pelvic radiation, and all of these were female (Table 1).

Of the enrolled patients, 60% (n = 15) had a distal ureteral stent that crossed the midline, while 40% (n = 10) did not (Table 1).

Table 1. Demographic data

Sex, n (%)	
Male	18 (72)
Female	7 (28)
Age (year) SD	54.28±11.65
Height (meter) SD	1.57±0.15
Cause, n (%)	
External ureteral compression	10 (40)
Ureteral stone (treatment or obstruction)	9 (36)
Ureteral stricture	5 (20)
Post kidney transplantation	1 (4)
Stent indwelling duration (months) SD	2.68±1.14
Stent type, n (%)	
Percuflex plus	14 (56)
Inlay optima	8 (32)
Universa	3 (12)
Working status, n (%)	
Employed	15 (60)
Unemployed	5 (20)
Retired due to age	4 (16)
Retired due to health issues	1 (4)
History of previous pelvic radiation n (%)	9 (36)
Position of the distal end of ureteral stent, n (%)	
Cross the midline	15 (60)
Not cross the midline	10 (40)

SD = standard deviation

There was no significant difference between the two groups in terms of demographic data, duration of stent indwelling time, stent size (French, Fr), and length (cm) (Table 2).

USSQ Subscore analysis

The median total USSQ Score was 59 (range 28-112). There was no significant difference in total USSQ score between the two groups (OR 1.05, 95%CI 0.2-1.20, p = 0.492). Concerning the USSQ sub-scores, there were no significant differences between the two groups in the section pertinent to urinary symptoms (represented by U, p = 0.509), pain (P, p = 0.957), general health (G, p = 0.443), working performance (W, p = 0.770), sexual matters (S, p = 0.716), and additional problems (A, p = 0.272) (Table 2).

Each item of the USSQ subscore was analyzed. There were no significantly higher scores in the cross-midline group including urinary frequency (represented by U1, p = 0.738), nocturia (U2, p = 0.943), urgency (U3, p = 0.620), urgency incontinence (U4, p = 0.371), hematuria (U8, p = 0.071), pain during urination (P6, p = 0), and bothersome of pain (P9, p = 0.566). There was no significant difference in the pain in the kidney area between the two groups (P7, p = 0.812). (Table 3) There was a significant relationship between being female and symptoms of hematuria (U8, p = 0.026). There were no significant correlations between other parameters and urinary tract symptoms.

60% (n = 15) of participants experienced pain, with 73% (n = 11) reporting flank pain. Flank pain did not differ significantly between the two groups (p = 0.601). The mean pain score was 4.63 (range 0-10). Only 26.7% of patients (n = 4) had lower abdominal pain, all of these had distal ureteral stent crossing the midline. The cross-midline group experienced significantly

Table 2. Comparison between 2 groups

Demographic data	Crossing-midline group (n=15)	Not crossing-midline group (n=10)	P-value
Age years±SD	55.93±10.46	55.93±10.46	0.396
Weight (kg)±SD	61.65±13.90	60.02±13.74	0.776
Height (meter)±SD	1.54±0.18	1.60±0.07	0.396
Duration (months)±SD	2.60±1.23	2.80±1.06	0.678
Stent size (Fr)±SD	5.84±0.68	5.86±0.38	0.935
Stent length (cm)±SD	25.80±0.63	26.57±2.51	0.454

SD = standard deviation

Table 3. Ureteral Stent Symptom Questionnaires subscore analysis

Subscore n±SD	Crossing midline	Not crossing midline	P-value
Urinary symptoms	26.87±6.84 (14-39)	25.10±5.78 (18-35)	0.509
Pain	7.47±7.25 (0-20)	7.30±8.06 (0-24)	
	12.33±5.50 (6-26)	10.80±3.49 (8-17)	0.957
General health	4.8±3.55 (0-10)	5.30±4.92 (0-12)	0.443
Working performance	1.27±0.46 (1-2)	1.20±0.42 (1-2)	0.770
Sexual matters	9.67±2.53 (7-15)	8.60±1.96 (5-12)	0.716
Additional problems	9.67±2.53 (7-15)	8.60±1.96 (5-12)	0.272

higher levels of lower abdominal pain (p 0.041) (Table 4). Other pain symptom parameters (P6, P7, P9) did not different significantly between the two groups (Table 5).

In terms of the general health domain, there was no difference between the two groups in terms of light activity (G1, p = 0.174), and heavy activity (G2, p = 0.416) (Table 3). The position of the stent also did not significantly affect working performance. Between the two groups, the days off from work after stent insertion or replacement did not differ significantly (W2 p = 0.051, W3 p = 0.529). With regard to sexual matters, all of the participants (100%, n = 25) were already sexually inactive before stent placement, and their reasons were not related to stent placement.

Discussion

The ureteral stent has been widely used to treat multiple urological problems. Even with its undoubted benefits, an indwelling stent usually leads to undesirable symptoms, such as LUTS, hematuria, dysuria, abdomen, and flank pain.[1,2,5] Since the development of the USSQ (Ureteral stent symptom questionnaires) in 20031, the morbidity of the ureteral stent has been more clearly defined.

With regard to the overall and sub-score, there were no significant differences between the two groups. These results did not differ from the studies by Abt et. al.[2] and Lingeman et. al.[5] as both studies reported that all domains in the USSQ did not significantly differ.

Table 4. Ureteral Stent Symptom Questionnaires subscore analysis

Subscore n±SD	Crossing midline	Not crossing midline	P-value
U1 (Urinary frequency, range 1-5)	2.73±1.03 (1-5)	2.60±0.84 (1-4)	0.738
U2 (Nocturia, range 1-5)	3.53±0.83 (2-5)	3.5±1.27 (2-5)	0.943
U3 (Urinary urgency, range 1-5)	2.73±1.16 (1-5)	3.00±1.49 (1-5)	0.620
U4 (Urge incontinence, range 1-5)	1.80±0.86 (1-4)	1.50±0.71 (1-3)	0.371
U8 (Urinary incontinence, range 1-5)	1.87±1.25 (1-5)	1.2±0.42 (1-2)	0.071
P6 (Pain or discomfort during voiding, range 1-5)	1.33±1.45 (0-5)	1.20±1.14 (0-4)	0.809
P7 (Hematuria, range 1-5)	0.80±0.77 (0-2)	0.90±0.88 (0-2)	0.767
P9 (Flank pain during voiding, range 1-2)	1.4±1.45 (0-4)	1.40±1.78 (0-5)	1.000
G1 (Discomfort during light activity, range 1-5)	1.60±0.83 (1-4)	1.20±0.42 (1-2)	0.174
G2 (Discomfort during sternous activity, range 1-5)	2.07±1.1 (1-4)	1.70±1.06 (1-4)	0.416
W2 (Time spend on bed, days)	0.67±1.98 (0-3)	0.10±0.32 (0-1)	0.051
W3 (Decrease activity after stenting, days)	0.8±1.37 (0-5)	1.30±2.54 (0-5)	0.529
A1 (UTI-liked symptoms)	2±1 (1-5)	1.20±0.63 (1-3)	0.035*
A2 (ATB use)	1.67±0.62 (1-3)	1.70±0.48 (1-2)	0.887
GQ	3.67±1.76	3.700±2	0.965

Table 5. Pain score and pain location

Subscore	Crossing midline	Not crossing midline	P-value
P2 (Flank pain)	n = 6	n = 5	0.622
P3 (Pain score) n ± SD	1.8±2.57	2.4±3.06	0.601
P2 (Lower abdominal pain)	n = 4	n = 0	0.041*
P3 (Pain score) n ± SD	1.2±2.48	0+/-0	N/A

SD = standard deviation

The pathophysiology of ureteral stent-related symptoms was divided into two areas, the first part concerning trigonal area irritation near the distal end of the ureteral stent. Since the trigonal area has the highest density of sensorium nerve ending in the urinary bladder[11], one could assume that the longer the distal end of the ureteral stent, the greater the irritation leading to higher stent-related symptoms. This may explain our finding as to why the patients who had a distal end of the ureteral stent that crossed the midline of the urinary bladder had significantly higher lower abdominal pain, a finding also in line with other studies.[8,9,12,13] However, those studies[8,9,12,13] showed other parameters associated with LUTS, such as urinary frequency (U1), urgency (U3), urgency incontinence (U4), and dysuria (U7) to be significantly higher in crossed midline groups, while ours showed no difference. Other factors, such as differences in bladder sensitivity and pain tolerance, might play a role in this situation.

The second explanation was that refluxing of urine into the renal pelvis may cause flank or back pain[12-14] In 1991, Mosli showed that reflux happened in the majority of patients who had an indwelling ureteral stent, and reflux was higher during the voiding phase.[14] Since flank pain was the most frequently reported pain symptom, reflux into the renal pelvis was the most likely cause. Nevertheless, there was no difference in flank pain during micturition (P6, P7), findings similar to those previously reported by Abt[2] and Lingeman.[5] In this regard, other factors may play a role in this issue, such as differences in bladder capacity, compliance, and pressure during the micturition phase in each patient.

There was a significant difference in suprapubic pain, patients in the crossing midline group reporting higher levels of this type of pain, supporting the idea that bladder irritation by the distal end of the ureteral stent was the primary cause of the symptoms. However, this symptom was not the most reported flank pain being experienced the most. These findings waere in line with a study by Lingeman[5], and Abt[2] that reported patients experiencing flank pain more frequently than suprapubic pain.

Regarding additional matters, patients who had a distal coil that crossed the midline had significantly higher symptoms of urinary tract infection (A1, p = 0.01). Of 15 patients that had a distal coil crossing the midline, 73% (n = 11) had symptoms of urinary tract infection, while only 10% (n = 1) in the other group had symptoms of urinary tract infection. In terms of antibiotic use, there was no significant difference between the two groups (A2, p = 0.574). Finally, there was no significant difference in overall satisfaction level (GQ)between the two groups (p = 0.965).

A possible explanation of the difference in reported pain may be that reflux can occur in patients with indwelled ureteral stents.[14] Another is that each patient might have a different pain perception. Furthermore, underlying causes, such as prior pelvic radiation and post-renal transplantation, could lead to impaired bladder sensation, which in turn leads to lower levels of suprapubic pain and irritative symptoms.

With regarding to working performance, Giannarini8 reported that the crossed-midline group had a higher score in working performance. Even though our study found no difference, there was a trend toward higher days off after stent placement (W1) in the crossed-midline group. This may be as a consequence of lower abdominal pain (P2, P3), which was higher in the crossed-midline group. Albeit this explanation, since other parameters such as urinary symptoms, pain and discomfort did not differ, other factors, such as waiting time, procedure, or type of stent used might play role in this finding.

In terms of the additional problems domain, the results showed significantly higher UTI-like symptoms in the crossed-midline group. El-

Nahas12 reported that a positive urine culture was related to higher urinary symptoms. However, since our study did not perform a urine culture to confirm infection, these symptoms cannot be judged as infection. Due to stent-related symptoms potentially mimicking UTI symptoms and the lack of urine culture, having UTI-like symptoms could not be entirely attributed to infection. Also, as we found that both groups have the same scores for urinary tract symptoms, these UTI-like symptoms may be caused by the procedure itself, or stent-related symptoms.

Another significant finding was that female patients had higher levels of hematuria (U8) compared to males. From our data, patients with a history of previous radiation were all female and radiation cystitis in combination with bladder irritation from the ureteral stent and stent migration may lead to a higher rate of hematuria.

One could argue that the longer the stent, the more likely it is to cross the urinary bladder midline. Our results showed no difference in length and size between the two groups. From these findings, we could imply that they did not contribute to stent-related symptoms in this study. Furthermore, stent migration might play a role in stent-related symptoms, even though there were no differences in stent length.

To our knowledge, this was the first study to utilize a standardized Thai version of USSQ. Before the development of USSQ stent-related symptoms were frequently assessed using OABSS questionnaires.[13] Even though USSQ was translated into multiple languages[2,7], multiple studies still use the OABSS questionnaires[9,10] or even develop a simpler version.[12]

Whilst USSQ was the only standardized tool used for the assessment of stent-related symptoms and quality of life, it also had limitations. As discussed by El-Nahas[12] and Lingeman[5], USSQ is a very sophisticated questionnaire, and from the point of view of the patient, can be very demanding and confusing, and time consuming. As we conducted the study by completing the USSQ before stent replacement or removal, the psychological, medical conditions and time constrain may affect the focus of the patient as they answer the questionnaire. This may explain the high dropout rate in our study. In their study, El-Nahas et. al. had developed simpler questionnaires, which had only 6 questions. They stated that the simple version could make answering the questionnaires more quickly, require less recall, and be easier for patients.[12] Alternatively, handing over the USSQ to patient and asking them to return the questionnaires during their next visit may be a viable option.

Since the number of enrolled patients in our study was less than in other studies[2,5,8,9] due to the high dropout rate, generalization of these results to the general population with indwelling ureteral stent may be difficult. A future study with a larger sample size could provide more accurate results.

Stent movement can occur as a result of the movement and position of the patient[15], and the stent-related symptoms may also vary from immediately after stent placement until later. Lingeman[5] demonstrated that the USSQ score had changed over the course of 30 days after stent placement. The symptoms were highest immediately after stent placement and gradually improved over time. In our study, the USSQ was administered before stent replacement or removal, therefore these symptoms may be less severe compared to immediately after stent placement. Furthermore, our study did not collect USSQ before and after stent placement, since the majority of our patients had undergone stent placement before. By comparing USSQ before and after stent placement, these data can provide valuable insights into how stent-related symptoms cause problems to the patients, and how each cause of stent placement affects stent-related symptoms before and after stent placement. Conducting a study using the USSQ and performing an X-ray to assess the position of the DJ stent during stent indwelling, even though time and resource-consuming, will give more accurate information in this regard.

In this study, the cause of stent indwelling was different from many previous studies. While external ureteral compression was the most common cause followed by ureteral obstruction from stone or stone-related treatment, other studies[2,5,8,9] usually enrolled patients undergoing stone treatment. One might imply that differences in the causes of stent placement may affect stent-related symptoms. However, since our findings were similar to Abt[2] and Lingeman[5], the relationship between the causes of stent placement and stent-related symptoms may be less clear.

Double J ureteral stents were used in all patients in this study. Lingeman showed that different stent types do not affect stent-related symptoms.[5] Although we can infer from Lingeman5 and our result that the ureteral stent of double J design does not affect stent-related symptoms, there may be other factors to consider. These factors are the material of the ureteral stent and their coating. Stent type was left to the discretion of the surgeon, and as these were all the same in this study it is unclear as to whether differences in material and coating may play a role in stent-related symptoms. Further studies comparing the effects of different stent materials and coating on stent-related symptoms may be needed to answer this question.

Our study had some limitations. First, our study had a high dropout rate and limited numbers of patients enrolled. Second, our study was designed as a cross-sectional study and did not perform randomization. Performing a prospective randomization study by randomizing patients into two groups, one with the distal end of the ureteral stent crossed and a second with the stent not crossed midline could give more robust data. Third, since our study was a cross-sectional study design, we did not evaluate the USSQ score before and after stent placement which would add weight to the findings of the study.

Conclusion

The results of this study show that the position of the distal end of the ureteral stent does not affect urinary symptoms. Discussion with the patient about stent placement, procedures, and related symptoms before, and after stent placement remains crucial.

Conflict of Interest

The authors declare no conflict of interest.

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Original Article

Comparison of biochemical recurrence rate and oncologic outcomes between anterior and lateral approach to laparoscopic radical prostatectomy

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Keywords:
Prostate cancer, lateral approach laparoscopic prostatectomy, anterior approach laparoscopic prostatectomy, laparoscopic radical prostatectomy

Abstract

Objective: Malignancy of the prostate is the fourth most common malignancy in older Thai men. At present, laparoscopic prostatectomy is one of the most common forms of treatment for prostate cancer. In Rajavithi Hospital, two different approaches are used to carry out a laparoscopic prostatectomy, the anterior approach and the lateral approach. The aim of this study was to compare the oncologic outcomes between the two approaches and to follow the biochemical recurrence rate after surgery. The pathological, oncological outcomes between an anterior approach laparoscopic prostatectomy (AA-LRP) and a lateral approach laparoscopic prostatectomy (LA-LRP) were compared with a focus on pathologic outcomes including free margin, lymphovascular invasion, and seminal vesical invasion.

Materials and Methods: A retrospective review was carried out using prospectively collected data on 230 patients who underwent AA-LRP (n = 96) and LA-LRP (n = 134) carried out by a single surgeon between January 2005 and December 2022. Pathological and biochemical recurrence were also examined.

Results: No statistical significance was found in overall oncologic outcomes between the AA-LRP and LA-LRP, positive margin between the anterior approach (32.7%) and lateral approach (42.4%) (p = 0.166). No statistically significant differences were found regarding LVI-positive and seminal vesicle-positive between the two techniques. Kaplan–Meier analysis did not show any statistically significant differences with respect to biochemical recurrence between the two approaches, specifically anterior approach (mean follow-up 108 months) no biochemical recurrence = 73.0% lateral approach (mean follow-up 78 months) no biochemical recurrence = 66.7% (p = 0.371).

Conclusion: We conclude from this data from our institute that there was no statistically significant difference in oncologic outcome and biochemical recurrence rate in this single-surgeon comparative series between AA-LRP and LA-LRP. Further prospective studies are warranted to determine whether any particular technique is superior to the other in oncologic outcomes and biochemical recurrence rate.

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Introduction

Prostate cancer is a common cancer found in elderly male patients, with incidence varying by region. In Asia, including Thailand, prostate cancer is the fourth most common cancer among elderly men.[1,2] With an increasing aging population in Thailand, the incidence of prostate cancer is expected to increase.[3]

Currently, treatment of prostate cancer requires assessing the risk of the cancer spreading to nearby areas. The treatment options include surgery, radiation therapy, hormone therapy, and active surveillance.[4,5] Prostate cancer screening using prostate specific antigen(PSA) levels has improved early detection which increases the chances of successful surgical treatment.[6] At Rajavithi Hospital, a significant number of laparoscopic surgeries have been performed, utilizing both anterior and lateral approaches. These surgical techniques reflect growing experience in minimally invasive prostate cancer treatment in Thailand.[7]

The aim of this study was to report our experience in oncological outcome and biochemical recurrence rate between anterior approach laparoscopic prostatectomy (AA-LRP) and lateral approach laparoscopic prostatectomy (LA-LRP) in Rajavithi Hospital.

Material and Methods

We retrospectively collected information of patients who had undergone laparoscopic prostatectomy by either the lateral or anterior approach between 1st January 2005 and 31st March 2021 at Rajavithi Hospital with follow up until 31st December 2022. Patient data were excluded from further analysis if they had a non-prostatic primary malignancy on final pathology, had received androgen deprivation therapy or prior therapy, the procedure was converted from laparoscopic to open surgery, or there was incomplete data from hospital records. Finally, data from 230 patients diagnosed with prostate cancer were analyzed. The patients' records were retrospectively reviewed extracted data including: age, PSA, localized Pathologic report from prostate biopsy and prostate weight (Table 1).

Statistical analyses

The statistical analyses were processed using statistical software SPSS ver. 20.0. Categorical variables were assessed using the Pearson chi-square test and Fisher's Exact Test. P values were calculated, and $p < 0.05$ was considered as statistically significant.

Table 1. Clinicopathological characteristics of matched anterior approach and lateral approach laparoscopic prostatectomy

Characteristics	Surgical technique		P-value
	Anterior approach	Lateral approach	
Patients, n (%)	96 (41.7)	134 (58.3)	
Age, years (mean±SD)	68.0±6.40	68.47±7.70	0.63
Preoperative PSA (mean±SD)	15.46±18.25	16.93±22.89	0.62
Postoperative PSA (mean±SD)	0.73±4.18	0.24±1.56	0.26
Follow up, months (mean±SD)	94.36±61.08	63.90±42.36	0.00
Pathological, weight (g)	51.32±20.21	45.98±27.03	0.12
PSA, n (%)			
≤ 10	47 (54.6)	64 (51.6)	0.82
10.1-20	23 (26.7)	38 (30.6)	
> 20	16 (18.6)	22 (17.7)	
Preoperative Gleason Grade Group, n (%)			
Grade Group 1	44 (52.3)	70 (56.9)	0.21
Grade Group 2	18 (21.4)	28 (22.7)	
Grade Group 3	8 (9.5)	14 (11.4)	
Grade Group 4	11 (13.1)	5 (4.0)	
Grade Group 5	3 (3.6)	6 (4.9)	

SD = standard deviation, PSA = prostate specific antigen

Results

A total of 230 patients (134 LA-LRP and 96 AA-LRP) were included in the final analysis. Median age for the entire cohort was 70 years, and mean follow-up was 94 ± 61.08 months for the anterior approach and 63 ± 42.36 months for lateral approach (p = 0.00). The mean pre-operative PSA of LA-LRP and AA-LRP was 16.93 ± 22.89 and 15.46 ± 18.25 (p = 0.62). There were no statistically significant differences between the two surgical approaches including patient age at the time of surgery, preoperative PSA level, biopsy Gleason score, and clinical tumor stage.

