BMC Gastroenterology

RESEARCH Open Access

Effect of incision location and type of fistula on postoperative urinary retention after radical surgery for anal fistula: a retrospective analysis

Chen Li[1,2†], Ningyuan Liu[2†], Zichen Huang[1,2], Zijian Wei[1,2], Keyi Li[1,2], Wenxiao Hou[2], Sangyu Ye[1] and Lihua Zheng[2*]

Abstract

Background Postoperative urinary retention (POUR) is a common complication characterized by fullness of the bladder without the ability to urinate. Its etiology in proctology surgery is multifactorial. This study aimed to identify the risk factors for POUR after radical surgery for anal fistula.

Methods We retrospectively reviewed the clinical records of 511 patients who underwent radical surgery for anal fistula at the China-Japan Friendship Hospital from August 2022 to December 2023. Risk factors for POUR were analyzed by means of binary logistic regression analyses.

Results POUR occurred in 57 patients (11.2%) within 48 h post-surgery, and males were predominantly affected (84.4%). Independent risk factors included a history of urological disease (OR = 6.048; $p < 0.001$), incisions at position 1 (OR = 2.228; $p = 0.046$), high anal fistula (OR = 4.768; $p < 0.001$), VAS score ≥ 7 (OR = 2.805; $p = 0.010$), and GAD-7 score ≥ 5 (OR = 2.405; $P = 0.024$).

Conclusion POUR is a significant complication post-radical surgery for anal fistula, particularly among patients with urological disease, high anal fistula, and incisions at position 1. Surgeons should pay more attention to surgical methods for high anal fistulas and fistulas in the anterior rectum, and monitor postoperative bladder volume in high-risk patients. Enhanced postoperative pain and anxiety management can reduce the incidence of POUR and prevent long-term bladder damage.

Keywords Postoperative urinary retention, Radical surgery for anal fistula, Risk factors, Urological disease, High anal fistula

[†]Chen Li and Ningyuan Liu contributed equally to this work.

*Correspondence:
Lihua Zheng
btv126@126.com
[1]Beijing University of Chinese Medicine, Beijing 100105, China
[2]Department of Proctology, China-Japan Friendship Hospital, Beijing 100029, China

Introduction

Postoperative urinary retention (POUR) is defined as the inability to void urine despite a full bladder post-surgery, often leading to increased residual urine volume and discomfort [1]. Anal fistula refers to an abnormal connection between the anorectum and the perianal skin, and typically results from infection in the anal crypts (80-90%). Radical surgery remains the mainstay treatment [2], but POUR is a frequent complication with varying reported incidences (1-52%) due to different definitions and methodologie [3, 4]. However, the etiology of POUR in proctology surgery remains unclear. Previous studies have indicated that various factors, such as sex [5, 6], age [7, 8], history of previous illness [4, 8–11], surgical method [12], anesthesia method [8, 13, 14], surgical duration [15, 16], intraoperative fluid volume [3, 17], and postoperative pain, could be risk factors for POUR. Complex benign proctology surgeries usually require longer operative times and more complex operations, increasing the risk of bladder overfilling and overstretching of the forced urethral muscles [3]. Intraoperative stimulation of the anal sphincter can also affect the associated nerves, leading to urinary retention. Moreover, a variety of postoperative factors, such as perianal pain, anal packing discomfort, anxiety, and bladder overdistension, influence the associated muscles and nerves that lead to POUR. POUR can impose significant physical, emotional, and financial burdens on patients. The aim of this study was to determine the risk factors for POUR after radical surgery for anal fistula under general anesthesia. The results of this study can be used to identify strategies for its prevention and management to reduce the incidence of POUR and avoid irreversible damage caused by persistent bladder overdistension to improve patient satisfaction with surgery.

Materials and methods

Ethical approval for this study (2022-KY-121-2) was provided by the Ethical Committee of the China-Japan Friendship Hospital on 15 July 2022.

Study design

This was a retrospective analysis study on patients with anal fistula managed at China-Japan Friendship Hospital from August 2022 to December 2023.