Also, in this study, intraoperative data were recorded. the mean operative time was 483 ± 156 minutes in the AA-LRP group and 348 ± 96 minutes in the LA-LRP group (p < 0.01). The mean estimated blood loss (ml ± SD) was 1,419.0 ± 1,217.0 in the AA-LRP group and 660.0 ± 60.0 in the LA-LRP group (p < 0.01). The mean catheterization time and length of stay (days ± SD) were 12.2 ± 6.8 in the AA-LRP group and 9.3 ± 4.4 in the LA-LRP group (p < 0.01). The complication rate was 24.6% in the AA-LRP group and 1.6% in the LA-LRP group (p < 0.01).

Although the LA-LRP group has a more aggressive pathological outcome, with extraprostatic extension occurring in 24.0% of patients compared to 12.0% in the AA-LRP group (p = 0.037), the positive surgical margin rates were 42.4.0% for the LA-LRP group versus 32.6% for the AA-LRP group, showing no statistically significant difference (p = 0.16). Other factors, such as seminal vesicle invasion (SV), lymphovascular invasion (LVI), and lymph node (LN) invasion, were also not statistically significant.

In the LA-LRP group, 9.8% had seminal vesicle invasion, while the AA-LRP group had 8.4%. Additionally, the LA-LRP group had 8.0% with lymph node invasion, compared to 3.0% in the AA-LRP group. The results regarding lymphovascular invasion are difficult to interpret due to incomplete pathological records: in the AA-LRP group, 31.6% are affected compared to 22.1% in the LA-LRP group (Table 2).

Biochemical recurrence rate was also investigated. A Kaplan–Meier analysis showed no statistically significant differences in biochemical recurrence between the two approaches. The anterior approach (mean follow-up of 108 months) had a biochemical recurrence-free rate of 73.0%, while the lateral approach (mean follow-up of 78 months) had a rate of 66.7% (p = 0.371).

The univariate Kaplan-Meier analysis showed no significant difference in the 5-year BCR-free survival, which was 80.0% for AA-LRP group vs 68.0% for the LA-LRP group (Figure 1).

In accordance with the guidance from the National Comprehensive Cancer Network (NCCN) we divided preoperative PSA into three groups, specifically less than 10 ng/dl, 10 to 20 ng/dl and more than 20 ng/dl and we analyzed BCR-free survival into 3 groups resulting in a significant difference in BCR-free survival from the univariate Kaplan-Meier analysis for Preoperative PSA in all patients who underwent LRP. Surgical approach, whether LA-LRP and AA-LRP, was not an independent predictor of BCR (Figure 2).

Discussion

Laparoscopic prostatectomy remains the standard procedure for minimal invasive surgical treatment of prostate cancer in Thailand.[8] In 2011 our institution published a report on the technical aspects and experience of 100 cases in Rajavithi Hospital.[9] Since that time, we have started using LA-LRP to make the procedure more straightforward and less invasive for both the surgeon and the patient. Laparoscopic prostatectomy is a treatment of choice for prostate cancer, a procedure

Table 2. Oncological outcomes of anterior approach and lateral approach laparoscopic prostatectomy

Characteristics	Surgical technique		P-value
	Anterior approach	Lateral approach	
Positive surgical margin n (%)	31 (32.6)	56 (42.4)	0.166
Lymph node invasion n (%)	5 (8.0)	2 (3.0)	0.269
Seminal vesicle invasion n (%)	8 (8.4)	13 (9.8)	0.819
Lymphovascular invasion n (%)	6 (31.6)	23 (22.1)	0.386
Extraprostatic extension n (%)	11 (12.6)	31 (24.2)	0.037

SD = standard deviation, PSA = prostate specific antigen

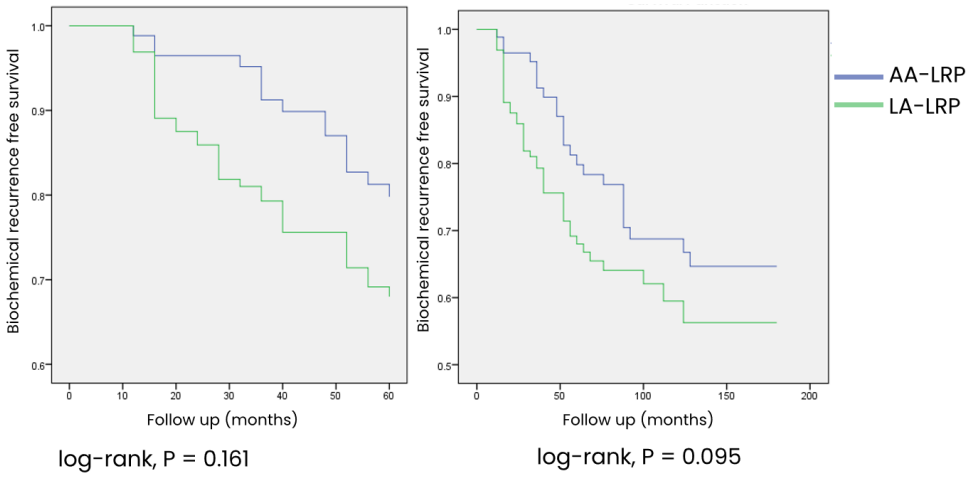

Figure 1. Biochemical recurrence-free survival for men undergoing laparoscopic prostatectomy for LA-LRP and AA-LRP

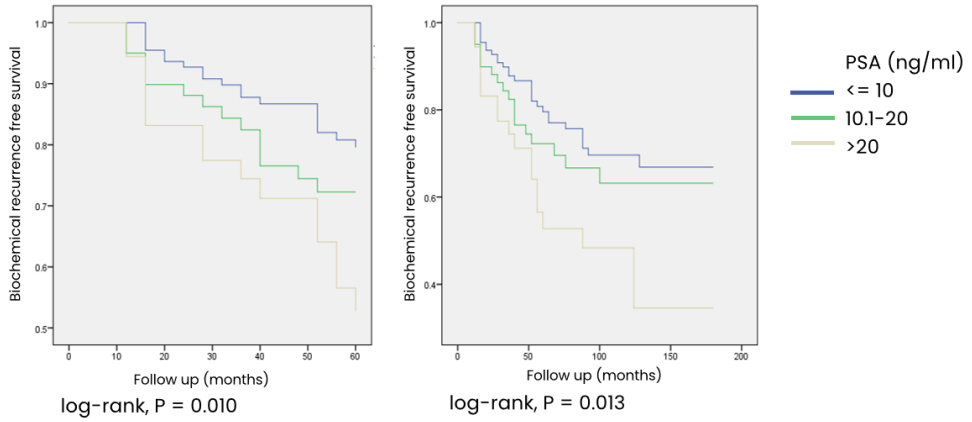

Figure 2. Biochemical recurrence-free survival for men undergoing laparoscopic prostatectomy for PSA

which is associated with decreased blood loss, less postoperative pain and shorter hospitalization[10] LRP is a challenging technique and the learning curve to successfully perform LRP is extensive.[11]

To our knowledge, this is the first study to investigate the impact of approach in LRP techniques (LA-LRP vs AA-LRP). Similar to the report by Mendoza et al.[12] we found that surgical technique was not an independent predictor of positive surgical margin rate and also that both approaches did not affect biochemical recurrence-free survival. Despite significantly higher rates of extraprostatic extension in the LA-LRP group, and the margin analysis was higher in this group there was no statistically significant difference between the two groups. We found a positive surgical margin rate of 32.0% in the AA-LRP group and 42.0% in the LA-LRP group. In this study all the procedures were performed by a single surgeon which resulted in a high level of consistency in the data. Martínez-Holguín et al.[13] conducted research titled 'Comparison between Laparoscopic and Open Prostatectomy: Oncological Progression Analysis between 2007 and 2015', and they found that the surgical approach in prostatectomy did not influence the status of surgical resection margins or biochemical recurrence in their series which was 77.0% BCR-free (mean follow up 49 months). Nyberg et al.14, compared surgical techniques between open radical prostatectomy and robotic assisted radical prostatectomy. The major outcome was BCR-free survival at 6 years, the results in the robotic assistance group was 86.0% compare with the open group which was 84.0% (not statistically significant). In our study 5-year BCR-free survival was 80.0% for the AA-LRP group and 68.0% for the LA-LRP group (mean follow up 60 months).

Magheli et al.[15] investigated the impact of surgical technique between open, robotic and laparoscopic and they found that the robotic approach has a significant positive margin rate

in comparison with the laparoscopic and open technique 19.5% vs 13.0% vs 14.4% (p = 0.01). Even though the positive margin was higher in the robotic group the BCR-free did not differ between the groups. Rozet et al.[16] reported no statistically significant differences with respect to pathological outcomes and complication rates for laparoscopic vs robotic among patients with comparable preoperative characteristics. The positive surgical margin rate in that study in the robotic group was 19.5% and 15.8% for the laparoscopic group.

In our study, we compared subgroups of laparoscopic approaches and found that the positive surgical margin rates were not significantly different between the anterior approach (32.6%) and the lateral approach (42.4%). However, in the lateral approach group, most positive margins were found at the apex. The higher rate of positive margins in LA-LRP may be because of differences in how the prostate is accessed and observed during surgery. In LA-LRP, it is harder to clearly see the apex[17], which is an important area where positive margins often happen. Also, because the lateral approach focuses on preservation of the nerves, it might affect the ability to completely remove the cancer but improving the surgical technique can help reduce this risk.[18]

There are limitations to the present study. First, because of the relatively newer LA-LRP approach for treatment of prostate cancer in comparison to AA-LRP extended follow-up was not available. Second, there is a bias present for the surgical technique offered to each patient. As AA-LRP was performed before LA-LRP the surgeon already had extensive experience with carrying out this laparoscopic prostatectomy approach which may have impacted the outcome. Vickey et al.[11] reported that more extensive surgeon experience was associated with a lower risk of 5-year biochemical recurrence following surgery in a recent study examining the learning curve of LRP which is about 250 cases. Third, we didn't include the incidence of perioperative complications and functional outcomes such as continence rate after the procedure between the two different technique. However, this has been the subject of previous studies and hence was not a primary goal in our study.[19,20]

We believe that the positive surgical margin recorded in LA-LRP is higher due to the higher rate of extraprostatic extension in the group and also that the surgeon had more experience and could select higher stage disease to perform surgery.

Conclusion

In conclusion, using BCR-free survival as a surrogate end point, we have demonstrated no difference in oncologic effectiveness between LA-LRP and AA-LRP techniques. The implication is that the patients who undergo surgery in the contemporarily significant predictors of BCR in this patient population are adverse pathologic features, including EPE, SVI, PSM, and LN involvement. Patients who are at increased risk of disease recurrence and mortality can therefore be treated with either LA-LRP or AA-LRP.

Conflict of Interest

The authors report no conflicts of interest.

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Original Article

Evaluation of AI and radiologist contouring in prostate MRI for targeted MRI/US fusion biopsy

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Keywords:
AI contouring prostate gland, MRI fusion biopsy of prostate, MRI prostate

Abstract

Objective: Prostate cancer is an increasingly prevalent public health issue, particularly in aging populations such as Thailand. While traditional diagnostic methods like systematic transrectal ultrasound-guided biopsy are widely used, they can result in overdiagnosis and unnecessary treatment. MRI/Ultrasound (MRI/US) Fusion Biopsy offers greater precision by targeting suspicious areas detected in MRI scans. However, manual contouring of the prostate and lesion locations by radiologists or urologists is time-consuming and subject to variability, potentially delaying diagnosis and treatment.

Materials and Methods: This retrospective study developed and evaluated an AI-based prostate segmentation model using 125 annotated prostate MRI cases (3,193 images) from a public dataset for training, and then it was tested on 109 clinical cases (2,952 images) from the National Cancer Institute. The model combined a YOLO-based bounding box detection with the segment anything model (SAM) for prostate segmentation. Model performance was compared to radiologist-drawn contours using dice similarity coefficient (DSC) and % relative percent difference (RPD) in prostate volume estimation.

Results: For cases not requiring post-processing, the AI model achieved a mean DSC of 0.72 and an RPD of 8.90% in comparison to radiologist contours. For cases requiring post-processing, the DSC dropped to 0.66 and the RPD increased to 13.45%. These results indicate a high level of agreement between the AI and expert annotations, particularly in standard cases.

Conclusion: The AI-based model demonstrated promising accuracy with regard to segmentation of the prostate gland on MRI scans, comparable to radiologist performance. This approach has the potential to reduce diagnostic delays and lessen the workload of radiologists in prostate cancer workflows. Future improvements should focus on enhancing model precision, incorporating prostate imaging-reporting and data system (PI-RADS) scoring, and validating the system across diverse clinical settings to support safe and effective integration into routine diagnostic practice.

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Introduction

Cancer remains a major public health issue in many countries around the world, with a steadily increasing incidence rate. This rise can be attributed to several factors, including the aging global population, population growth, and notably, lifestyle changes among Asians, particularly dietary habits that are becoming more Westernized. According to statistics, prostate cancer has been the most common cancer in men in the United States for many years. In Thailand, the country is transitioning into an aging society, and age is one of the most significant risk factors for prostate cancer hence the incidence of prostate cancer is increasing.

The primary goal of cancer treatment is to achieve a cure while minimizing treatment-related side effects. It is therefore essential to have up-to-date knowledge of treatments and surgical techniques that are both appropriate and in alignment with current standards. According to the publication Cancer in Thailand 2019-2021[1], prostate cancer ranks as the fourth most common cancer among Thai males, with an incidence rate of 8.7 per 100,000 population. This rate continues to increase over time.

Traditionally, the diagnosis of prostate cancer has relied on systemic transrectal ultrasound-guided biopsy (TRUS biopsy), which is widely accepted. However, this approach may lead to overdiagnosis and overtreatment, along with the risk of biopsy-related complications. In recent years, MRI of the prostate has been increasingly used prior to biopsy. If suspicious lesions are detected, a targeted biopsy using magnetic resonance imaging-ultrasound fusion-guided prostate biopsy (MRI/US fusion biopsy) can be performed. This technique uses three-dimensional imaging in conjunction with real-time ultrasound, enabling physicians to clearly visualize and localize suspicious areas within the prostate, allowing for precise, targeted biopsies rather than random sampling.

This MRI/US fusion technique helps reduce unnecessary biopsies and minimizes biopsy-related complications, especially when MRI findings suggest a low risk of prostate cancer.

In Thailand, MRI/US fusion-guided prostate biopsy has become increasingly widespread. However, the procedure requires delineation (segmentation) of the prostate gland and identification of suspicious lesions to ensure accurate fusion with ultrasound images during biopsy. This task is typically performed by radiologists or urologists. In routine clinical practice, patients who show abnormal findings from prostate-specific antigen (PSA) testing or digital rectal examination are referred for an MRI of the prostate. The use of this technique has reduced the incidence of patients who will need to proceed to biopsy. Instead, lesions are reported using the prostate imaging-reporting and data system (PI-RADS), graded from 1 to 5. If a patient has a PI-RADS score of 3-5 or if malignancy is suspected, urologists usually advise patients to return to a radiologist for prostate and lesion contouring prior to fusion biopsy. In some hospitals, this contouring is done by the urologists themselves (Fig. 1).

The process of contouring the prostate typically takes about 15-20 minutes. Having the patient return to the radiologist for this step often causes delays in the biopsy workflow.

The implementation of artificial intelligence (AI) for automatic prostate segmentation has the potential to reduce the time required for prostate biopsy procedures and alleviate the workload of radiologists and urologists involved in manual prostate contouring. This advancement may expedite diagnosis and treatment for patients. In recent years, there has been growing interest in research into the application of AI technologies to this domain.

For instance, Ghafoor et al. in 2023[2] conducted a study comparing the delineation of index lesions on prostate MRI between radiologists and urologists collaborating in MRI/US Fusion Prostate Biopsy procedures. Their findings indicated

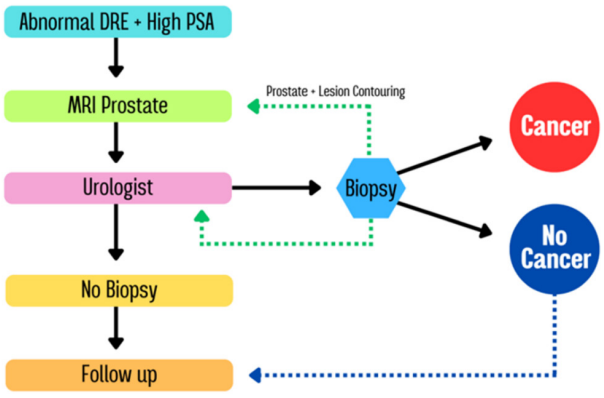


Figure 1. Workflow of prostate cancer diagnostic evaluation using prostate MRI

substantial inter-observer variability in lesion contouring between the two specialties, potentially reducing the accuracy of targeted biopsies. Schelb et al. in 2021[3] evaluated the consistency and accuracy of lesion delineation among multiple radiologists versus a deep learning-based AI model trained for automatic segmentation. The study showed that AI-based segmentation could improve the precision of lesion localization on prostate MRI. Similarly, Nachbar et al. in 2020[4] investigated the use of AI for prostate lesion contouring on MRI for online adaptive radiotherapy planning. The study demonstrated that AI-based contouring is a promising tool for radiotherapy, allowing for rapid and accurate treatment plan adjustments, thereby enhancing treatment efficacy and safety while reducing the workload of radiologists. In addition, in 2023 Palazzo et al.[5] compared manual and AI-based auto-contouring on CT scans, reporting that AI-based method achieved high accuracy and were clinically viable. Their use significantly reduced radiation treatment planning time, highlighting the benefit of AI as a supportive tool for radiation oncologists.

The aim of this study was to evaluate and compare AI-based prostate segmentation with radiologist-delineated contours on prostate MRI. The AI model used in this study was trained on a public dataset comprising 125 MRI cases (3,193 images), which included expert-labeled prostate segmentations. The trained AI model was then tested on an internal dataset of 109 prostate MRI cases (2,952 images) from the National Cancer Institute. In this study prostate volume measurements derived from AI-generated contours were compared to those manually delineated by radiologists.

Materials and Methods

Study population

This retrospective study included 109 patients who underwent MRI fusion-guided prostate biopsy between 2020 and 2023. Inclusion criteria were: (1) patients who had MRI fusion prostate biopsy during the specified period, and (2) MRI images that were interpreted and segmented by the same radiologist, including both prostate gland and suspicious lesion contours. The prostate gland contouring was performed by radiologists with expertise in prostate MRI interpretation.6 Exclusion criteria included patients whose MRI studies were not reviewed and contoured by a radiologist (Fig. 2).

AI model evaluation and comparison metrics

The quality of AI-generated segmentations was evaluated by comparing them with manual contours created by radiologists. The comparison was based on the dice similarity coefficient (DSC) to assess spatial overlap and the relative percent difference (%RPD) in calculated prostate

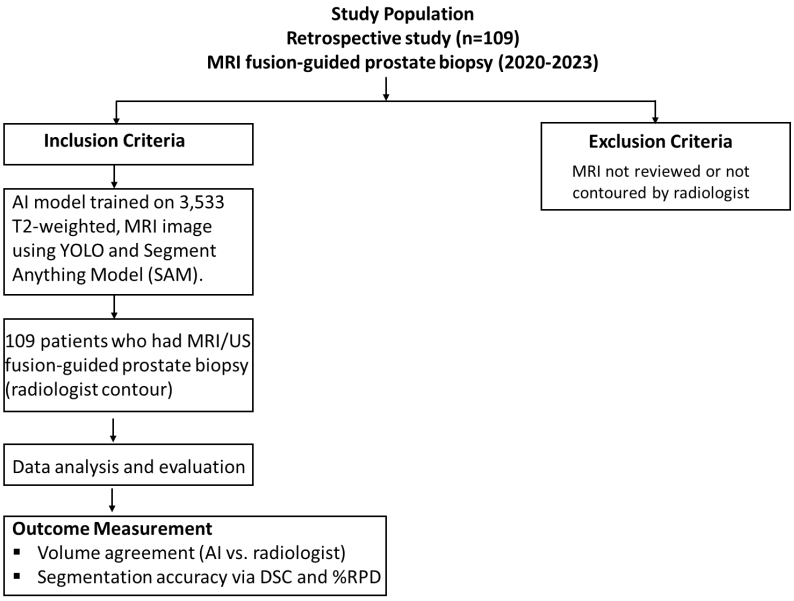


Figure 2. Methodological workflow of AI-based prostate segmentation study

volumes. Statistical significance of the differences in DSC values was assessed using the Wilcoxon signed-rank test, with a primary focus on evaluation of the volume agreement between AI and radiologist contours.

Post-processing refers to the additional refinement of AI-generated prostate contours using image-cleaning and smoothing techniques after the initial segmentation. The 'without post-processing' results represent the raw output directly from the AI model, while the 'with post-processing' results include morphological adjustments to remove noise and enhance contour continuity. However, in this analysis, post-processing slightly reduced segmentation accuracy, indicating that excessive smoothing may have altered true prostate boundaries.

MRI data of the prostate used for training the AI model

In this study, a public dataset named "Prostate158" was used for training the AI model. Although the dataset contains multiple imaging sequences, only 3T prostate T2-weighted sequences were selected for model training. The ground truth segmentations provided in the dataset distinguish the prostate into the peripheral zone (PZ) and the transitional zone (TZ), but these were combined into a single whole-prostate segmentation for training purposes. A total of 3,533 paired images and prostate labels were used to train the model to localize the prostate in MRI scans.

Development of the AI model for automatic prostate segmentation

The AI model for automatic prostate segmentation was developed using a combination of two models. First, the YOLO (You Only Look Once) model was trained to detect the bounding box of the prostate in MRI images. Once the prostate region was localized, the segmentation of the prostate boundary was refined using a fine-tuned segment anything model (SAM) (Fig. 3).

Outcome Measurement and data analysis

In this study, the prostate volume was calculated using the predictions from the trained AI model, which generated prostate contours on T2-weighted MRI (T2w MR) images for every slice. These AI-generated contours were compared with the volumes calculated from manual segmentations performed by radiologists. The prostate volume was calculated using the equation described in [1].

Anteroposterior * Transverse * Longitudinal * π/6 [1]

Note: The results are presented in grams.

Additionally, the accuracy of the AI-generated contours (contour_AI) was evaluated against the contours manually drawn by radiologists using the DSC, a metric that quantifies the level of agreement between the AI-based and radiologist-based segmentations.

$$DCS = \frac{2|contour\_AI \cap contour\_Radiologist|}{|contour\_AI| + |contour\_Radiologist|}$$

Note: A DSC value close to 1 indicates a high similarity between the AI-generated contour and the radiologist's contour.

The difference in volume between the AI-based and radiologist-based prostate contours was assessed using the %RPD. This value was calculated as the percentage difference in prostate volume (in grams) between the AI and radiologist measurements. The volume was derived from the prostate area in each MRI slice using the equation described in [2].

Area Contour * pixel spacing * Slice Thickness [2]

To evaluate the efficacy of the use of AI in interpreting MRI slides for the identification of prostate cancer locations, this study compared AI-based interpretation with that of diagnostic radiologists, aiming to assess the level of agreement between the two approaches. A study by Zhaonan et al.[7] employed AI technology to interpret prostate cancer findings and compared the results with those of diagnostic radiologists. It was found that AI and radiologists had a disagreement rate of 20% across 98 samples, with a 12% difference in interpretation between AI and radiologists. With a statistical power (β) of 80% and a significance level (α) of 0.05, the estimated sample size was approximately 107 cases. To account for potential data loss during collection, an additional 10% of the calculated sample size was included. Therefore, data from a total of 109 cases were collected in this study. The analysis included:

(1) A comparison between the prostate volume calculated from the formula and the

Table 1. Baseline demographic and clinical characteristics of the patients

Parameter	Mean / n (%)	Range
Age (years)	68.6	45-85
PSA (ng/ml)	18.3	0.59-341
PI-RADS 3	18 (16.5)	-
PI-RADS 4	42 (38.5)	-
PI-RADS 5	49 (45.0)	-

PSA = prostate specific antigen

volume determined by the manual contouring by the radiologists;

(2) A comparison between the prostate volume calculated from the formula and the volume derived from AI model-generated contours;

(3) A direct comparison between prostate volumes obtained from radiologist-drawn contours and those from the AI model.

Results

Total of 109 patients were analyzed. Their demographic and clinical characteristics are summarized in Table 1. The age of the patients ranged from 54 to 85 years, with a mean age of 68.6 years. PSA levels ranged from 0.59 to 341 ng/ml, with a mean of 18.26 ng/ml. PI-RADS scores were distributed as follows: PI-RADS 3 in 18 cases, PI-RADS 4 in 42 cases, and PI-RADS 5 in 49 cases. Among the 109 patients, 83 were diagnosed with prostate cancer, with the following staging: Stage 1 (n = 12), Stage 2 (n = 49), Stage 3 (n = 15), and Stage 4 (n = 7). The remaining 26 patients were not diagnosed with cancer.

Prostate volumes calculated using the formula described in equation [1] ranged from 14.3 to 203.9 g, with a mean of 44.51 g.

The mean DSC between radiologist-drawn and AI-generated contours was 0.72 without post-processing and 0.66 with post-processing. The %RPD between radiologist and AI volumes increased from 8.90% to 13.45% after post-processing. The statistical analysis is presented in Table 2 and the results suggest that post-processing did not substantially alter segmentation performance.

The mean %RPD of prostate volume comparisons were as follows:

- Between the calculated volume from Equation [1] and the radiologist-drawn contours:
  - 20.48% (without post-processing)
  - 39.04% (with post-processing)
- Between the calculated volume from Equation [1] and the AI model-generated contours:
  - 20.11% (without post-processing)
  - 55.56% (with post-processing)
- Between the radiologist-drawn contours and the AI model-generated contours:
  - 8.9% (without post-processing)
  - 13.45% (with post-processing

Discussion

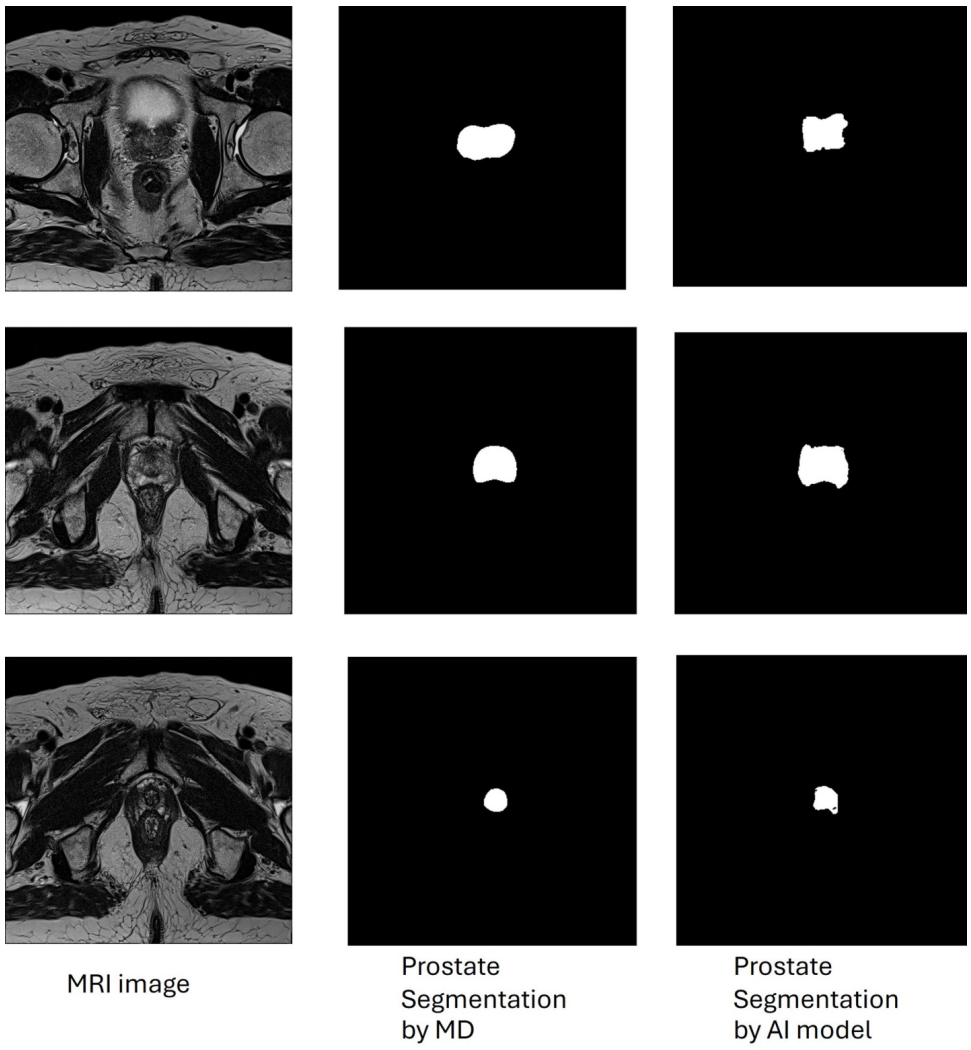
This study selected cases of patients who underwent prostate biopsy based on the prevalence of prostate cancer among the sample population of 109 cases. The variations in prostate volume and cancer stage were also included as these are key factors in the development and training of AI models. The goal was to enable an accurate comparison between AI-assisted diagnosis and radiologist interpretation.

The performance of an AI model for automatic prostate gland segmentation on MRI was evaluated and compared to manual segmentation

Table 2. The average DSC and average RPD of prostate volume

Case type	The average DSC comparing prostate contouring between the radiologist and the AI model	The average of the RPD of the prostate volume			P-value (two-tailed)
		Prostate size from Equation [1] vs contour_ Radiologist	Prostate size from Equation [1] vs contour_AI	contour_ Radiologist vs contour_ AI	
Without post-processing n = 56	0.72	20.48	20.11	8.90	< 0.001
With post-processing n = 53	0.66	39.04	55.56	13.45	0.815

DSC = dice similarity coefficient, RPD = relative percent difference, AI = artificial intelligence



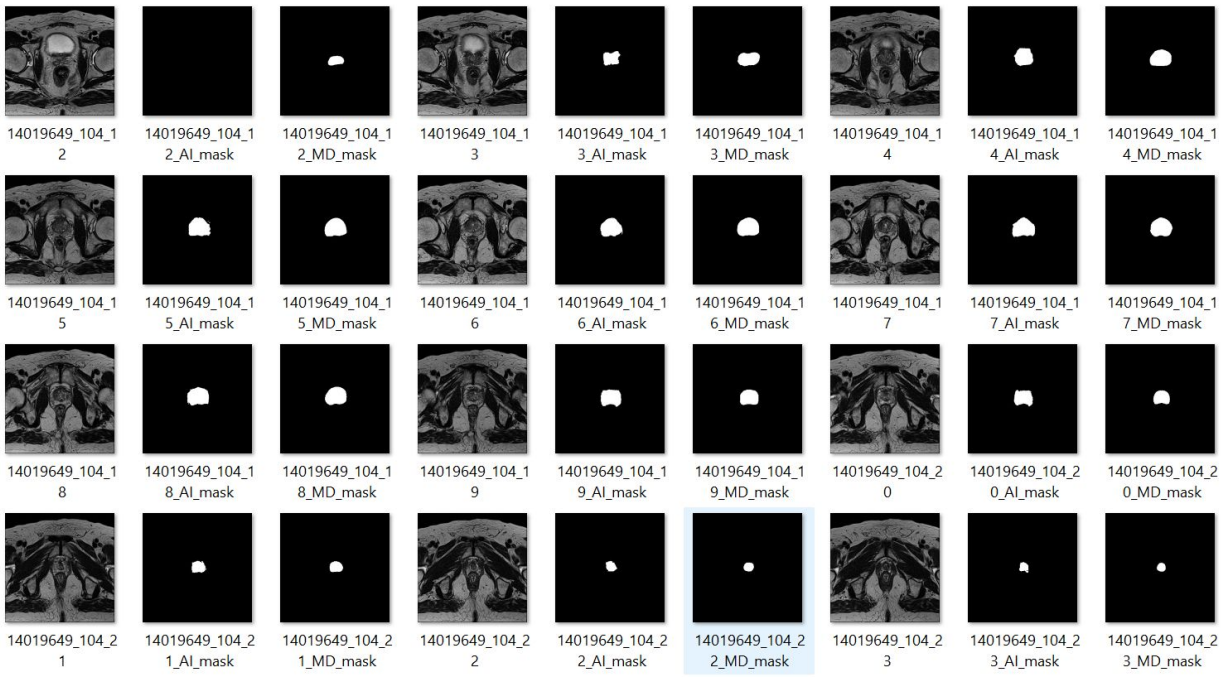


Figure 3. Example of prostate MRI images comparing prostate gland contours manually drawn by a radiologist and those generated by the AI model

by diagnostic radiologists. The aim was to support the accuracy of MRI-guided fusion biopsy procedures. The results demonstrated that AI was effective in producing prostate contours closely resembling those drawn by radiologists, as indicated by the DSC, a standard metric for assessing segmentation accuracy. The findings suggest that AI has strong potential for reducing the workload and processing time for radiologists and urologists in prostate cancer diagnostics, hence improving the experience for patients.

The rationale behind the selection of biopsy-confirmed cases lies in the higher likelihood of detecting cancer, as evidenced by 83 out of 109 cases being positive, encompassing a wide range of prostate sizes and cancer stages. This diversity enhanced the training of the AI mode land allowed for more meaningful comparisons with radiologist-drawn contours.

These findings are consistent with related studies, including that by Ghafoor et al. in 2023[2], which emphasized the value of AI in MRI fusion biopsy workflows. In that study the ability of AI was highlighted with regard to the reduction of inter-reader variability between radiologists and urologists, a common issue in traditional diagnostic pathways. However, in contrast, Thimansson et al. in 2024[8] reported low agreement levels between AI and both local and expert radiologists, suggesting that real-world implementation of AI for prostate cancer screening requires additional model training and validation in specific populations for reliable outcomes.

The benefits of using AI for prostate segmentation are substantial. One major advantage is the reduction in processing time as AI can rapidly identify suspicious regions, minimizing patient waiting time for biopsy procedures. Additionally, AI alleviates the workload of radiologists, allowing them to focus on more complex diagnostic tasks. The use of AI also reduces human error, particularly in cases of fatigue or inexperience, improving the accuracy of cancer detection. In terms of clinical implementation, our team has linked the hospital's PACS system with the developed AI model. This integration allows automatic prostate contour generation whenever a prostate MRI is performed, demonstrating the potential for real-world clinical applications.

This study demonstrated that AI can achieve a satisfactory level of accuracy in prostate contouring. The average DSC between radiologist contours and AI-generated contours was 0.72 in the without post-processing group, considered a good level of agreement, while the with post-processing group showed a slightly lower average DSC of 0.66. This decline suggests that the post-processing step may have introduced alterations that reduced the similarity between AI and radiologist contours.

In terms of volume accuracy, the mean %RPD between mathematically calculated prostate volume (from equation [1]) and radiologist contours was 20.48% in the without post-processing group and increased to 39.04% in the with post-processing group. Similarly, the RPD between the calculated volume and AI contours was 20.11% and 55.56%, respectively. When comparing radiologist and AI-drawn volumes directly, the RPD increased from 8.90% to 13.45% after post-processing. These findings suggest that post-processing may have negatively impacted segmentation precision. Moreover, prostate volume estimation using mathematical formulas showed the lowest reliability compared to radiologist and AI-based measurements, which were more consistent with each other.

The current AI model was trained using axial T2-weighted imaging (T2WI) for prostate gland segmentation. However, precise delineation of targeted lesions would require the inclusion of additional MRI sequences, particularly diffusion-weighted imaging (DWI) and apparent diffusion coefficient (ADC) maps. Future work is planned to extend model training using these sequences to improve lesion-level segmentation accuracy and enhance diagnostic performance.

Although this study highlights the potential of AI in prostate segmentation, certain limitations must be acknowledged. The sample size was relatively small, and larger, more diverse populations are necessary to validate the performance of the AI model across different clinical environments. In addition, the accuracy of the AI model may be influenced by the quality of input images sourced from multiple locations, as the model was trained using public MRI datasets. This could affect the generalizability and reliability of diagnostic results. A potential limitation is that all manual prostate contours were performed by a single radiologist. This may introduce observer bias and limit the diversity of the ground truth, potentially

affecting the generalizability of the performance of the AI model compared to multi-radiologist consensus.

Another challenge lies in the tendency of the AI model to mistakenly include surrounding anatomical structures, such as the urethra or rectum—especially near the apex region—as part of the prostate. This necessitates a post-processing step, which, as shown, may inadvertently degrade accuracy. Further refinement of the model is needed to improve its precision in the identification of cancer-suspected regions, including the ability to distinguish PI-RADS scores and differentiate prostate zones for more effective clinical implementation.

To enhance clinical applicability, future development should focus on expansion of the training dataset using diverse imaging data from multiple institutions. This would improve the efficacy of the AI model with regard to generalization and accurate analysis of MRI scans. Additionally, incorporation of advanced machine learning techniques such as deep learning would enable the AI to adapt better to various clinical contexts, including PI-RADS score classification and prostate zone segmentation.

Real-world testing in different hospitals and cancer centers is also essential to ensure reliable AI performance under practical conditions. If AI is to be integrated into clinical workflows, clear medical standards and guidelines should be established to ensure its safe and effective use alongside human radiologists.

Conclusion

This study demonstrates the high potential of AI in automatic prostate segmentation from MRI, with promising results with regard to a reduction in radiologist and urologist workload and processing time. While some limitations remain, further development and clinical validation could enable AI to enhance the efficiency and accuracy of prostate cancer diagnostics, ultimately contributing to faster and more precise patient care.

Conflict of Interest

The author declares no conflict of interest.

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Original Article

Complications of ureteroscopy with intracorporeal lithotripsy in patients with urinary tract infection

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Keywords:
Ureteric calculi, ureteroscopy, lithotripsy, urosepsis, SIRS, complications

Abstract

Objective: To study the risk of complications associated with ureteroscopy with intracorporeal lithotripsy in patients with urinary tract infection.

Materials and Methods: 420 patients who underwent ureteroscopy with lithotripsy from March 2022 to March 2024 in Sisaket Hospital were enrolled onto this study. Data pertinent to baseline characteristics, perioperative variables, successful outcome and associated complications were collected retrospectively. The efficacy of the procedure, including complications, length of hospital stay, and pain score, was analyzed and comparisons were made between patients with and without sepsis.

Results: 89 patients were categorized as being in the sepsis group, and 331 patients in the non-sepsis group. The average age in the sepsis group was 51.2 years and patients in the non-sepsis group were slightly older at 55.56 years. 58.43% of the sepsis group had no underlying disease, and 56.19% of the non-sepsis group ($p = 0.706$). There was no significant difference betweentotal complications in the sepsis and non-sepsis group at 24.72% and 18.73% respectively ($p = 0.221$). The most common complication was post-operative fever. There were no serious complication in the sepsis group. The mean hospital stay in the sepsis group was 3.99 days, which is significantly higher than in the non-sepsis or controlgroup, which was 2.94 days ($p = 0.002$). The pain score in the sepsis was significantly higher than in the controls.

Conclusion: Our study demonstrated that the postoperative complications of URSL in a non-sepsis group are comparable to the sepsis group. But sepsis increased the length of hospital stay and resulted in higher postoperative pain. The definitive treatment with URSL is safe for ureteric stone in mild sepsis patients. However, further large comparative studies with adequate follow-up stone clearance are recommended to support our results.

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Introduction

Ureteric calculi are a form of urinary calculi, which are one of the most prevalent urinary problems worldwide with a rate of 1-5% in Asia and 16.90% in the northeast region of Thailand. This is widely believed to be the country is located in a tropical area, resulting in an increased rate of the condition. The calculi found in patients in the northeast region of Thailand are calcium-containing stones (whewellite, dahllite, and weddellite).[1-3]

The presence of ureteric calculi can have consequences at multiple levels of severity and can involve pain, infection, urinary obstruction leading to renal failure or being a cause of death. The current treatment according to European Association of Urology Guidelines is ureteroscopy, a standard treatment for ureteral stone patients with a low rate of spontaneous passage, pain with optimal pain medication or urinary obstruction and renal failure. Ureterscopy can remove all stones with one operation, despite the potential for complications and longer admission time.