Inclusion and exclusion criteria

We retrospectively analyzed patients' clinical records. All patients who underwent radical surgery for anal fistula under general anesthesia were included irrespective of age.

The exclusion criteria were as follows: (1) patients whose clinical records were missing substantial data; (2) patients who were diagnosed with serious systemic illnesses or malignant tumors; (3) patients who were diagnosed with mental illness psychiatric or behavioral disorders; (4) patients who were diagnosed with inflammatory bowel disease, radiation enteritis or tuberculous anal fistula; (5) patients who had suspicious anorectal masses that prevented the completion of surgery.

Surgical procedures

Patients were required to fast and abstain from drinking for more than 6 h before surgery and were advised to empty their bladders. All surgeries were performed after the injection of fentanyl hydrochloride and application of propofol cream for general anesthesia.

Patients with low anal fistulas were treated with direct incisions. The specific surgical operation involved the use of a probe from the external orifice and the internal orifice of the anal fistula near the anal sinus along the probe via a one-time incision.

Patients with high anal fistulas were treated with a loose combined cutting seton (LCCS). The specific surgical operations were as follows. The probe was inserted from the external orifice of the fistula, fistula was cut on the basis of its extension, and a finger or hemostatic forceps was used to bluntly separate the fistula from the trauma along the direction of the fistula to the rectum. The probe from the internal orifice was passed upward through the fistula via curved hemostatic forceps guided by fingers to stretch into the enteric cavity, and finally, to the top of the fistula. A silk thread seton was ligated between the highest spot of each fistula and the internal orifice (a cutting seton), and was tied firmly. A complex anal fistula was hung between the various incisions on the silk thread to keep the incision drainage open (a loose draining seton) [18].

At the end of the surgery, the anus was packed with hemostatic gauze, and compression was applied to slow the bleeding.

Postoperative care

In the ward, all patients were given intravenous analgesics (flurbiprofen injection, 100 mg, QD) and oral analgesics (loxoprofen, 60 mg, PRN). Patients were dressed daily postoperatively. Before discharge, patients were required to perform at least one independent urination and defecation.

If the patient was unable to urinate or had incomplete urination, the nurse advised him or her to use warm compress and medicated sitz bath. If these measures failed and the swollen bladder could be palpated by the physician, catheterization was performed. For each patient who underwent catheterization, the urine volume typically ranged from 400 to 600 ml. If the volume exceeded 600 ml, we clipped the catheter and left it in place to avoid an impact on the patient's vital signs. In this study, POUR was defined as the need for catheterization within 48 h after surgery. This definition is similar to that used in prior studies [6] and is practical because of its simplicity and expediency.

Data collection

The following details were documented from the patients' clinical records: (1) Preoperative variables: sex, age, body mass index (BMI), duration of disease, prior history of diabetes, hypertension, urological diseases, neurological diseases, proctology surgery history, smoking history, and drinking history; (2) Intraoperative variables included the duration of surgery, intraoperative fluid volume, number of surgical incisions, number of quadrants involved, location of surgical incisions (twelve equal clockwise markings in the lithotomy position were used to divide the perineum into 12 parts), whether the primary surgery was combined with other proctology surgeries, and the numbers of cutting setons and loose draining setons recorded for patients with a high anal fistula; (3) Postoperative variables included: postoperative pain visual analogue scale (VAS) score, postoperative generalized anxiety disorder-7 (GAD-7) score, the presence of urinary tract infection, and length of hospital stay.

Statistical analysis

The Shapiro−Wilk test was used to assess the normality of the distribution of continuous data. Continuous normally distributed data are expressed as the mean and standard deviation (SD), and nonnormally distributed data are expressed as the median and interquartile range (IQR) and were evaluated with rank-sum tests. Categorical data are described as the percentage (%) of cases and were evaluated by means of the chi-square test. Odds ratios (ORs) and 95% confidence intervals (CIs) derived from binary logistic regression analysis were used to assess risk factors for POUR. After univariate analysis of all potential risk factors, those with a P value < 0.05 were identified as significant risk factors and included in the multifactorial binary logistic regression analysis. A backward elimination strategy was used to achieve the most suitable model to estimate the adjusted relative risks with the final multivariable model. Differences were considered significant when $P<0.05$. All the statistical analyses were performed with SPSS (version 25.0, IBM, Inc., Chicago, Illinois, USA).