The most common postoperative complications are fever and urinary tract infection, which increase the mortality rate of patients. Current evidence suggests that among patients undergoing ureteroscopy (URS) for treatment of stone disease, the risk of postoperative urosepsis is 5.00%.[4] Increased infection rate can be found in elderly patients or patients with a Sequential Organ Failure Assessment (SOFA) score of at least 2, and patients with upper urinary tract stones.[5] At present, there is no specific study regarding post-ureteroscopic infection prevention. The sole recommendation at present is preprocedural treatment to limit or eliminate the potential for infection in patients who will undergo a surgical procedure for stone removal by upper tract urinary diversion (with a ureteral stent or percutaneous nephrostomy tube). Patients face an elevated risk of complications in association with stent placement hence, the procedure is avoided in patients with untreated urinary tract infections (UTI). There is no clear criteria to assess the level of severity or any definition for the mentioned UTI evaluation.[6] However, in a study by Mohamed Bakr, in emergency treatment of URS in patients with mild sepsis, no difference in outcome, complications, or admission time was found, in comparing preop-procedures associated with double-J ureteral stent insertion with definitive URS management of ureteral stone after resolution of sepsis.[7]

The definition of sepsis as described in the third international consensus on sepsis and septic shock (sepsis-3) is "life-threatening organ dysfunction due to a dysregulated host response to infection".[8] A study by Eamon and colleagues found that in a study involving 184,875 patients, urinary tract infection was found as the second most common cause of sepsis, following pulmonary infection. Sepsis was shown to be an important cause of increasing the mortality rate of patients to 20.00% regarding severity level of infection. Currently many criteria can be applied in the evaluation of infection, although Sepsis-3 provides recommendations in the quick Sequential Organ Failure Assessment (qSOFA) for patient assessment. From a review of pertinentliterature, the qSOFA has a high specificity rating, however has the lowest sensitivity in comparison to Systemic Inflammatory Response Syndrome (SIRS) and National Early Warning Score (NEWS). Consequently, the guidelines in 2021 still recommended SIRS and NEWS for patient assessment. This study used SIRS because it has the highest level of sensitivity.[9-11] Any complications associated with the surgery were classified and collected by using the Clavien-Dindo Classification (Table 1).

The objective of this study is to study the safety of ureteroscopy with intracorporeal lithotripsy in patients with sepsis. Is there a significant difference in complications of ureteroscopy with intracorporeal lithotripsy between patients with and without sepsis?

Materials and Methods

Study design

This retrospective study was approved by the institutional review board (COA no.010/2024). Data concerning 420 patients were retrospectively reviewed. Patients who met the inclusion criteria and underwent ureteroscopy with lithotripsy in Sisaket Hospital between March 2022 and March 2024 were enrolled onto this study. Exclusion criteria were patients with multi-organ failure, incomplete data records, dying due to non-operative causes, or refusing treatment. The patients were divided into two groups: the group with urinary tract infection (sepsis) which included patients with a SIRS score of at least 2 with symptoms of UTI (dysuria, frequency, urgency,

Table 1. The complications associated with surgery using The Clavien-Dindo Classification.

Grade	Definition
I	Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic, or radiological interventions.
II	Requiring pharmacological treatment with drugs other than such allowed for grade I complications. *Blood transfusions and total parenteral nutrition are also included.
III	Requiring surgical, endoscopic, or radiological intervention.
IIIa	Intervention not under general anaesthesia.
IIIb	Intervention under general anaesthesia.
IV	Life-threatening complications requiring intermediate care/intensive care unit management. *Includes central nervous system complications.
IVa	Single-organ dysfunction. *Includes dialysis.
IVb	Multiple-organ dysfunction.
V	Death of the patient.

suprapubic pain, chills, fever, and flank pain) and the group that had no clinical urinary tract infection (control / non-sepsis). Sepsis identification criteria in the study were aSIRS of at least 2 with an infection (body temperature more than 38° C or less than 36° C, a heart rate more than 90 / minute, a respiratory rate more than 20 /minute or a $paCO_2$ less than 32 mmHg and a white blood cell count of more than 12,000 /cubic millimeter or less than 4,000 /cubic millimeter or band form more than 10.00%. Primary outcome was complications associated with surgery (Clavien-Dindo classification) and the secondary outcome was length of hospital stay.

Baseline characteristics were recorded, including age, gender, body mass index (BMI), comorbidity, duration of symptoms, need for antibiotics and timing of antibiotics before operation, urine culture, stone location, extent and degree of hydronephrosis. Data related to surgery were recorded, including time of operation, postoperative stenting, stone fragmentation, surgeon and anesthesia. Postoperative data were recorded for analysis of outcome, including perioperative and postoperative complications and length of hospital stay, also postoperative pain score.

Surgical procedure

The URSL procedure involved the placing of the patients in the lithotomy position, and the insertion of an 8/9.8 Fr semi-rigid ureteroscope (Richard Wolf, Germany)approach the stone. The stone was then fragmented with pneumatic intracorporeal lithotripsy (Swiss LithoClast-EMS Medical, Switzerland) or holmium YAG laser (Richard Wolf, Germany) and stone forceps were used to extract the fragments of the stone. After the operation was done, a 4.8 Fr, 26 cm Double-J ureteral, open-end Ureteral catheter stent or no postoperative stent was inserted, as directed by the surgeons.

Data analysis

Descriptive statistics are reported as number, percentage, mean and standard deviation. Inferential statistics were used to compare complications using the Chi square test and exact probability test. Length of hospital stay was compared using an independent t-test or Mann Whitney U test, depending on data distribution.

Results

A total of 420 cases were included in the study, the sepsis group = 89, the non-sepsis or control group = 331. The demographic data and clinical characteristics of both groups are shown in Table 2.

The average age of the sepsis group was 51.2 years and the control group was 55.56 years. 58.40% of the sepsis patients were male, average BMI was 23.3 kg/m^2. Duration of symptoms is significantly different between the groups. in the sepsis group average duration was shorter than control group (11.5 and 38.3 days, respectively, $p < 0.001$). No statistical difference was found between the duration of the antibiotic use with sepsis group being 24.3 hours, and the control group 19.6 hours.

58.43% of the sepsis group had no underlying disease, and 56.19% of the controls ($p = 0.706$).

Table 2. The demographic data and clinical characteristics (N= 420)

	Sepsis group (n=89)	Normal group (n=331)	P-value
Gender n (%)			0.520
Malen	52 (58.43)	181 (54.68)	
Female	37 (41.57)	150 (45.32)	
Age (years), mean (SD)	51.24 (14.79)	55.56 (11.96)	0.004
BMI (kg/m^2), mean (SD)	23.3 (4.33)	24.08 (4.42)	0.137
Comorbidity, n (%)			0.706
None	52 (58.43)	186 (56.19)	
Diabetes melitus	14 (37.84)	37 (25.52)	
Cardiovascular disease	0 (0.00)	5 (3.45)	
Chronic kidney disease	9 (24.32)	35 (24.14)	
Immunosuppressive	1 (2.70)	1 (0.69)	
Hypertension	7 (18.92)	39 (26.90)	
Orthers	6 (16.22)	29 (19.31)	
Duration of symptoms (mean, day)	11.56 (21.32)	38.32 (50.04)	< 0.001
Duration of antimicrobial (mean, hour)	24.31 (32.05)	19.63 (13.48)	0.039
Urine culture, n (%)			0.280
Negative	72 (80.90)	283 (85.50)	
E. Coli	17 (19.10)	48 (14.50)	
Klebsiella pneumoniae	5 (29.41)	5 (54.17)	
Proteus mirabilis	3 (17.65)	4 (8.33)	
Enterococcus faecalis	2 (11.76)	3 (6.25)	
Enterobacter	1 (5.88)	3 (6.25)	
Acinetobacter baumannii	2 (11.76)	1 (2.08)	
Staphylococcus spp.	0 (0.00)	4 (8.33)	
Maximum stone diameter (cm), mean (SD)	1.12 (0.75)	0.85 (0.44)	0.001
Location of stone, n (%)			0.002
Proximal ureter	20 (2.47)	121 (36.56)	
Mid ureter	9 (10.11)	32 (9.67)	
Distal ureter	42 (47.19)	152 (45.92)	
Ureterovesical junction	18 (20.22)	26 (7.85)	
Degree of hydronephrosis, n (%)			0.071
None	0 (0.00)	16 (4.83)	
Mild	43 (48.31)	170 (51.36)	
Moderate	43 (48.31)	126 (38.07)	
Severe	3 (3.37)	19 (5.74)	

SD = standard deviation, BMI = body mass index

In both groups, the most common comorbidity was diabetes mellitus 25.52% and 24.32% in the sepsis and controlgroups, respectively (p = 0.434). The second most common in the control group was hypertension, 26.90% and in the sepsis group was chronic kidney disease, 24.32%.

In most common locations of stone in both groups were distal followed by proximal, and the most common degree of hydronephrosis was mild. Positive urine culture in the sepsis group and control group were 14.50% and 19.10% respectively, these results showed no statistically significant difference (p = 0.287). *E.coli* was the most common pathogen in both groups.

Patients in the sepsis group had not received previous treatment 87.64%, a higher number than the control group 66.16% (p = 0.002). The operative treatment in the non-sepsis group was DJ stent insertion(14.20%), ESWL (8.16%) and URS (5.44%). Whereas, in the sepsis group was URS (5.62%), DJ stent (3.37%) and PCN insertion (2.25%). The mean operative time in the sepsis group was 22.11 minutes (SD = 14.12) and in the non-sepsis group was 23.98 minutes (SD = 16.50)

(p = 0.329), showing no significant difference. After surgery a DJ stent was most frequently inserted in the sepsis group 51.69% , and a ureteric catheter in 33.71% of cases; in the non-sepsis group DJ stent was used in 43.20% of cases and ureteric catheter 32.93%. Stone fragmentation was almost always done using pneumatic lithotripsy in both groups.

Outcome

Total complications in the sepsis and non-sepsis groups were 24.72% and 18.73% respectively (p = 0.221), showing no significant difference. In the non-sepsis group, intraoperative and postoperative complications were classified using to the Clavien-Dindo system: Grade I complications occurred in 43 patients, including postoperative fever in 42 patients and hematuria in 1 patient. Grade II 10 patients (postoperative UTI 6, AUR 1 and hematuria 3), grade III 7 patients (ureteric perforation 1, mucosal injury 2 and stone retropulsion to kidney 3, bleeding intraoperation 1 all cases were managed by Double-J ureteral stent insertion) and grade IVa 2 patients, both patients having septic shock with acute respiratory failure and required transfer to ICU. Meanwhile, in the sepsis group, Grade I complications were observed in 18 patients. (postop fever 18), and Grade II 4 patients (postop UTI 1, Hematuria with clot retention 3 which was managed by retained Foley catheter with continued bladder irrigation.) There were no serious complication in the sepsis group. The mean hospital stay in the sepsis patients was 3.99, higher than the control groups which was 2.94 days (p = 0.002). Thepain score in sepsis patients was significantly higher than the non-sepsis group (1.17 and 0.77, respectively, p = 0.007). No patients in the sepsis group returned to the hospital but 3 patients in the non-sepsis group revisited the hospital within 30 days postoperative.The cause of the revisit was hematuria in 2 cases and urinary tract infection in 1 case.

Discussion

In this study, we aimed to evaluate the ability to definitively treat with URSL and compare postoperative complications to patients with no sepsis. Current standard guidelines according to EAU state that although most small ureteric calculi can be spontaneously passed, some patients develop complications (infection, refractory pain, deterioration of renal function) and need a stone removal procedure. Indications for removal of ureteral stones are stones with a low likelihood of spontaneous passage, persistent pain despite adequate analgesic medication, persistent obstruction and renal insufficiency (renal failure, bilateral obstruction, or single kidney). But if a patient develops a clinically significant infection and obstruction, guidelines suggest to treat infection with subsequent drainage for several days before starting stone removal. However, in a study by Mohamed Bakr, for ureterolithotomy in patients with mild sepsis, no differences with regard to safety and complications, or length of admission, were found, in comparison to preop-procedure Double-J ureteral stent insertion with definitive URS management.[6,7] A systematic review showed that older age, comorbidities such as diabetes mellitus and ischemic heart disease, preoperative stent placement, positive urine culture, and longer procedure time were independently associated with increased postoperative urosepsis risk.[4] Also, Laih et al found that age, operative time, hydronephrosis, proximal location, SOFA and qSOFA scores were significantly associated with postoperative sepsis with SOFA score being the highest predictor of sepsis.[12]

Our results showed that baseline characteristics, degree of hydronephrosis and stone position in both groups were not significantly different, with the exception of the average age of the non-sepsis group being higher than the sepsis group. The most common organism causing urinary tract infection in Sisaket hospital is *E.coli.* Susceptibility to antibiotics from previous data collected in our hospital showed susceptibility to cephalosporins as 60%, carbapenem 85% and quinolones as about 32%. Therefore, the antibiotics that were mostly used in this study were from the cephalosporin groups consistent with the previous recommendations by the AUA that did not recommend quinolones due to higher drug resistance. The duration of preoperative and postoperative antibiotic prophylaxis is unclear, given the paucity of research for high-risk patients.[13] In this study the the duration of antibiotics before the procedure is not significantly different in the two groups. In the sepsis group, we started antimicrobial drugs as soon as possible and wait for the availability of the operating room and team.

In the non-sepsis group, we started antimicrobial drugs when patients were admitted the night before surgery. National and regional antibiotic resistance patterns can differ significantly; the choice of antibiotic prophylaxis should be tailored to institutional or regional antimicrobial susceptibility. Despite the duration of symptoms and previous procedures, other perioperative parameters were comparable. The operative data from both groups did not differ significantly i.e. operative time, postoperative ureteral stent, stone fragmentation and anesthesia.

However, patients in the emergent URS group had a significantly longer operative time, which increased the risk of perioperative urinary tract infection in the previous study. But in this study, the incidence of postoperative urosepsis was not significantly different in the two groups. Although the sepsis group had a higher rate of postoperative fever, they have the same rate of septicemia as the non-sepsis group and no need of any further procedure with the exception of empirical broad-spectrum antibiotics. New techniques and higher-quality equipment may help to decrease urosepsis. At our institution, we do not currently measure intrarenal backflow, a factor that may contribute to higher infection rates.[13] Potential increases in intrarenal pressure are related to infectious and hemorrhagic complications, as well as kidney damage.[14] This is an area where modern technology and methods offer significant advantages. Consequently, URS under appropriate antimicrobial coverage and with skilful surgeons appears to be a feasible and safe option for the treatment of infected hydronephrosis.[7] Our subgroup analysis revealed no statistically significant differences in postoperative complications across patient ages, gender or comorbidities. The advantages of emergency ureteroscopy from a meta-analysis by Picozzi et al. showed significant advantages regarding immediate ureteroscopy for ureteral stone colic and presents as being a safe treatment with a high success rate, more rapid stone clearance, relief from colic pain and a reduction in follow-up visits, radiation exposure and ultimately the costs.[15]

The results showed that definitive URSL in the sepsis group increased the length of hospital stay. When reviewing medical records regarding the cause of increased hospitalization, it was found that patients were admitted longer, waiting 2-5 days for hemoculture and urine culture results. Some patients also required treatment for comorbidities, such as anemia in chronic disease requiring transfusion. It was also found that operative pain scores were slightly higher in the sepsis group than in the non-sepsis group with average pain scores of 1.17 and 0.77, respectively.

Conclusions

URSL without pre-procedure urinary tract diversion appears to be a safe and effective alternative to temporary ureteral stenting in carefully chosen cases of urinary tract infection. There were no significant operative complications with regard to differences in subsequent management, However, increased length of hospital stay and slightly higher postoperative pain were factors associated with sepsis. The definitive treatment with URSL is safe for ureteric stone in UTI without multi-organ failure patients. Risk of selection bias and lack of information regarding postoperative imaging are potential limitations. Further large comparative studies with adequate follow-up in relation to stone clearance are recommended to support our results.

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Conflict of Interest

The author declares no conflicts of interest.

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Original Article

A comparison of complications following transperineal and transrectal prostate biopsy in Rajavithi Hospital

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Keywords:
Transrectal, transperineal, biopsy, complications, MRI fusion biopsy

Abstract

Objective: Prostate cancer is one of the most prevalent cancers globally. While transrectal ultrasound-guided biopsy remains the gold standard, it carries several risks of complication. Recent advancements in 3D magnetic resonance imaging have improved cancer detection rates and reduced the incidence and severity of complications. Since 2021, Rajavithi Hospital has implemented this technology, yielding promising results but lacking comprehensive data regarding complications. The objective of this study is to compare the complications associated with prostate biopsy via the perineum versus the rectum and investigate the factors related to the occurrence of complications from prostate biopsy.

Materials and Methods: This retrospective study was performed using data from patients who underwent MRI fusion prostate biopsy in the Division of Urology, Department of Surgery, Rajavithi Hospital between 2021 and 2024. Data were collected from medical records, including age, digital rectal examination, PIRADS score, history of previous biopsy, biopsy core, Gleason score, prostate volume, PSA, and methods.

Results: A total of 200 patients underwent prostate biopsy, with 150 patients (75.0%) receiving the procedure via the transperineal route and 50 patients (25.0%) via the transrectal route. A total of 34 patients experienced complications: 26 in the the transperineal approach group and 8 in the transrectal approach group. A urinary tract infection (UTI) was reported in several cases after the transrectal procedure, but the findings were not statistically significant ($p = 0.250$). Complications such as gross hematuria, LUTS, pain, hematochezia, hematospermia, and AUR occurred variably without statistical significance.

Conclusion: This study found no significant difference in complications associated with prostate biopsy via the perineum and the rectum. The most common complication from both methods is lower urinary tract symptoms (LUTS).

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Introduction

Prostate cancer is one of the most common cancers among men, accounting for approximately 21.0% of all cancer cases. In Thailand, it ranks as the fourth most common cancer in males. The mortality rate associated with prostate cancer is reported as being 10.0%.[1]

Since 1991, the mortality rate from prostate cancer has gradually declined, because of several factors: earlier screening through prostate-specific antigen (PSA) testing, advancements in treatment, and the emergence of other causes of mortality during prostate cancer treatment.[2]

The utilization of PSA testing in conjunction with prostate biopsy has significantly influenced the incidence and mortality rates of prostate cancer. In the United States, the screening has led to an increase in prostate cancer detection rates from 7.8% to 12.9%, while the mortality rate from prostate cancer has decreased from 3.0% to 1.8%.[1]

Currently, the U.S. Preventive Services Task Force (USPSTF) recommends PSA screening for men aged 55 to 69 years (Grade C) and advises against routine screening for men over 70 years (Grade D) to mitigate unnecessary treatment in cases of low-risk prostate cancer.[3]

A method for prostate biopsy using ultrasound, which initially recommended the collection of six tissue samples, has evolved to a standard collection of twelve samples.[4] Prostate biopsy via the transrectal approach utilizes an 18-gauge needle, which is guided by an ultrasound probe. In contrast, the transperineal approach is indicated for patients without a rectum, such as those who have undergone surgical procedures or have congenital abnormalities. A lower risk of post-procedural infection has been demonstrated in the latter approach.

The advancement of multiparametric magnetic resonance imaging (mpMRI) has enhanced the ability to detect prostate cancer lesions. Additionally, mpMRI fusion with prostate biopsy has improved the efficacy of tissue sampling with regard to increased sensitivity in comparison to transrectal ultrasound (TRUS) biopsy (93.0% vs. 48.0%) and a higher negative predictive value (89.0% vs. 74.0%). However, this technique hasresulted in decreased specificity (41.0% vs. 96.0%) and positive predictive value (51.0% vs. 90.0%).[5] Overall, mpMRI fusion with prostate biopsy shows a greater detection rate of clinically significant cancers while reducing the incidence of clinically insignificant cancers in comparison to traditional methods.[6]

Infection is the most common complication after prostate biopsy, with rates ranging from 0.1% to 7.0%. Sepsis has been shown to occur at rates between 0.3% and 3.1%.[7] Most infections manifest as symptomatic urinary tract infections or mild fever. Hospitalization rates due to infection increased from 0.6% to 4.1%[8,9], but mortality rates remained within the typical range for general infections.[10,11] A primary factor contributing to severe infections is the presence of fluoroquinolone-resistant bacteria in fecal matter.[12]

Hemorrhage is another frequent complication following prostate biopsy.[13] Studies indicate that patients experience hematuria in 23.0% to 63.0% of cases post-biopsy, with urinary retention having an incidence of 0.7% urinary due to blood clots. Rectal bleeding occurs in 2.1% to 21.7% of patients, typically presenting as minor bleeding that responds well to pressure. Additionally, some patients report hematospermia, with frequency ranging from 9.8% to 50.4%, which may be clinically insignificant but often causes anxiety among patients[14,15]. Urinary retention occurs in approximately 0.2% to 0.4% of patients following the procedure.

The aim of thisstudy is to compare complications from prostate biopsy through the perineum versus the rectum and identify factors linked to these complications.

Materials and Methods

This retrospective study included all patients who underwent mpMRI fusion prostate biopsy between 2021 and 2024 at Rajavithi Hospital in Bangkok, Thailand. Medical records of inpatient notes, outpatient notes and operative notes were reviewed .

The data collected included age, digital rectal examination (DRE), PIRADS score, history of previous biopsy, biopsy core, Gleason score, prostate volume, PSA levels, and approach. Data pertinent to complications was also collected from medical records within 14 days of the procedure. This study was approved by the Ethics and Research Committee of Rajavithi Hospital. Incomplete data from medical records were excluded in this study.

Statistical analysis

Data analyses were performed using SPSS, version 22.0 (SPSS Inc., Chicago, IL, USA). The categorical variables were presented as number and percentages. Comparisons between the two groups were analyzed using the chi-squared or Fisher's exact test. A p-value less than 0.05 was considered to be statistically significant.

Results

A comparison of complications between transperineal and transrectal biopsy approaches is shown in Table 1. The study included 150 patients in the transperineal group and 50 patients in the transrectal group. Complications were reported in 26 cases from the transperineal group (17.3%), while 8 cases were reported in the transrectal group (16.0%). No urinary tract infections (UTIs) were documented in the transperineal group. However, 1 case was recorded in the transrectal group (2.0%). Gross hematuria occurred in 4 cases within the transperineal group (2.6%) and 1 case in the transrectal group (2.0%). The most common complication in the transperineal group was lower urinary tract symptoms (LUTS), with an overall incidence of 8.0%. These symptoms included urgency and dysuria, with the latter being more prevalent. In contrast, the most frequent complications in the transrectal group were urgency and urinary retention, each affecting 4.0% of patients. One case of both hematochezia and hematospermia were observed in the transrectal

Table 1. Comparison of complications following transperineal and transrectal prostate biopsy.

Factors	Methods of biopsy		P-value
	Transperineal (n =150) n (%)	Transrectal prostate (n = 50) n (%)	
Complication			0.828[a]
Yes	26 (17.3)	8 (16.0)	
No	124 (82.7)	42 (84)	
Gross hematuria			1.000[b]
Yes	4 (2.7)	1 (2.0)	
No	146 (97.3)	49 (98.0)	
Hematochezia			0.250[b]
Yes	0 (0.0)	1 (2.0)	
No	150 (100.0)	49 (98.0)	
Hematospermia			1.000[b]
Yes	4 (2.7)	1 (2.0)	
No	146 (97.3)	49 (98.0)	
UTI			0.250[b]
Yes	0 (0.0)	1 (2.0)	
No	150 (100.0)	49 (98.0)	
AUR			1.000[b]
Yes	6 (4.0)	2 (4.0)	
No	144 (96.0)	48 (96.0)	
LUTS			0.524[b]
Yes	12 (8.0)	2 (4.0)	
No	138 (92.0)	48 (96.0)	
Pain			1.000[b]
Yes	2 (1.3)	0 (0.0)	
No	148 (98.7)	50 (100.0)	
Scrotal hematoma			1.000[b]
Yes	1 (0.6)	0 (0.0)	
No	149 (99.4)	50 (100.0)	

Values are represented as n (%), [a] = The p-value from Pearson Chi-Square, [b] = The p-value from Fisher's Exact Test, * significant at $p < 0.05$

UTI = urinary tract infection, AUR = acute urinary retention

group (2.0%). No hematochezia was found in the transperineal group. However, hematospermia was noted in 4 cases within the transperineal group (2.6%). Additionally, pain and scrotal hematoma were reported solely in the transperineal group, with an incidence of 2 cases (1.3%) and 1 case (0.6%), respectively.

Based on the data presented in Table 1, there were no statistically significant differences in the incidence of complications between the transperineal and transrectal biopsy groups.

The associated factors of complications are shown in table 2. DRE was the sole factor associated with complications, with normal DRE leading to more complications compared to abnormal DRE. (21.5% and 7.7% respectively) (p = 0.015)

Discussion

200 patients who underwent mpMRI fusion prostate biopsy at Rajavithi Hospital were analyzed, 150 patients were placed in the transperineal group and 50 patients in the transrectal group. There weas an incidence of 26 complications observed in the transperineal group (17.3%) and 8 cases in the transrectal group (16.0%). The most common complication in both groups was LUTS.

Table 2. Factors associated with complications following transperineal and transrectal prostate biopsy.

Factors	Complications		P-value
	No (n = 166) n (%)	Yes (n = 34) n (%)	
Age Group (years)			0.052[a]
50-59	13 (81.3)	3 (18.8)	
60-69	67 (76.1)	21 (23.9)	
≥ 70	86 (89.6)	10 (10.4)	
UD			0.772[a]
None	29 (82.9)	6 (17.1)	
DM	35 (79.5)	9 (20.5)	
None DM	102 (84.3)	19 (15.7)	
History of prior biopsy			0.651[a]
No	52 (81.3)	12 (18.80)	
Yes	114 (83.8)	22 (16.2)	
DRE			0.015[a*]
Unsuspected	106 (78.5)	29 (21.5)	
Suspected	60 (92.3)	5 (7.7)	
PSA			0.075[b]
< 4	4 (100.0)	0 (0.0)	
4-9	63 (75.9)	20 (24.1)	
≥ 10	99 (87.6)	14 (12.4)	
Number of core biopsy			0.381[b]
< 20	20 (90.9)	2(9.1)	
≥ 20	146 (82.0)	32 (18.0)	
PIRADS			0.759[b]
< 3	4 (100.0)	0 (0.0)	
3	46 (79.3)	12 (20.7)	
4	63 (85.1)	11 (14.9)	
5	53 (82.8)	11 (17.2)	
Volume			0.472[a]
≥ 25	13 (92.9)	1 (7.1)	
> 25	153 (82.3)	33 (17.7)	

Values are represented as n (%), [a] = The p-value from Pearson Chi-Square, [b] = The p-value from Fisher's Exact Test, [*] significant at $p < 0.05$

UD = underlying diseases, DM = diabetes melitus, PSA = prostate-specific antigen, DRE = digital rectal examination

Urinary retention was a second common complication in the transrectal group. These differences did not reach statistical significance. These findings suggest that both biopsy techniques carry similar risks of complications, leading clinicians to make decisions based on other factors such as patient preference, clinical indications, and procedural considerations rather than concerns about complication rates.

According to a study by Andrea Alberti et al. in 2023[16] which demonstrated that most complications following mpMRI fusion transrectal prostate biopsy were classified as Clavien-Dindo (CD) grade 1 including hematuria, hematochezia, hematospermia, and multiple conditions and as CD grade 2 including urinary retention and infection. Similarly, in our study most complications were CD grade 1 and only 3 cases were CD grade 2. The study same by Alberti et al. also indicated that age over 70 years and a body mass index (BMI) greater than 25 kg/m^2 were significant predictors of post-procedural complications. But in our study, a surprising finding was that normal DRE was significantly associated with more complications. We hypothesized that a normal DRE may lead to a higher number of core biopsies in comparison to patients with initial abnormal findings. The data revealed that among the 135 patients with normal DRE, 126 patients (93.3%) had more than 20 core biopsies collected. In contrast, among the 65 patients with abnormal DRE, 52 patients (80.0%) had more than 20 core biopsy collected. However the analysis of the number of biopsy cores did not show a statistically significant relationship with complications. This lack of significance could be due to the small number of complication cases. We concluded that mpMRI fusion transrectal prostate biopsy is a safe procedure with a low risk of severe complications when performed by experienced professionals.

In a study conducted by Sebastian Berg et al. in 2023, complications following mpMRI fusion prostate biopsy via the transperineal approach were compared to those from the transrectal approach. The study specifically included patients at low risk of infection-related complications and concluded that transrectal prostate biopsy is associated with a higher incidence of infection-related complications in comparison to transperineal biopsy.[17] In our study there was only 1 case of infection related complications, observed in transrectal group. No statistically significant difference in infection-related complications was observed between the two groups, even when patients with low infection risks were not excluded from the analysis. In practical hospital settings, urologists often prescribe a seven-day course of antibiotics due to the socioeconomic challenges of many patients, which limits their access to medical services. This practice may lead to a lower-than-anticipated incidence of infection-related complications. We suggest that either method can be applied based on the discretion and expertise of the surgeon.

A comparative study conducted by Po-Fan Hsieh et al. reported a higher incidence of urinary retention among patients undergoing transperineal biopsy in comparison to those receiving transrectal biopsy (18.5% vs. 4.7%, p = 0.009).[18] However, our findings indicated that equivalent rates of urinary retention occurred following both transperineal and transrectal biopsy procedures (4.0% vs. 4.0%). Consequently, it is advisable to inform patients about the risks for urinary retention in both procedures, which should not influence the discretion of the surgeon in selecting the approach.

There are some limitations in this study, for example the various procedures were performed by many urologists and residents therefore, the levels of expertise and experience were not equal. Moreover, this study was carried out in a single center meaning the findings may not be transferable.

Conclusion

In this study, there were no statistically significant differences in complications between the two groups. We recommended that either method can be employed according to the judgment and expertise of the surgeon.

Conflict of Interest

The authors declare no conflict of interest.

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Invited Review Article

Robotic urologic reconstruction: preservation of open principles and expansion of possibilities

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Keywords:
Robotic surgery, urologic reconstruction, single-port robot

Abstract

Robotic surgery has transformed the carrying out of many urological subspecialties, but its greatest potential may lie in complex reconstruction. Traditional open surgery remains the foundation for urethral and ureteral reconstruction, where tactile feedback and vascular preservation are paramount. However, robotic technology now enables these same principles to be applied with magnified precision, stable visualization, and access to planes once unreachable by hand. This review summarizes how robotic systems offer new dimensions in reconstructive urology from retroperitoneal access to fluorescence-guided dissection, and discusses their applications in ureteral, bladder neck, and gender-affirming surgeries.

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Introduction

By necessity, reconstructive urology has always been a field of precision, patience, and anatomical respect. Whether repairing a urethral stricture or reconstructing a ureter, the goal remains unchanged: to restore continuity between healthy, well-vascularized tissue without tension.[1] Traditionally, open surgery offered the tactile feedback and direct visualization needed for such meticulous work. Yet open approaches are associated with longer recovery, larger incisions, and limited exposure in deep or re-operative fields.[2]

With the advent of robotic technology, many urologists questioned whether its advantages can be applied to reconstruction. Over the past decade, evidence and experience have shown that robotics does not replace open principles, it refines them. The robot serves as an extension of the hands and eyes of the surgeon, enhancing precision, vascular preservation, and ergonomics in complex cases once considered too challenging for minimally invasive surgery.[2]

Access and exposure: from limited space to optimal visualization

Surgical evolution has often been driven by improved visualization. Laparoscopic cholecystectomy, for instance, replaced open surgery for cholecystitis not because it was luxurious or high-tech, but because it offered superior operative

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vision which allowed surgeons to clearly identify small vessels in conjunction with a critical view of safety.[3]

Robotic surgery offers a similar step forward for reconstructive urology. For example, the open Y-V plasty for bladder neck contracture has existed since 1975[4] but was rarely performed due to poor exposure of the retropubic (Retzius) space. With the robotic system, this procedure has become both feasible and reproducible[5], mirroring the transition from open to robotic radical prostatectomy.

A key debate in reconstructive surgery concerns the route of access. Traditional open retroperitoneal surgery minimizes bowel manipulation and avoids the peritoneal cavity, reducing postoperative ileus and adhesions. Early laparoscopic and robotic procedures, however, were mainly intraperitoneal, raising concerns about bowel complications and prolonged recovery.[6]

The single-port (SP) robotic system has reshaped this paradigm. Using a low anterolateral incision[7] about two fingerbreadths above the pubic ramus, surgeons can directly enter the retroperitoneum. This technique parallels the classic Gibson incision but benefits from robotic articulation and enhanced visualization for deep, controlled dissection with minimal trauma. Importantly, it can be performed in the supine or lithotomy position, eliminating the need for flank positioning, which adds time and morbidity.[8]

This approach provides a familiar plane for open-trained urologists while preserving the advantages of minimally invasive surgery, specifically reduced pain, faster recovery, and superior visualization. It has proven especially useful for buccal graft ureteroplasty, retroperitoneal pyeloplasty, and donor nephrectomy, and is particularly valuable for patients with a "hostile abdomen" due to prior surgery and radiation.[7]

Seeing beyond the scar: near-infrared fluorescence (NIRF) and ICG guidance

One of the greatest challenges in re-operative reconstruction is the distinguishing of viable from scarred tissue. In open surgery, surgeons relied on palpation and color, skills difficult to reproduce through a laparoscopic lens.

Robotic systems equipped with NIRF and indocyanine green (ICG) imaging have changed this.[9] By injecting ICG via a nephrostomy or retrograde ureteric catheter, or by using white-light endoscopy, surgeons can visualize the ureter in real time[2] (Fig. 1). Under NIR light and intravenous ICG (add and intravenous ICG), poorly perfused or ischemic segments appear dark, while healthy

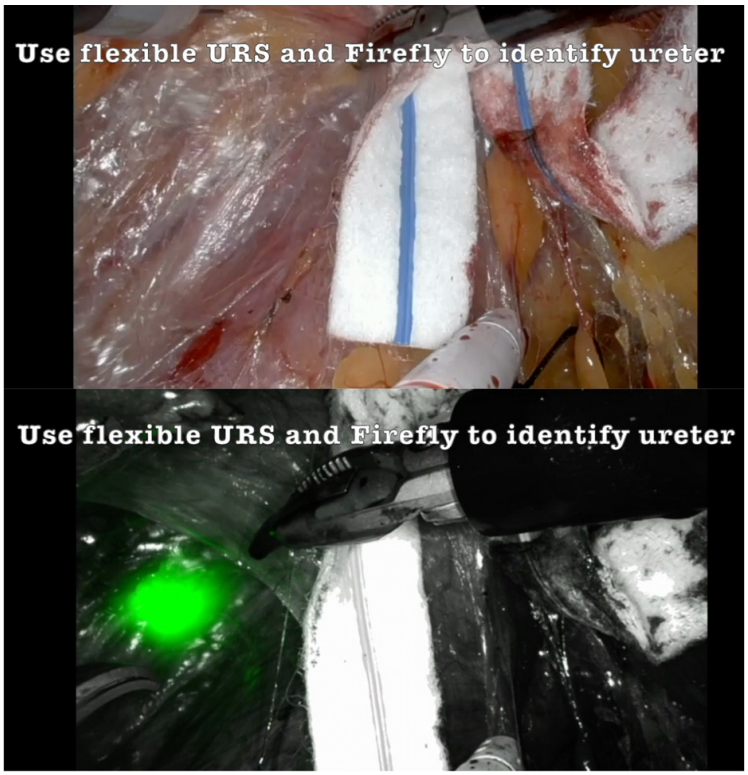

Figure 1. A and B demonstrate ureteral identification using white light from a ureteroscope combined with near-infrared fluorescence imaging.

tissue fluoresces brightly facilitating accurate identification of strictures, preservation of viable segments, and confirmation of perfusion before anastomosis[2] (Fig. 2).

This ability to "see the unseen", the vascular integrity of ureteral or bladder tissue, improves reconstructive precision and supports the same vascular principles long emphasized in open surgery.

Technical advantages beyond visualization

Beyond 3D magnification and tremor filtration, robotic systems offer several key advantages that directly impact reconstructive precision:

1. Tremor elimination and motion scaling

Delicate tasks such as suturing a 3 mm ureter are stabilized by tremor elimination and motion scaling (e.g., 3:1 or 5:1)[10]. This allows fine, watertight anastomoses that would be technically challenging by hand.

2. Instrument dexterity in confined spaces

Seven degrees of wrist motion enable maneuvers impossible with straight laparoscopic tools[11] an aspect particularly useful in deep pelvic or reoperative fields, such as posterior urethral reconstruction.

3. Surgeon ergonomics

The ergonomic design of the robotic system reduces physical strain[12], allowing surgeons to maintain precision even during long reconstructive cases. This aspect translates into better consistency and fewer fatigue- related errors.

Applications in reconstructive urology

Robotic technology has expanded the horizons of reconstructive urology by combining the precision of open surgery with minimally invasive benefits. Enhanced visualization, superior articulation, and real-time vascular imaging have made robotics invaluable in complex reconstructions.

1. Pyeloplasty

Robotic pyeloplasty is now the preferred minimally invasive approach for ureteropelvic junction obstruction (UPJO), with success rates above 90–95%.[13,14] Excellent outcomes have also been demonstrated with Y-V pyeloplasty and re-operative cases with less pain, blood loss, and shorter hospitalization in comparison with open repairs.[15,16]

2. Ureteral reconstruction

The robotic platform supports diverse reconstructive techniques including uretero-ureterostomy, ureteroneocystostomy with psoas hitch or Boari flap, and ileal or appendiceal substitution.[2,17]

Robotic buccal mucosa graft (BMG) ureteroplasty is particularly suited for long or recurrent strictures, enabling tension-free, watertight anastomoses with excellent visualization. ICG assists in assessing graft bed perfusion. In cases involving very long defects, robotic ileal ureter substitution has achieved success rates approaching 100% with low morbidity.[18]

3. Bladder neck and posterior urethral reconstruction

Robotics provides superb exposure in deep pelvic spaces. After failed endoscopic incisions, robotic Y-V plasty[5] and buccal graft bladder

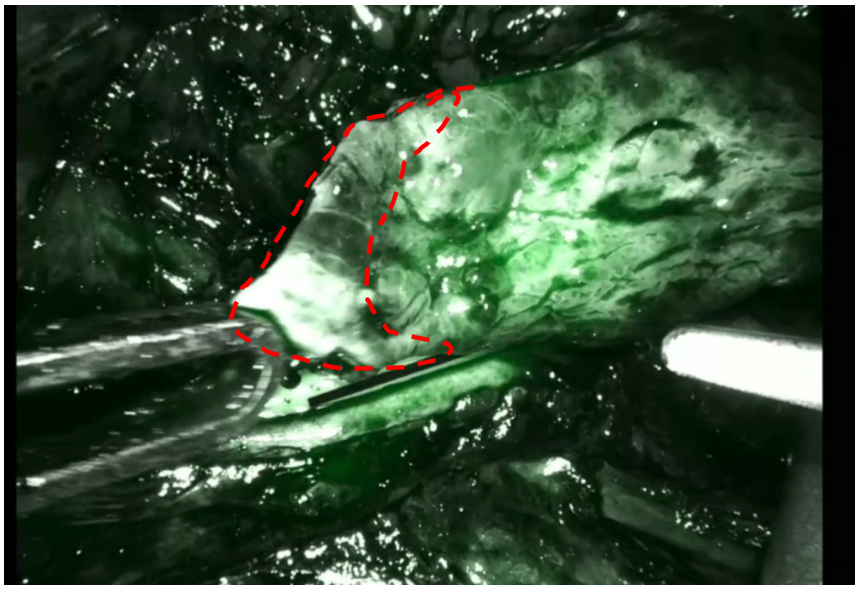

Figure 2. Spiral renal pelvic flap – the red line indicates the area of hypoperfusion.

neck reconstruction[19] have been shown to allow precise dissection of the posterior bladder neck and trigone, areas often difficult to access even in open surgery.[20]

In selected pelvic fracture urethral injury (PFUI) cases[21], robotics have been shown to enhance visualization during combined abdomino-perineal approaches and facilitate tension-free anastomosis in re-operative or complex cases.

4. Ureteroenteric stricture and augmentation cystoplasty

Robotic repair of ureteroenteric strictures after urinary diversion offers comparable success to open repair, with less blood loss and quicker recovery.[22] Similarly, robotic augmentation cystoplasty has been shown to achieve equivalent functional outcomes while minimizing incision-related morbidity.[23]

5. Transgender and gender-affirming surgery

Robotic assistance improves precision and safety in gender-affirming surgery[24,25] by allowing clear visualization of the rectoprostatic and rectovaginal planes, thereby reducing complications such as rectal injury in vaginoplasty or urethro-vaginal fistula during vaginectomy for phalloplasty.