Results

In this study, of 511 patients, 57 (11.2%) developed POUR. The average age of the patients was 39.79 ± 11.99 years, 85.5% were male, and 14.5% were female.

Characteristics of the participants: A previous history of urological disease is more prevalent among POUR patients

The preoperative clinical records revealed no difference in the sex ratio between the POUR group and the non-POUR group (males: 91.2% vs. 84.4%, $P=0.194$). The average age in the POUR group was higher than that in the non-POUR group (44.79 ± 13.7 vs. 39.17 ± 11.624, $P=0.002$). There were no differences between the POUR and non-POUR groups in terms of BMI, history of diabetes, hypertension, neuropsychiatric diseases, proctology surgery history, smoking history, drinking history, or duration of disease. However, a higher proportion of patients in the POUR group had a history of urological disease (22.8% vs. 5.5%, $P<0.001$). This finding revealed that only age and history of urological disease

Table 1 Basic and clinical characteristics of the participants

Variable	non-POUR group (n = 454)	POUR group (n = 57)	x^2	P value
Sex, *n* (%)				
Male	385 (84.8)	52 (91.2)	1.689	0.194
Female	69 (15.2)	5 (8.8)		
Age (years, IQR, mean±SD)	37 (31,45)	44.79±13.74	-3.118	**0.002**
BMI (kg/m^2, IQR)	25.26 (23.17,28.06)	25.51 (23.15,26.70)	-0.586	0.558
<24 kg/m^2, *n* (%)	150 (33.0)	18 (31.6)	0.049	0.825
≥24 kg/m^2, *n* (%)	304 (67.0)	39 (68.4)		
Diabetes, *n* (%)	23 (5.1)	4 (7.0)	0.094	0.759
Hypertension, *n* (%)	62 (13.7)	12 (21.1)	2.237	0.135
Urological diseases, *n* (%) *	25 (5.5)	13 (22.8)	19.578	**< 0.001**
Neurological diseases, *n* (%)	15 (3.3)	3 (5.3)	0.141	0.708
Proctology surgery history, *n* (%)	140 (34.4)	21 (40.4)	0.726	0.394
Smoking history, *n* (%)	120 (26.5)	21 (36.8)	2.678	0.102
Drinking history, *n* (%)	124 (27.4)	19 (33.3)	0.872	0.350
Duration of disease (months, IQR)	5 (1,18)	6 (2,36)	-1.812	0.070

* Urological diseases (n) including benign prostatic hypertrophy (20), urinary tract infection within the last six months (11), kidney stones (2), ureteral calculi (3), postoperative bladder cancer (3), postoperative prostate cancer (1), postoperative kidney cancer (1).

significantly differed according to the preoperative data. (Table 1)

Surgical approaches: the complexity of surgery is associated with POUR

According to the intraoperative clinical records, the duration of surgery [22.8% vs. 59.9%, $P<0.001$], intraoperative fluid volume [57.4% vs. 87.8%, $P<0.001$], number of surgical incisions [3 (1, 4) vs. 1 (1, 3), $P<0.001$], and number of quadrants [3 (1, 3) vs. 1 (1, 2), $P<0.001$] involved were significantly greater in the POUR group. Interestingly, the proportion of patients with incisions at positions 1, 3 and 9 was significantly higher in the POUR group than in the non-POUR group (30.4% vs. 18.8%, $P=0.045$; 60.7% vs. 30.8%, $P<0.001$; 53.6% vs. 26.7%, $P<0.001$). The proportion of patients with high anal fistula was higher in the POUR group than in the non-POUR group (77.2% vs. 44.3%, $P<0.001$); among patients with high anal fistula, differences in the number of cutting setons [3 (0.25,3) vs. 0 (0,2), $P<0.001$] and loose draining setons [2 (0,3.75) vs. 0 (0,2), $P<0.001$] between the POUR and non-POUR groups were also significant. In conclusion, the duration of surgery, the intraoperative fluid volume, and the complexity of the surgery were associated with POUR. Moreover, the location of the surgical incisions also had an important effect on the occurrence of POUR. (Table 2)