Limitations and learning curve

Despite its advantages robotic reconstruction still presents several challenges:

- Cost and access remain significant barriers, particularly in developing regions where robotic systems are scarce.[26]
- Loss of tactile feedback requires adaptation, as surgeons must rely on visual cues to assess tissue tension and perfusion. The new da Vinci 5 robotic surgical system introduces limited tactile feedback, but further evidence is needed to confirm its benefit.[27]
- Access to training remains demanding since reconstructive cases are relatively rare. Mentorship, fellowship programs, and simulation training are essential to shorten the learning curve.[28]

As technology becomes more accessible and experience spreads, these limitations are steadily diminishing. The next generation of urologists will most likely view robotic reconstruction as a standard component of their practice rather than a specialized niche.

Philosophy: technology as a tool, not a replacement

At its core, reconstructive urology is an art guided by enduring principles regarding the need for tension-free anastomosis, preservation of blood supply, and gentle tissue handling. Robotics does not replace these principles; it magnifies our ability to apply them in confined or difficult spaces.

Robotic systems allow surgeons to see more, preserve more, and injure less, bringing open surgical craftsmanship into a minimally invasive era.

Conclusion

Robotic surgery has evolved from a minimally invasive option to a powerful reconstructive platform. It preserves the foundational principles of open surgery while expanding access, enhancing visualization, and improving anatomical fidelity.

Rather than viewing open and robotic techniques as opposing approaches, they should be seen as complementary instruments within the same surgical orchestra where technology enhances, but never replaces, the judgment and skill of the surgeon.

Conflict of Interest

The authors declare no conflict of interest.

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Case Report

MRI-PET fusion biopsy in prostate cancer at Lerdsin Hospital: two cases report

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Keywords:
Prostate cancer, MRI-PET fusion, targeted biopsy, mpMRI, PSMA PET, image-guided biopsy

Abstract

MRI–PET fusion biopsy is a novel technique that enhances the accuracy of prostate lesion localization and sampling. This method potentially improves diagnostic precision when compared with conventional MRI-guided biopsy. In the two cases described here MRI–PET fusion ultrasound biopsy was utilized for prostate cancer evaluation. A 65-year-old male with a prostate-specific antigen (PSA) level of 8.0 ng/ml underwent prostate MRI, which revealed two suspicious lesions (PI-RADS 5 and PI-RADS 4). MRI–PET imaging alone identified only the PI-RADS 5 lesion (SUVmax 21.51) and an additional area of uptake in the transitional zone (SUV 6.83). Fusion biopsy confirmed adenocarcinoma Gleason score (GS) 4 + 4 and 4 + 3 in the PI-RADS 5 and 4 lesions, respectively, while the transitional zone was benign (BPH). Laparoscopic radical prostatectomy confirmed GS 4 + 4 with 10% tumor involvement. The second case involved a 75-year-old male with a PSA level of 7.53 ng/ml who underwent MRI, which demonstrated PI-RADS 5 and 3 lesions. PET imaging showed positive uptake in both (SUVmax 10.53). Fusion biopsy revealed benign prostatic hyperplasia in both lesions. In these two cases, MRI–PET fusion ultrasound biopsy enabled improved lesion detection and boundary delineation in comparison with standard MRI. Although slightly more expensive, this technique may enhance diagnostic accuracy. Further studies are warranted to evaluate its role in patients with PSA levels of 4–10 ng/ml.

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Introduction

MRI–PET fusion prostate biopsy for prostate cancer detection

Prostate cancer is one of the most prevalent malignancies affecting men worldwide. Its early and accurate detection is crucial for effective treatment and improved outcomes. Traditional diagnostic methods, including prostate-specific antigen (PSA) testing and digital rectal examination (DRE), have limited specificity and sensitivity, often resulting in unnecessary biopsies or missed diagnoses.[1] Standard transrectal ultrasound (TRUS)-guided biopsy, although commonly used, also lacks precision in targeting suspicious intraprostatic lesions.[2]

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Multiparametric magnetic resonance imaging (mpMRI) has substantially enhanced the detection and localization of clinically significant prostate cancer (csPCa) by providing high-resolution anatomical and functional information.[3] Prostate-specific membrane antigen (PSMA) is a 750-amino acid type II membrane glycoprotein highly expressed in prostate cancer cells but present at low levels in normal prostate and certain non-prostatic tissues (e.g., kidneys and salivary glands). It plays a critical role in both diagnostic imaging and therapeutic targeting of prostate cancer. Radiotracers such as 68Ga-PSMA-11 or 18F-DCFPyL, enable highly sensitive detection of prostate cancer lesions at primary, metastatic, or recurrent sites, outperforming conventional imaging modalities (CT, MRI, bone scan), particularly in cases with low PSA levels.[4,5]

MRI–PET fusion prostate biopsy involves the co-registration of mpMRI and PET images to generate a detailed map of the prostate, identifying areas of increased metabolic activity suggestive of malignancy. These fused images guide targeted biopsies, improving sampling accuracy while minimizing unnecessary tissue extraction.[6] Studies have demonstrated that MRI–PET fusion biopsy increases the detection rate of clinically significant prostate cancer in comparison to conventional TRUS-guided biopsy, especially in patients with prior negative biopsy results but persistently elevated PSA levels.[7]

A recent study confirmed similar findings, particularly among patients at high risk of prostate cancer, showing a diagnostic accuracy of 68Ga-PSMA PET/CT at 92.0% compared with 86.2% for mpMRI.[8]

The PRIMARY score is a five-category scale developed to identify csPCa on 68Ga-PSMA-11 PET/CT using a combination of anatomical sites, uptake pattern, and intensity. Previous studies reported an area under the curve (AUC) of 0.796 (95% confidence interval (95%CI): 0.738-0.853) for the PRIMARY score and 0.851 (95%CI: 0.783-0.918) for SUVmax, although the specificity of the PRIMARY score was limited to 65.0% when comparing scores 3-5 versus 1-2.[9]

By integrating the superior anatomical resolution of an MRI with the metabolic and molecular imaging capabilities of a PET, MRI–PET fusion biopsy represents a significant advancement in prostate cancer diagnostics. It offers several potential advantages including reduced detection of indolent tumors, improved risk stratification, and enhanced guidance for focal therapy and active surveillance.[10] The aim of this study is to apply the technique in two patients with PSA levels between 4-10 ng/ml to evaluate the procedural steps, advantages, and limitations of this newly introduced method in Thailand.

Case Report

Case 1

A 65-year-old Thai male with a history of dyslipidemia and previous transitional cell carcinoma (TCC) of the right renal pelvis presented with lower urinary tract symptoms (LUTS) and an elevated PSA level of 8.0 ng/ml. He had undergone laparoscopic right nephroureterectomy with bladder cuff excision three years earlier. To further evaluate his condition, mpMRI combined with 18F-PSMA PET was performed at Chulabhorn Hospital.

Imaging findings:

- MRI findings:
  - o A lesion measuring 0.9 × 0.6 × 0.9 cm with marked diffusion restriction located in the right anterior transition zone, classified as PI-RADS 5 (lesion A).
  - o A second lesion, measuring 0.5 cm, located in the right peripheral zone, corresponding to PI-RADS 4 (lesion B).
- 18F-PSMA PET/MRI findings:
  - o A PSMA-avid hypo-T2 nodule (0.9 × 0.6 × 0.9 cm) with significant diffusion restriction in the right anterior transition zone at the mid-gland level (SUV = 21.51), suspicious for malignancy (lesion C).
  - o Diffuse mild PSMA uptake (standardized uptake value (SUV) = 6.83) in a symmetrical hypo-T2 lesion with moderate diffusion restriction at the posterior paramedian region of the prostatic base (lesion D).

The patient received a rectal enema the day before the procedure and an intravenous dose of ceftriaxone 2 gm administered 30 minutes prior to surgery. Before biopsy, 18F-PSMA PET/MRI data were imported into the Koelis Trinity System (Model KURO-3000) workstation, and prostate boundaries were delineated on MRI. A SUV threshold of 2.5 was used to define PET-positive lesions[11], which were marked as biopsy targets. Lesion SUV and volume were recorded for analysis.

Under spinal anesthesia and with Trendelenburg positioning, the MRI-defined prostate volume (from T2W images) was registered with the real-time 3D transrectal ultrasound data using the Koelis system's tracking algorithm, allowing precise localization of PET-positive targets for biopsy. Transperineal biopsies were then performed and divided into five groups according to imaging correlation and sampling strategy:

- Group 1: MRI (+), PET (+) — Lesion A = Lesion C (SUV = 21.51)
- Group 2: MRI (+), PET (−) — Lesion B
- Group 3: MRI (−), PET (+) — Lesion D (SUV = 6.83)
- Group 4: Systematic (random) biopsy – right peripheral zone
- Group 5: Systematic (random) biopsy – left peripheral zone

Collected tissue samples were sent to the Institute of Pathology, Ministry of Public Health. After the biopsy, the patient was admitted for observation for 24-hours and discharged the following day. He was prescribed ciprofloxacin 500 mg twice daily for five days and advised to return immediately if complications occurred. Post-procedure, he experienced mild hematuria for two days with no other adverse events. Follow-up for pathology results was scheduled for two weeks post-op (Fig. 1).

Pathological results

- Group 1: Prostatic acinar adenocarcinoma, Gleason score 4+4 = 8 (Grade Group 4)
  - o Tumor involved 2 of 7 cores (~5% of total tissue)
  - o Cribriform glands: present
  - o Perineural invasion: not identified
- Group 2: Prostatic acinar adenocarcinoma, Gleason score 4+3 = 7 (Grade Group 3)
  - o Tumor involved 1 of 6 cores (~20% of total tissue)
  - o Cribriform glands: present
  - o Perineural invasion: not identified
- Group 3: Benign prostatic tissue
- Group 4: Prostatic acinar adenocarcinoma, Gleason score 3+3 = 6 (Grade Group 1)
  - o Tumor involved 1 of 6 cores (~2% of total tissue)
  - o Cribriform glands: not identified
  - o Perineural invasion: not identified
- Group 5: Benign prostatic tissue

3 months later, the patient underwent a laparoscopic radical prostatectomy with bilateral pelvic lymph node dissection. Intraoperatively, mild adhesion was noted at the perineum, with an estimated blood loss of 100 ml. The pathological report revealed the following findings:

Prostate gland

- Diagnosis: acinar adenocarcinoma
- Gleason Score: 4 + 4 = 8 (Grade Group 4)
- Intraductal carcinoma: present
- Tumor involvement: approximately 10% of the entire prostate gland
- Cribriform glands: present
- Extraprostatic extension: not identified
- Seminal vesicle invasion: not identified
- Surgical margins: all resection margins free of tumor
- Lymphovascular invasion: not identified
- Perineural invasion: not identified

Pelvic lymph nodes

- Metastasis: No evidence of metastatic disease in examined lymph nodes

Case 2

A 75-year-old Thai male with a medical history of psoriasis presented with a six-month history of lowLUTS, including urinary frequency, urgency, nocturia (2–3 times per night), and a sensation of incomplete bladder emptying. He had no history of urinary tract infections, hematuria, or urinary retention. Initial treatment with alfuzosin (Xatral XL) 10 mg once daily at bedtime resulted in partial improvement of symptoms. The PSA level at presentation was 4.37 ng/ml, however, a repeat test three months later revealed a rise to 7.53 ng/ml, prompting further evaluation with multiparametric MRI (mpMRI).

MRI findings:

- A 2.4 × 1.6 cm lesion in the left transitional zone extending from the base to the mid-gland and involving the peripheral zone. The lesion exhibited capsular bulging, raising suspicion for extraprostatic extension, and was classified as PI-RADS 5 (version 2.1).
- A 1.0 cm low-T2-signal nodule with an indistinct margin in the right transitional zone at the mid-gland level, classified as PI-RADS 3 (version 2.1).

Figure 1. MRI–PET fusion prostate biopsy in case 1

- No evidence of suspicious pelvic lymphadenopathy.

PSMA PET–MRI findings

- A PSMA-avid lesion on the left side at the mid-apex, measuring 2.3 × 1.8 × 1.2 cm, with a maximum standardized uptake value (SUVmax) of 10.52, corresponding to the PI-RADS 5 lesion.
- A second PSMA-avid lesion in the right mid-gland transitional zone, measuring 1.3 × 1.1 × 1.2 cm, with an SUVmax of 10.53, corresponding to a PI-RADS 4 lesion.

An MRI/PSMA-PET/ultrasound fusion-guided biopsy was subsequently performed. Targeted biopsies were obtained from both the left transitional zone and the right mid-gland lesions, along with systematic biopsies from the right and left prostate lobes (Fig. 2).

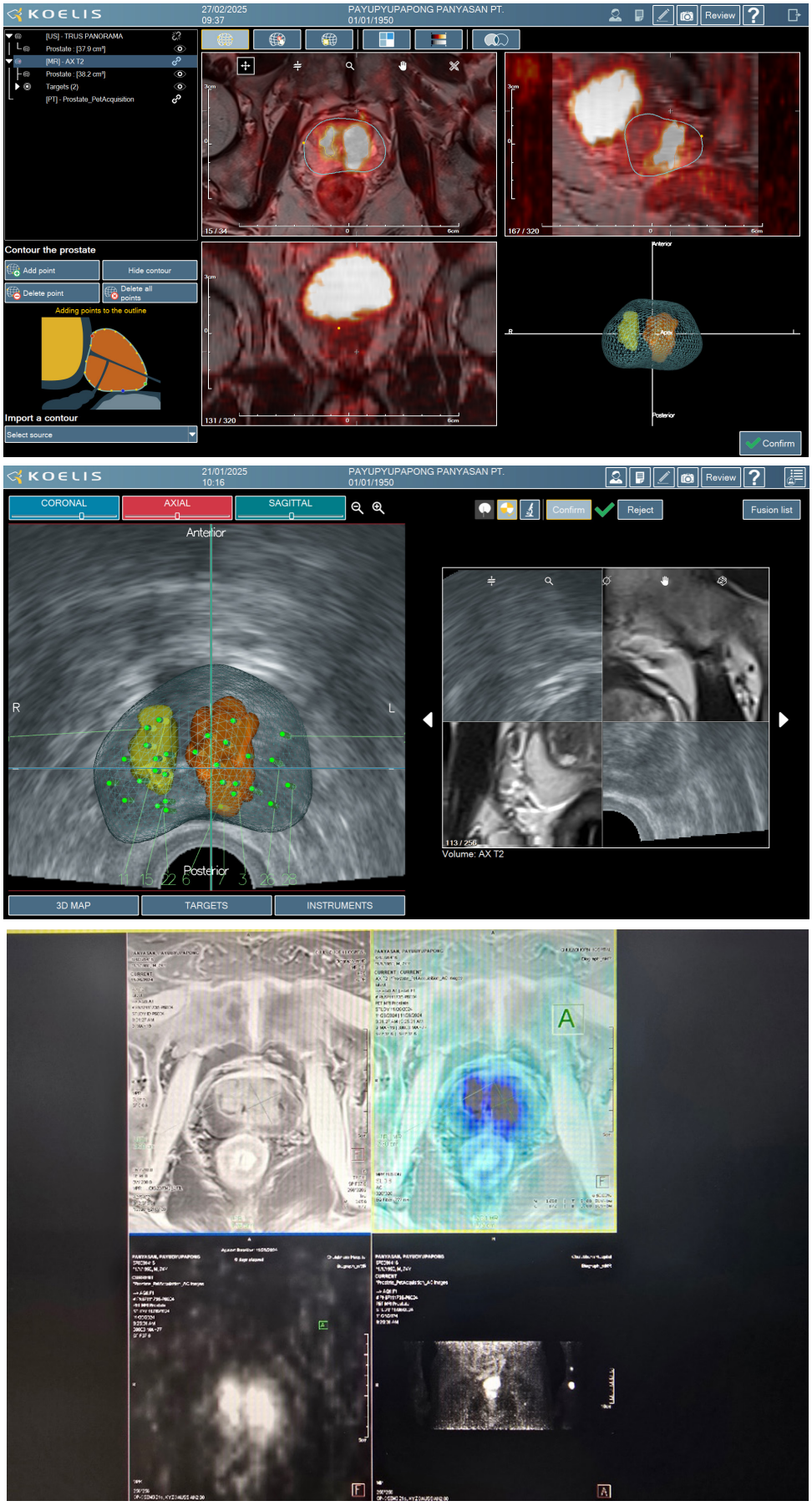

Figure 2. MRI–PET fusion prostate biopsy in case 2

Post-procedure, the patient experienced mild hematuria for one day without other adverse events. Pathological examination revealed that all sampled cores, including both targeted and systematic biopsies, showed benign prostatic hyperplasia (BPH) with no evidence of malignancy.

Discussion

MRI of the prostate is now widely used to identify suspicious lesions before biopsy. Recent systematic reviews and meta-analyses evaluating PI-RADS v2.1 reported approximate detection rates of clinically significant prostate cancer (csPCa) as 12%, 60%, and 85% for PI-RADS 3, 4, and 5 lesions, respectively. These results confirm that higher PI-RADS scores show a strong correlation with an increased likelihood of detecting csPCa.[12,13] MRI-ultrasound fusion prostate biopsy provides high soft-tissue resolution, particularly for lesions located in the peripheral zone. Recent meta-analyses have demonstrated a sensitivity of 87-93% and a specificity of 68-75%.[14,15]

mpMRI and prostate-specific membrane antigen positron emission tomography (PSMA-PET) have become critical tools in the diagnosis and management of csPCa. PSMA-PET. This is particularly evident when combined with MRI (PSMA PET/MRI), which further improves diagnostic performance, with a reported sensitivity of 97% and specificity of 66%. The pooled negative likelihood ratio (NLR) for PSMA PET/CT is 0.05, a score superior to the 0.16-0.26 reported for mpMRI.[16,17] Yujia Li et al. reported an area under the receiver operating characteristic curve (AUC) for the PRIMARY score, SUVmax, and PSMA-PET to be 0.796 (95%CI: 0.738-0.853), 0.851 (95%CI: 0.783-0.918), and 0.806 (95% CI: 0.742-0.870), respectively, with an SUVmax cutoff value of 6.5 corresponding to a specificity of 79%.[11]

This study supports the premise that the PI-RADS scoring system depends heavily on radiological expertise. Emerging techniques such as PSMA PET/MRI may improve lesion localization and help refine patient selection, potentially reducing unnecessary biopsies. To date most urologists are less familiar with the interpretation of PI-RADS than radiologists, PET/MRI may enhance lesion identification and diagnostic confidence, especially among younger or less experienced clinicians.

In our experience, the procedural workflow of PSMA-PET fusion biopsy closely resembles that of MRI–ultrasound fusion biopsy. However, PSMA-PET fusion provides clearer lesion boundaries due to distinct tracer uptake, allowing for more accurate targeting. This advantage reduces reliance on advanced radiological interpretation. However, despite this benefit, the cost of PSMA PET/MRI remains higher, at approximately 5,000 THB at Chulabhorn Hospital, posing a limitation for routine use. Furthermore, PSMA uptake may occur in benign conditions such as adenoma or prostatitis; therefore, SUVmax values must be interpreted cautiously when determining biopsy indications.

In case 1, MRI demonstrated a lesion in the right anterior transitional zone (PI-RADS 5) and another in the right peripheral zone (PI-RADS 4). PSMA-PET imaging showed uptake only in the first lesion, possibly due to the small size (5 mm) or a false-negative result in the second. The lesion with high SUVmax (21.51) corresponded to adenocarcinoma with a Gleason score of 4 + 4 (Grade group 4), consistent with prior evidence indicating that an SUVmax ≥ 8 is strongly associated with csPCa.10

In case 2, MRI revealed a larger lesion (2.4 × 1.6 cm) classified as PI-RADS 5, with PSMA-PET showing concordant uptake (SUVmax 10.53). However, histopathology revealed benign prostatic hyperplasia. This discrepancy contrasts with previous findings[10] and may suggest that the SUVmax cutoff predictive of csPCa could be higher in Asian populations compared to Western cohorts or reflect a potential false-positive PET result. This is based on a study of only two individuals but the findings warrant a more extensive study with a larger sample size.

Conclusion

These observations raise important considerations regarding optimal SUV thresholds for malignancy prediction. Limitations of our report include the novelty of the biopsy technique, variability in SUVmax measurement between institutions, and the higher cost compared with standard diagnostic methods, which may affect cost-effectiveness and accessibility. A potential focus for future research could involve the establishment of correlations between SUV values and Gleason scores, defining clinically meaningful

SUV cutoff values to distinguish prostate cancer from benign conditions. This would validate the diagnostic accuracy and cost-effectiveness of PSMA PET/MRI-guided biopsy in routine clinical practice, particularly among patients with PSA levels between 4-10 ng/ml.

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Case Report

Colo-renal fistula in a patient with recurrent UTI: a case report and review of the literature

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Keywords:
Colorenal fistula, renocolic fistula

Abstract

Colorenal fistula is a rare and diagnostically challenging condition due to the variation of clinical presentations and diverse etiologies. This is a case report on a patient presenting with pneumaturia and recurrent urinary tract infections (UTIs). The patient had a 19-year history of multiple UTIs, including episodes of acute pyelonephritis, orchitis, and cystitis. A severe episode occurred five years earlier, when he developed a liver abscess. Computed tomography (CT) revealed air within the left renal pelvis and urinary bladder. The atrophic left kidney was adherent to the descending colon, leading to a diagnosis of colorenal fistula. The patient underwent left nephrectomy with segmental colon resection. The postoperative course was uneventful except for a wound infection on day 4, which was resolved with treatment. Histopathological examination demonstrated chronic inflammation. This case presents as a chronic colorenal fistula with a prolonged asymptomatic phase.

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Introduction

Colorenal fistula, first reported in 1839, represents an abnormal communication between the colon and the kidney. Among all reno-enteric fistulas, the colorenal type is the most frequently reported.[1] Chronic renal obstruction and delayed management of renal calculi can result in a loss of renal function, persistent inflammation, and eventual fistula formation.[2]

The etiology of colorenal fistulas is heterogeneous and includes iatrogenic causes (e.g., upper urinary tract tumor ablation, percutaneous nephrostomy), malignancy, trauma, chronic infection, or inflammation. Clinical manifestations vary widely, but commonly include abdominal or flank pain, fever, pneumaturia, and lower urinary tract symptoms (LUTS). As a consequence of the nonspecific presentation, diagnosis is often delayed or missed.

Imaging studies play a pivotal role in diagnosis. Retrograde pyelography remains the gold standard for confirmation of the presence of a fistulous tract.[3] Other useful modalities include contrast-enhanced CT or endoscopic evaluation. Treatment strategies range from conservative management, such as bowel rest and antibiotics, to definitive surgical intervention with nephrectomy and colectomy[4,5], depending on the etiology and renal function status.

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Case Report

In January 2025, a 71-year-old Thai man presented with a two-week history of a burning sensation in both testicles. At this visit, he also reported new onset pneumaturia occurring near the end of urination, without any passage of food particles or gross hematuria. The patient had a 19-year history of recurrent urinary tract infections (UTIs), as illustrated in Figure 1.

The patient had chronic renal failure and a known allergy to ceftriaxone. Ciprofloxacin had been used as the antibiotic therapy in all prior infections. His most severe episode occurred in April 2019, when he presented with right subcostal pain and dysuria. Urinalysis showed pyuria, and he was treated for cystitis with ciprofloxacin, consistent with his treatment history.

At follow-up one week later, his symptoms, including abdominal pain and dysuria, had not improved, although the degree of pyuria had decreased but was not completely resolved. Ciprofloxacin was continued. Three days later, he presented at the Emergency Department with worsening right abdominal pain, though he remained afebrile. He was admitted for evaluation, and a contrast-enhanced CT scan was performed for the first time (Fig. 2). The CT revealed a liver abscess, which became the primary focus of treatment at that time.

Upon retrospective review of the 2019 CT scan, air was also noted within the urinary bladder and left renal pelvis. However, this finding was not included in the initial report and was clinically overlooked, potentially because attention was focused on the acute liver abscess. The abscess was successfully treated with a six-week course of antibiotics.

A new non-contrast CT scan performed in January 2025 again demonstrated air within the bladder and left renal pelvis, and the left kidney had become progressively atrophic (Fig. 3).

The patient was treated for complicated UTI using sitafloxacin for two weeks. However, after the antibiotic course was completed, urinalysis

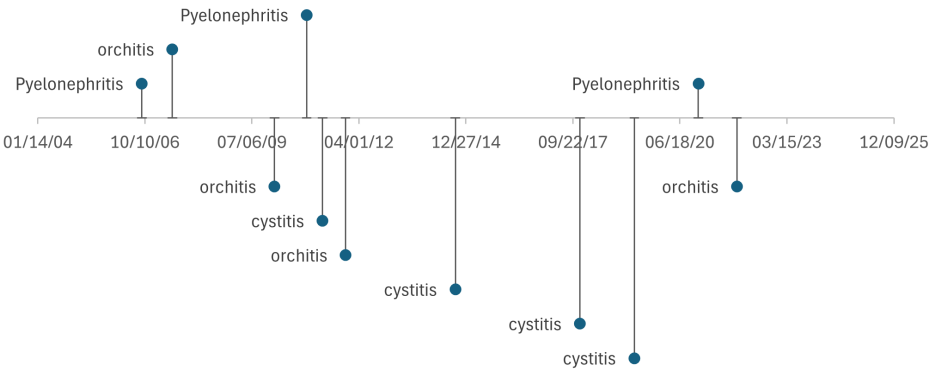


Figure 1. Timeline of urinary tract infections in this patient.

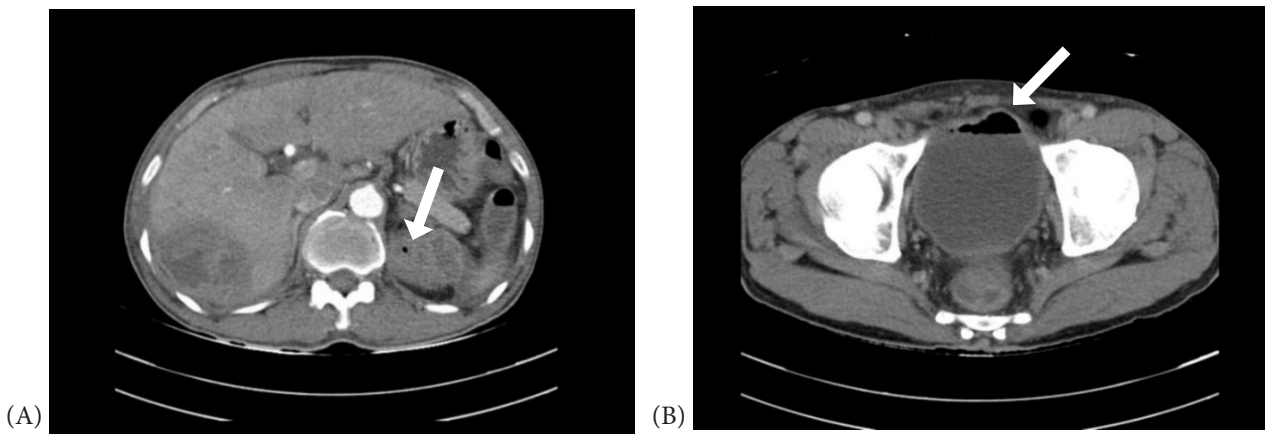


Figure 2. CT scan with contrast (April 2019) showing the liver abscess, air in the left kidney (A), and urinary bladder (B).

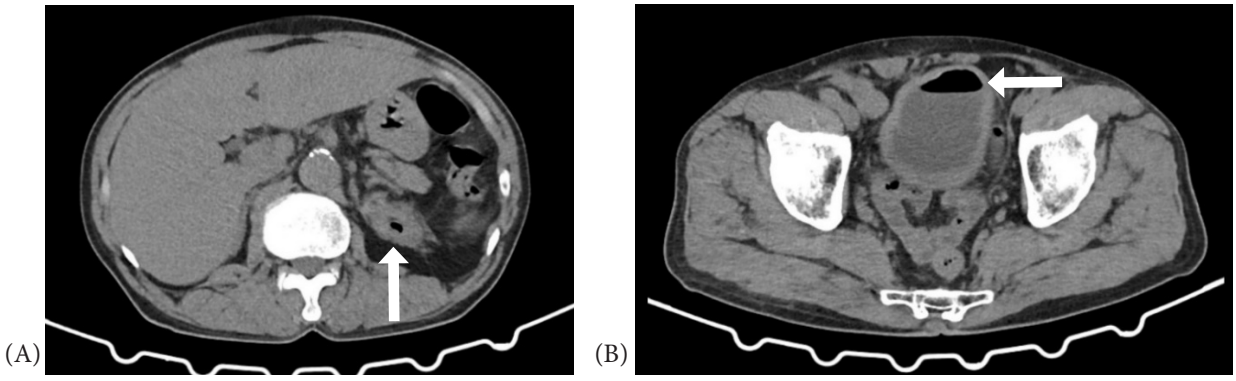


Figure 3. Non-contrast CT scan (January 2025) showing persistent air in the left kidney (A) and bladder (B).

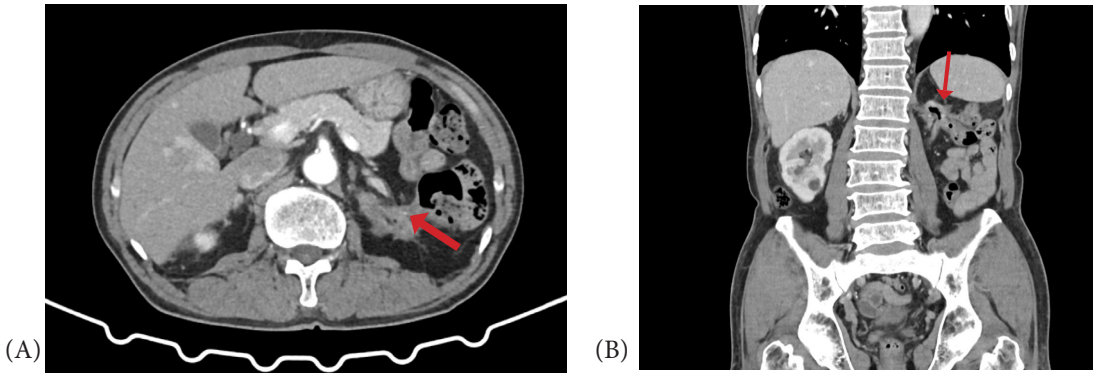


Figure 4. Contrast-enhanced CT scan (March 2025) demonstrating adhesion between the left kidney (A) and colon with a suspected fistula site (B).

still showed >100 pus cells/HPF, and his symptoms persisted. Upon further review of the CT images, a colorenal fistula was suspected due to persistent air in the left renal pelvis and the presence of fat stranding between the atrophic left kidney and the adjacent descending colon, despite the absence of a clearly visualized fistula tract.

This suspicion was reinforced by the persistence of pneumaturia despite appropriate antibiotic therapy, suggesting that the air source was not due to an active gas-forming infection. In addition, the CT scan excluded occurrence of a vesicocolic fistula. A contrast-enhanced CT performed in March 2025 (Fig. 4) confirmed the diagnosis of colorenal fistula.

Given that the left kidney was atrophic and non-functioning, a left nephrectomy was planned. Written informed consent was obtained for both the surgery and publication of the case details, including accompanying images.

Preoperative evaluation included a normal chest X-ray, with no evidence of tuberculosis. Although tuberculosis was considered a possible etiology, the initial work-up was negative. Surgery was primarily indicated to remove the fistulous tract, with the definitive etiology to be confirmed via histopathology. The patient underwent mechanical bowel preparation using Niflec solution one day before surgery. A general surgeon was consulted for the colonic portion of the operation. Asthe CT findings did not suggest malignancy, preoperative colonoscopy was not performed.

Intraoperative exploration via a long midline incision was performed to confirm the suspected fistula, with a plan for segmental colectomy if identified. Dense adhesions were noted around the left kidney. Left nephrectomy was completed, and upon mobilization of the splenic flexure, the left kidney was found to be firmly adherent to the descending colon with thick fibrotic tissue. Segmental colectomy was performed with end-to-end anastomosis. A Jackson-Pratt drain was placed in the renal fossa.

Gross examination of the bivalved specimen revealed a fistulous communication between the colon and the kidney. The mucosal surface appeared smooth with no visible mass (Fig. 5).

Postoperatively, the patient initially recovered well but developed fever on the fourth postoperative day. Examination revealed an infection at

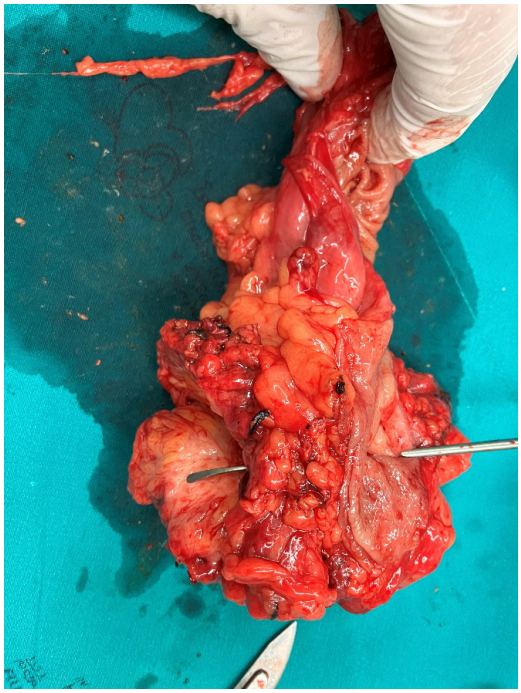
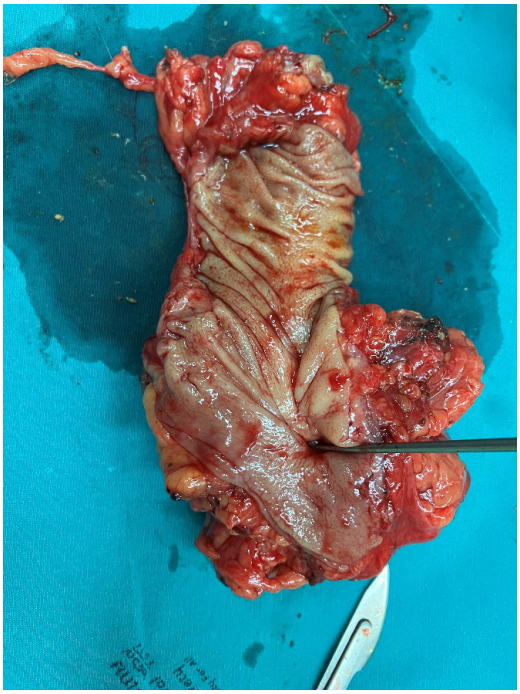
(A)  (B) 

Figure 5. Gross specimen (bivalved) showing the fistula tract from the colon to the kidney (A) with smooth mucosal surfaces and no mass (B).

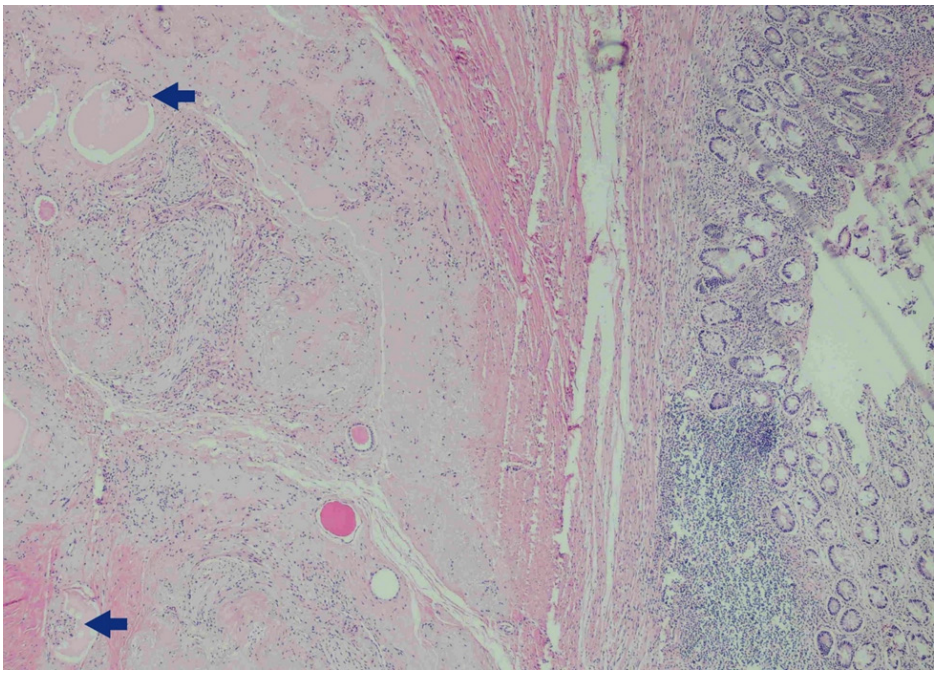


Figure 6. Histopathology showing a fistulous tract lined by colonic mucosa with surrounding chronic inflammation (left) and adjacent renal tissue with glomeruli (blue arrow) and marked fibrosis (right).

the surgical site, and all sutures were removed. A small amount of pus was drained from the umbilical region. The patient was treated with ciprofloxacin and metronidazole. Following suture removal and antibiotic therapy, he became afebrile, regained bowel function, and was discharged several days later.

Histopathologic examination demonstrated colonic mucosa invagination through the colonic wall, forming a fistulous tract connecting to renal tissue. Scattered chronic inflammatory cells surrounded the tract. The renal tissue exhibited glomeruli with dilated Bowman's spaces, tubular dilatation, and marked interstitial fibrosis (Fig. 6).

Discussion

In this patient, the differential diagnosis for pneumaturia included gas-forming infections such as emphysematous pyelonephritis or emphysematous cystitis. These conditions were excluded as the patient's pneumaturia persisted even after completion of a two-week, culture-directed antibiotic course. The persistence of pneumaturia strongly suggested a chronic, non-infectious source of air.

While a vesicocolic fistula is a more common cause of pneumaturia, this was ruled out based on CT findings. The presence of persistent air in the left renal pelvis, along with inflammatory fat stranding between the atrophic kidney and the adjacent colon, was highly suggestive of a colorenal fistula, even though the actual fistulous tract was not clearly visualized on imaging.

The choice of a long midline incision in this case was primarily guided by the need for potential segmental colectomy. After multidisciplinary discussion with the general surgery team, this approach was deemed optimal because it provided excellent exposure and superior control of the proximal and distal colon, which is critical for a safe resection and anastomosis.

An alternative incision, such as an anterior subcostal approach, might have sufficed for nephrectomy alone; however, it would have made colonic resection and anastomosis technically challenging. A laparoscopic approach was considered but not chosen due to the expected dense, chronic inflammation and fibrosis between the kidney and colon which was confirmed intraoperatively. The midline approach therefore offered the most secure and controlled operative field for this complex two-organ procedure, despite its known disadvantages such as greater postoperative discomfort and a potential risk of incisional hernia.

The decision to perform a segmental colectomy rather than simple fistula repair was based on two main considerations. First, simple repair is generally reserved for cases in which renal preservation is feasible. In this patient, the left kidney was atrophic and non-functioning, making nephrectomy unavoidable. Second, intraoperative findings revealed dense fibrotic adhesion involving the colon wall around the fistula. This chronic inflammatory process rendered simple closure of the colonic defect unsafe, as the tissue margins were unhealthy and poorly vascularized. Segmental colectomy was therefore required to remove the diseased portion and restore bowel continuity with healthy tissue.

Malignancy was excluded through multiple steps. Preoperative CT scans revealed no colonic mass, and intraoperative inspection confirmed that the mucosal surface of the fistulous tract was smooth and lesion-free. Histopathological analysis subsequently confirmed chronic inflammation with colonic mucosa lining the tract, with no evidence of neoplasia.

Colorenal fistula is a rare condition. Table 1 summarizes previously reported cases from 1953 to 2023, detailing the clinical presentations, etiologies, laterality, and management strategies for both the renal and colonic components.

Among the reviewed cases, female patients were slightly more prevalent than males (56.10%). Patient age ranged from 2 to 83 years, with a mean of 54.5 ± 19.33 years. The left kidney was affected in the majority of cases (85.96%, left : right = 49:8).

Table 1. Review case reports of colorenal fistula according to symptoms, causes, and treatments.