Postoperative variables: POUR patients have higher VAS and GAD-7 scores

According to the postoperative clinical records, the average VAS score [8 (6,9) vs. 6 (5,8), $P<0.001$] and GAD-7 score [4 (1,7) vs. 1 (0,4), $P=0.001$] were higher in the POUR group than in the non-POUR group, and the average length of hospital stay was also significantly longer for patients in the POUR group [8 (5.5,12.5) days vs. 5 (3,7) days, $P<0.001$]. However, there was no significant difference in the incidence of urinary tract infections (8.0% vs. 3.4%, $P=0.251$) between the two groups. Postoperative pain and anxiety were more likely to cause POUR, and POUR could prolong patients' hospital stays. (Table 3)

Univariate and multivariate logistic regression analysis findings

The univariate analysis results were similar to those of previous studies

In the univariate analysis, the following were significant risk factors were for POUR following radical surgery for anal fistula: age (OR=1.036, 95% CI=1.014–1.057; $P=0.001$), neurological disease (OR=5.070, 95% CI=2.423–10.611; $P<0.001$), duration of disease (OR=1.008, 95% CI=1.002–1.013; $P=0.005$), duration of surgery (OR=2.590, 95% CI=1.786–3.756; $P<0.001$), intraoperative fluid volume (OR=2.946, 95% CI=1.815–4.780; $P<0.001$), number of surgical incisions

Table 2 Intraoperative variables of the participants

Variable	non-POUR group ($n=454$)	POUR group ($n=57$)	x^2	*P* value
Duration of surgery (hours, IQR, mean±SD)	0.40 (0.26,0.6925)	0.81 ± 0.45	-5.411	**< 0.001**
<0.5 h, *n* (%)	272 (59.9)	13 (22.8)	28.266	**< 0.001**
≥0.5 h, *n* (%)	182 (40.1)	44 (77.2)		
Intraoperative fluid volume (mL, IQR)	500 (300,500)	500 (500,1000)	-5.021	**< 0.001**
<500 mL, *n* (%)	337 (87.8)	31 (57.4)	32.483	**< 0.001**
≥500 mL, *n* (%)	47 (12.2)	23 (42.6)		
Number of surgical incisions (IQR)	1 (1,3)	3 (1,4)	-4.799	**< 0.001**
Number of quadrants involved (IQR)	1 (1,2)	3 (1,3)	-4.527	**< 0.001**
Incisions at position 1, *n* (%)	74 (18.8)	17 (30.4)	4.031	**0.045**
Incisions at position 2, *n* (%)	27 (6.9)	5 (8.9)	0.080	0.778
Incisions at position 3, *n* (%)	121 (30.8)	34 (60.7)	19.419	**< 0.001**
Incisions at position 4, *n* (%)	8 (2.0)	3 (5.4)	1.086	0.297
Incisions at position 5, *n* (%)	75 (19.1)	9 (16.1)	0.292	0.589
Incisions at position 6, *n* (%)	213 (54.2)	37 (66.1)	2.800	0.094
Incisions at position 7, *n* (%)	57 (14.5)	11 (19.6)	1.007	0.316
Incisions at position 8, *n* (%)	4 (1.0)	0 (0.0)	0.000	1.000
Incisions at position 9, *n* (%)	105 (26.7)	30 (53.6)	16.810	**< 0.001**
Incisions at position 10, *n* (%)	8 (2.0)	1 (11.1)	0.000	1.000
Incisions at position 11, *n* (%)	54 (13.7)	13 (23.2)	3.465	0.063
Incisions at position 12, *n* (%)	31 (7.9)	6 (10.7)	0.211	0.646
High anal fistula, *n* (%)	201 (44.3)	44 (77.2)	21.990	**< 0.001**
Cutting seton (IQR)	0 (0,2)	3 (0.25,3)	-4.609	**< 0.001**
Loose draining seton (IQR)	0 (0,2)	2 (0,3.75)	-4.633	**< 0.001**
Combined surgeries, n (%)	190 (42.0)	24 (42.1)	0.000	0.992