Author	Year	Gender	Age (year)	Clinical Presentation	Cause	Side	Kidney	Colon	Result
BRIGGS et al.[6]	1953	Male	56	Flank pain	Staghorn	Left	Nephrectomy	Colon resection	Recovered
FETTER et al.[7]	1956	Female	48	Flank pain	Staghorn	Left	Nephrectomy	Colostomy → closure fistula	Recovered
Husted et al.[8]	1974	Female	78	Fever	Pyonephrosis, Diverticulitis	Left	Died	NA	Died
Brust et al.[9]	1974	Male	63	Flank pain, UTI	CA colon	Left	Nephrectomy	Colon resection	NA
Vargas et al.[10]	1975	NA	NA	NA	Pyonephrosis	Left	Nephrectomy	Closure fistula	Recovered
Underwood et al.[11]	1977	Female	69	Abdominal pain, vomiting	Staghorn stone	Left	Pyelolithotomy (two stages)	Colostomy, colon resection	Recovered
Goldman et al.[1]	1979	Female	54	Abdominal pain	Pyonephrosis	Left	Nephrectomy	Colon resection, colostomy	Recovered
Davillas et al.[12]	1981	NA	NA	NA	Renal stone, Pyonephrosis	Left	Nephrectomy	Colon resection	NA
List et al.[13]	1983	NA	NA	NA	XGP	NA	NA	NA	NA
Cohen et al.[14]	1983	NA	NA	NA	Renal stone	NA	Nephrectomy	Closure fistula	
Morozumi et al.[15]	1986	Female	53	Flank pain, fever	Renal stone, perinephric abscess	Right	Nephrectomy	Colectomy	Recovered
		Female	63	Flank pain, fever	Staghorn stone	Left	Nephrectomy	Colectomy	Recovered
Parsons et al.[16]	1986	Male	5	blood clots in the urine, frequency, dysuria	Pyonephrosis	Right	Nephrectomy	closure fistula	Recovered
Doughney et al.[17]	1986	Female	52	Nausea, vomiting, cough, fever	Staghorn stone, perinephric abscess	Left	Died before definite sergery	Colostomy	Died
Mooreville et al.[18]	1988	Female	83	Polyuria, back pain	Staghorn stone, pyonephrosis	Right	Nephrectomy	Conservative (could not do)	Recovered
Bretagne et al.[19]	1989	NA	2	NA	VUR, XGP	Right	Nephrectomy	Closure fistula	NA
Yamaguchi et al.[20]	1990	Female	58	Flank pain	XGP	Left	Nephrectomy	Closure fistula	Recovered
Connor et al.[21]	1991	NA	NA	NA	Staghorn stone	NA	NA	NA	NA
Lekili et al.[22]	1991	Male	8	Flank pain	Bilateral VUR, recurrent UTI	Right	Nephrectomy	Colon resection	
Lozano et al.[23]	1992	NA	NA	NA	Renal stone, pyonephrosis	Left	Nephrectomy	Closure fistula	NA

Table 1. Review case reports of colorenal fistula according to symptoms, causes, and treatments. (continued)

Author	Year	Gender	Age (year)	Clinical Presentation	Cause	Side	Kidney	Colon	Result
Yildiz et al.[24]	1993	NA	NA	NA	Chronic pyelonephritis	NA	NA	NA	NA
Mander et al.[25]	1993	Male	70	Pneumaturia, frequency, dysuria	UPJO	Left	Partial nephrectomy	Closure fistula	Recovered
Ono et al.[26]	1995	Female	68	Flank pain, fever	XGP, ureteric calculi	Left	Nephrectomy	Closure fistula	Recovered
Blatstein et al.[27]	1996	Male	57	Abdominal discomfort, weight loss	RCC	Left	Radical nephrectomy	En bloc resection	Recovered
Parvey et al.[28]	1997	Male	71	Flank pain, weight loss	UPJO, perirenal abscess	Left	Nephrectomy	Colectomy, colostomy	NA
		Female	45	Flank pain, fever	XGP, stone, perinephric abscess	Left	Nephrectomy	NA	NA
		Female	66	Fever	Acute suppurative pyelonephritis, perinephric abscess	Left	Nephrectomy	Colectomy, colostomy	NA
Borum et al.[29]	1997	Female	45	Cough	Staghorn stone, XGP, perinephric abscess	Left	Nephrectomy	Colon resection	Recovered
Majeed et al.[30]	1997	NA	NA	NA	XGP	Left	Nephrectomy	Colon resection	Recovered
		NA	NA	NA	XGP	Left	Nephrectomy	Colon resection	Recovered
		NA	NA	NA	XGP	Left	Nephrectomy	Colon resection	Recovered
		NA	NA	NA	XGP	Left	Nephrectomy	Colon resection	Recovered
Duddalwar et al.[31]	1998	Male	72	Abdominal pain, anorexia, weight loss, constipation	RCC	Left	Nephrectomy	Colon resection	Died
Tundidor et al.[32]	1999	Female	48	NA	Pyonephrosis	Left	Nephrectomy	Colon resection	Died
el Otmany et al.[33]	1999	NA	NA	NA	TB, ectopic kidney	Left	Nephrectomy	Sigmoid resection	Recovered
Tsujimoto et al.[34]	2000	Female	78	Pneumaturia	Staghorn stone	Left	Nephrectomy	Colon resection	Recovered
Benchekroun et al.[35]	2002	NA	NA	NA	Renal stone, TB	Left	Nephrectomy	Closure fistula	Recovered
Bachelier et al.[36]	2004	NA	NA	NA	XGP	Right	Nephrectomy	Repair fistula	NA
Fariña et al.[37]	2004	Female	75	Fever	Renal stone, XGP	Left	Nephrectomy	Colon resection	Recovered
Ito et al.[38]	2004	Male	51	Fever, abdominal pain	Diverticulitis, polycystic kidney	Left	Nephrectomy	Colon resection	Recovered

Table 1. Review case reports of colorenal fistula according to symptoms, causes, and treatments. (continued)

Author	Year	Gender	Age (year)	Clinical Presentation	Cause	Side	Kidney	Colon	Result
Matsuoka et al.[39]	2006	Female	60	Flank pain, fever	Parapelvic cyst, XGP	Left	Nephrectomy	Colon resection	Recovered
Gimenez et al.[40]	2008	NA	NA	NA	Staghorn stone, diverticulitis	NA	NA	NA	NA
Ishikawa et al.[41]	2008	Female	60	Hematuria, pneumaturia	Renal cyst	Left	Nephrectomy	Colon resection	Recovered
Lee et al.[42]	2009	Female	69	Flank pain	Bilateral obstructive uropathy (CA Cx), forgotten DJ stent, perinephric abscess	Right	Conservative	NA	Died
Chalise et al.[43]	2009	Male	55	NA	PCN, retrorenal colon	Left	Nephrectomy	Closure fistula	Recovered
Ould et al.[44]	2010	Male	28	Abdominal wound from firearm	Penetrating injury	Left	DJ stent	Repair fistula	Recovered
Sáenz et al.[45]	2010	NA	NA	NA	Radiofrequency ablation of RCC	NA	Nephrectomy	NA	NA
Wysocki et al.[4]	2010	Female	76	Hematochezia	Cryoablation	Left	Nephrectomy	Colon resection	NA
Lee et al.[46]	2011	Male	36	Pneumaturia	Car accident 4 months ago, kidney injury gr IV	Left	Nephrectomy	Colon resection	Recovered
Marwah et al.[47]	2012	Female	42	Flank pain, difficult to breath	Renal stone, emphysematous pyelonephritis, TB	Left	Subcapsular nephrectomy	Colon resection	Recovered
Zeller et al.[48]	2013	female	47	Flank pain	Staghorn, recurrent UTI	Right	Nephrectomy	Closure fistula	Recovered
Patil et al.[49]	2013	Female	25	Abdominal pain, fever	Staghorn stone, XGP	Left	Nephrectomy	Closure fistula	Recovered
Abdelaziz et al.[50]	2014	Male	28	Hematuria	automatic gun	Left	DJ stent only	Not done	Recovered
Elvas et al.[51]	2018	Female	64	Back pain, sepsis	Emphysematous pyelonephritis, TCC	Left	Nephrectomy	Colon resection	Died
Iwashita et al.[52]	2018	Male	65	Fever, abdominal pain	ADPKD	Left	Nephrectomy	Colon resection	Died
Auld et al.[53]	2018	Male	77	Watery and bloody diarrhea, sepsis	TCC	Left	RT, DJ stent	NA	Died
Mozo et al.[54]	2018	Male	58	NA	Cryoablation	Left	Repair fistula	Closure fistula	Recovered
Thiyagarajan et al.[55]	2018	Female	42	NA	Radiotherapy of CA Cx	Left	DJ stent only -> cure	Not done	Died (from CA Cx)

Table 1. Review case reports of colorenal fistula according to symptoms, causes, and treatments. (continued)

Author	Year	Gender	Age (year)	Clinical Presentation	Cause	Side	Kidney	Colon	Result
Yilmaz et al.[2]	2019	Female	76	Flank pain	Creteric calculi	Left	Nephrectomy	Repair fistula	Recovered
Numan et al.[56]	2019	Female	40	Fatigue, anemia, frequency	Staghorn stone, XGP, perinephric abscess	Left	Nephrectomy	Closure fistula	Recovered
Boopathy et al.[57]	2020	Male	55	NA	DJ stent	Left	DJ stent	Conservative	Recovered
Lulla et al.[58]	2021	NA	79	Flank pain	Staghorn, recurrent UTI, Hx of Crohn's disease	Left	Nephrectomy	Colectomy	NA
Goddard et al.[59]	2022	Male	32	NA	Gunshot wound	Left	DJ stent only	Not done	Recovered
Hillman et al.[60]	2023	Female	53	Altered mental status, fever, chill, dysuria	Emphysematous pyelitis	Left	Nephrectomy	Colectomy, colostomy	Recovered

UTI = urinary tract infection, CA = cancer, XGP = xanthogranulomatous pyelonephritis, VUR = vesicoureteral reflux, UPJO = ureteropelvic junction obstruction, RCC = renal cell carcinoma, TB = tuberculosis, Cx = cervix, ADPKD = autosomal dominant polycystic kidney disease, TCC = transitional cell carcinoma, RT = radiotheraphy, DJ = double J, Hx = history, PCN = percutaneous nephrostomy

Pain was the most frequent presenting symptom (Fig. 7), with flank pain reported in 32.35% of patients.[2,6,48,58,7,9,15,20,28,39,42,47] When combined with abdominal pain, seen in 14.71% of cases[1,11,31,38,49,52], pain-related symptoms accounted for 47.06% overall.

The second most common symptom was fever, which occurred in 26.47% of cases.[8,15,17,26,28,37–39,49,52] Other presentations included pneumaturia (8.82%)[25,34,41,46], hematuria (5.88%)[41,50], and lower urinary tract symptoms (LUTS) including frequency and dysuria (14.71%)[16,25,56,60]

Unlike most reported cases presenting with pain or fever, the main symptom in our patient was pneumaturia, a less common but highly specific finding reported in only 8.82% of cases. This sign was key to the eventual diagnosis, even though it had initially been overlooked.

The most common etiology of colorenal fistula was renal calculi, observed in 25.97% of cases. This was followed by renal infection or abscess (24.68%) and chronic inflammatory conditions such as xanthogranulomatous pyelonephritis (XGP) (19.48%), as illustrated in Figure 8.

Many cases involved multiple overlapping causes, for example, renal calculi coexisting with XGP or perirenal abscess. Stones were typically the primary factor. Other reported etiologies included:

- Renal malignancy (RCC, TCC, or squamous cell carcinoma): 6.49%[7,27,31,51,53]
- Colon carcinoma: 1.75%[9]
- Trauma such as gunshot wounds: 3.51%[44,46,50,59]
- Cryoablation or radiofrequency ablation: 3.51%[4,45,54]
- Ureteral (DJ) stent insertion: 3.51%[42,57]
- Renal cysts: 3.51%[41,52]
- Colonic diverticulitis: 5.26%[8,38,40]

Although stones (25.97%) and XGP (19.48%) were the predominant causes, the condition of our patient most closely resembled those caused by chronic infection and abscess (24.68%). Postoperative pathology demonstrated chronic inflammation without calculi, malignancy, or diverticulitis, supporting this classification.

Regarding management, nephrectomy was the most common treatment for the renal component, performed in 82.76% of cases (Fig. 9). Conservative management12 accounted for 1.72%, while DJ stenting[44,50,53,55,57,59] was repre-

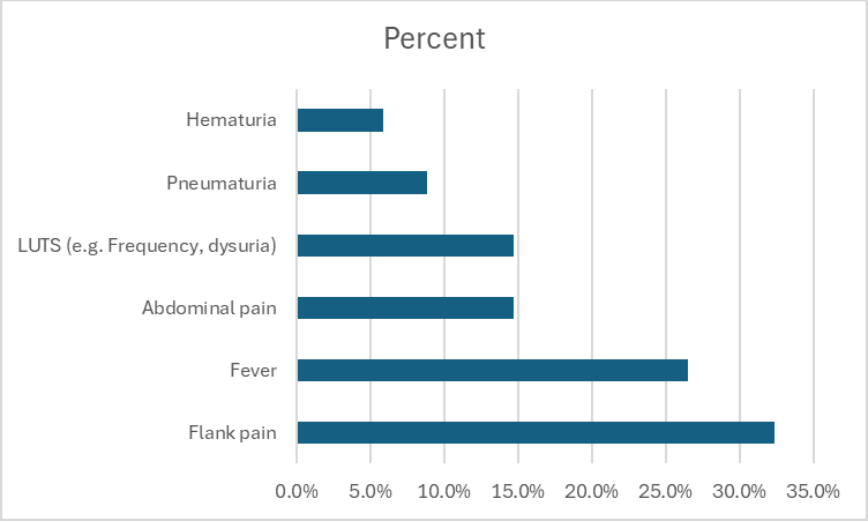


Figure 7. Distribution of symptoms among patients with colorenal fistula.

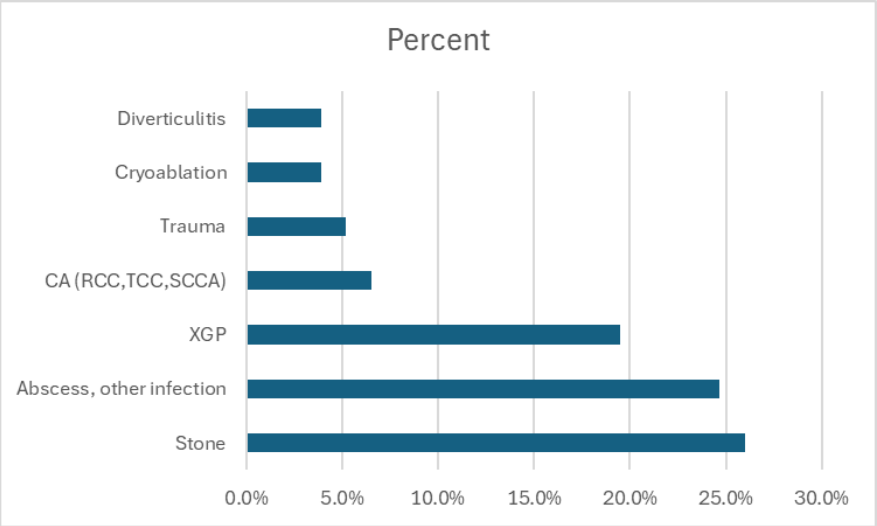


Figure 8. Etiologies of colorenal fistula reported in relevant literature.

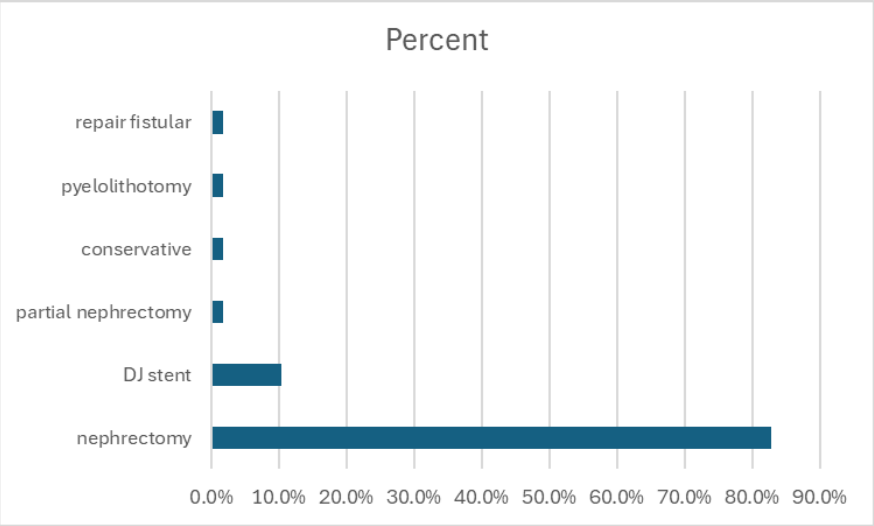


Figure 9. Management strategies for the renal component.

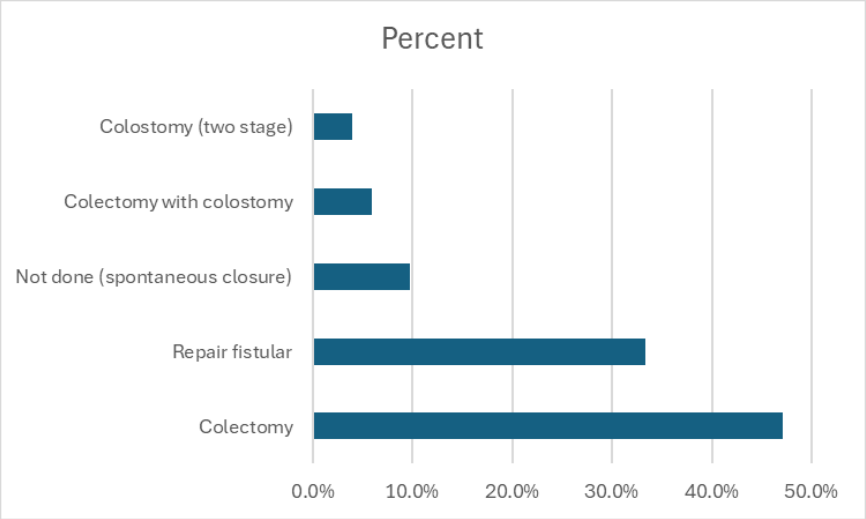


Figure 10. Management strategies for the colonic component.

sented in10.34% of cases. Partial nephrectomy[25] and pyelolithotomy[11] accounted for 1.72% of cases each.

In the case of the colonic component, 47.06% underwent resection, while 33.33% underwent fistula repair (simple closure or fistulectomy). Both colectomy and colostomy were performed in 5.88% of cases1,28,60, and approximately 9.80% healed spontaneously, mainly in cases secondary to trauma or DJ stent insertion[18,50,55,57,59] (Fig. 10).

The management of our patient mirrored the most common approach reported in the literature: nephrectomy for the non-functioning kidney (82.76%) and segmental colectomy (47.06%) rather than simple repair (33.33%), due to the extensive fibrosis found intraoperatively.

Currently, no standardized treatment algorithm exists for colorenal fistula.[5] Although nephrectomy is required in most cases, the choice depends on renal function and underlying pathology. Nephron-sparing or conservative approaches may be suitable in selected patients, particularly those with preserved renal function or traumatic etiologies. In this case, nephrectomy was necessary because of severe atrophy and non-functioning of the affected kidney.

The management of the colonic segment depends on the etiology, degree of inflammation, and overall patient condition. Initial conservative measures such as drainage, bowel rest, or stenting may be attempted in stable patients. However, definitive treatment typically requires surgical resection. The standard approach involves en bloc resection of the diseased colonic segment with primary anastomosis if local tissues are healthy. In the presence of severe infection or inflammation, a staged procedure may be safer, specifically initial resection with proximal diversion (e.g., colostomy), followed by delayed restoration of bowel continuity once inflammation is resolved.

Conclusions

Colorenal fistula is an uncommon and diagnostically challenging condition that requires a high index of clinical suspicion, especially in patients with a long history of recurrent UTIs. This case highlights how indirect but classic radiologic signs, such as persistent air within the urinary system, can be overlooked for years when attention is directed toward other acute pathologies, such as a liver abscess.

The key clinical lesson is that in any patient with chronic or recurrent UTIs, the persistence of air in the renal pelvis or urinary bladder, even when the fistulous tract is not directly visualized, should raise strong suspicion of a colorenal fistula. Such findings warrant thorough investigation and, in appropriate cases, surgical exploration.

Contrast-enhanced CT remains the most valuable diagnostic modality, both in identification of the underlying pathology and for surgical planning. Definitive treatment often requires en bloc resection of the affected kidney and the involved colonic segment, particularly when the renal unit is non-functioning or when chronic inflammation and fibrosis preclude conservative repair.

This case adds to the limited number of documented reports of colorenal fistula, underlining the importance of long-term vigilance in

patients with recurrent urinary infections and chronic renal inflammation. Early recognition and multidisciplinary surgical management can lead to favorable outcomes and prevent serious complications.

Conflict of Interest

The authors declare no conflict of interest.

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2.2 Include standard of treatment

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Requirements:

3.1 Interesting

3.2 Not previously published

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4.2 Creative and beneficial to all readers

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