Table 3 Postoperative variables of the participants

Variable	non-POUR group (*n* = 454)	POUR group (*n* = 57)	x^2	*P* value
VAS score (IQR)	6 (5,8)	8 (6,9)	-4.142	**< 0.001**
<7, n (%)	202 (58.2)	13 (25.5)	19.169	**< 0.001**
≥7, *n* (%)	145 (41.8)	38 (74.5)		
GAD-7 score (IQR)	1 (0,4)	4 (1,7)	-3.227	**0.001**
<5, *n* (%)	278 (79.7)	30 (58.8)	10.904	**0.001**
≥5, *n* (%)	71 (20.3)	21 (41.2)		
Urinary tract infection, *n* (%)	12 (3.4)	4 (8.0)	1.316	0.251
Length of hospital stay (days, IQR)	5 (3,7)	8 (5.5,12.5)	-5.384	**< 0.001**

Table 4 Univariate logistic regression analysis for risk factors for POUR following radical surgery for anal fistula

Variable	OR (95% CI)	*P* value
Sex, male	0.537 (0.207–1.391)	0.200
Age	1.036 (1.014–1.057)	**0.001**
BMI, ≥24 kg/m^2	1.069 (0.592–1.932)	0.825
Diabetes	1.414 (0.471–4.246)	0.537
Hypertension	1.686 (0.845–3.364)	0.138
Urological diseases	5.070 (2.423–10.611)	**< 0.001**
Neurological diseases	1.626 (0.456–5.798)	0.454
Proctology surgery history	1.292 (0.716–2.332)	0.395
Smoking history	1.614 (0.906–2.875)	0.104
Drinking history	1.323 (0.734–2.382)	0.352
Duration of disease	1.008 (1.002–1.013)	**0.005**
Duration of surgery, ≥0.5 h	2.590 (1.786–3.756)	**< 0.001**
Intraoperative fluid volume, ≥500 mL	2.946 (1.815–4.780)	**< 0.001**
Number of surgical incisions	1.482 (1.253–1.752)	**< 0.001**
Number of quadrants involved	1.797 (1.399–2.308)	**< 0.001**
Combined surgeries	1.003 (0.574–1.752)	0.992
Incisions at position 1	1.879 (1.008–3.504)	**0.047**
Incisions at position 2	1.329 (0.490–3.606)	0.577
Incisions at position 3	3.474 (1.950–6.189)	**< 0.001**
Incisions at position 4	2.724 (0.701–10.588)	0.148
Incisions at position 5	0.812 (0.381–1.730)	0.589
Incisions at position 6	1.646 (0.914–2.962)	0.097
Incisions at position 7	1.441 (0.704–2.950)	0.318
Incisions at position 8	0.000 (0.000-/)	0.999
Incisions at position 9	3.165 (1.789-5.600)	**< 0.001**
Incisions at position 10	0.875 (0.107–7.131)	0.901
Incisions at position 11	1.898 (0.958–3.760)	0.066
Incisions at position 12	1.401 (0.557–3.526)	0.474
High anal fistula	4.260 (2.233–8.127)	**< 0.001**
Cutting seton	1.505 (1.252–1.809)	**< 0.001**
Loose draining seton	1.400 (1.197–1.636)	**< 0.001**
VAS score, ≥7	4.072 (2.094–7.917)	**< 0.001**
GAD-7 score, ≥5	2.741 (1.481–5.072)	**0.001**

(OR = 1.482, 95% CI = 1.253–1.752; P < 0.001), number of involved quadrants (OR = 1.797, 95% CI = 1.399–2.308; P < 0.001), incisions at position 1 (OR = 1.879, 95% CI = 1.008–3.504; P = 0.047), incisions at position 3 (OR = 3.474, 95% CI = 1.950–6.189; P < 0.001), incisions at position 9 (OR = 3.165, 95% CI = 1.789-5.600; P < 0.001), high anal fistula (OR = 4.260, 95% CI = 2.233–8.127; P < 0.001), number of cutting setons (OR = 1.505, 95% CI = 1.252–1.809; P < 0.001) and number of loose draining setons (OR = 1.400, 95% CI = 1.197–1.636; P < 0.001), VAS score ≥ 7 (OR = 4.072, 95% CI = 2.094–7.917; P < 0.001), and GAD-7 score ≥ 5 (OR = 2.741, 95% CI = 1.481–5.072; P = 0.001). (Table 4).

Uncommon independent risk factors: postoperative anxiety and incisions at position 1

In the multivariate analysis, urological disease (OR = 6.048, 95% CI = 2.329–15.706; $P < 0.001$), incisions at position 1 (OR = 2.228, 95% CI = 1.015–4.893; $P = 0.046$), the presence of high anal fistula (OR = 4.768, 95% CI = 2.100-10.822; $P < 0.001$), a VAS score ≥ 7 (OR = 2.805, 95% CI = 1.282–6.138; $P = 0.010$), and a GAD-7 score ≥ 5 (OR = 2.405, 95% CI = 1.123–5.148; $P = 0.024$) were found to be independent risk factors for urinary retention following radical surgery for anal fistula. (Table 5)

Discussion

POUR is a significant complication of post-radical surgery for anal fistula, which can impose significant physical, emotional, and financial burdens on patients. The multifactorial nature of urinary retention makes it a challenging issue to address following proctology surgeries [19]. This study confirms the multifactorial nature of POUR, with the key risk factors being a urological disease history, high anal fistula, incision location, postoperative pain and anxiety. On the basis of the results obtained in this study, surgeons can target the prevention and monitoring of POUR in high-risk patients to reduce the incidence of POUR and improve patient satisfaction with surgery. Possible mechanisms of POUR and relevant recommendations for surgeons have been illustrated on the basis of previous literature and clinical experience. The specifics are as follows.

Possible mechanisms and risk factors

The bladder is regulated by both sympathetic and parasympathetic nerve fibers. Activation of the parasympathetic nerves causes the detrusor muscle to contract and the muscles of the bladder neck to relax, allowing the bladder to empty smoothly; conversely, sympathetic nerve activation prevents urination through the opposite mechanism [8]. Previous studies have suggested that the underlying pathological mechanisms of urinary retention can be categorized into two main types: mechanical obstruction at the bladder outlet and inhibition of detrusor muscle contraction [20, 21]. Moreover, the urethral and anal sphincters are part of the pelvic muscles and are innervated by common nerves. Stimulation of the anal canal decreases detrusor contraction pressure, thereby increasing bladder capacity [22]. In addition, anesthesia and analgesia may also cause bladder tone receptors to become less responsive to filling stimuli, leading to overfilling of the bladder [8, 23]. Thus, POUR following radical surgery for anal fistula may involve multiple factors.

Table 5 Multivariate logistic stepwise regression analysis of risk factors for POUR following radical surgery for anal fistula

Variable	OR (95% CI)	*P* value
Urological diseases	6.048 (2.329–15.706)	**< 0.001**
Incisions at position 1	2.228 (1.015–4.893)	**0.046**
High anal fistula	4.768 (2.100-10.822)	**< 0.001**
VAS score, ≥7	2.805 (1.282–6.138)	**0.010**
GAD-7 score, ≥5	2.405 (1.123–5.148)	**0.024**

Mechanistic analysis and management strategies

Incision location

In the current study, we identified the presence of incisions at position 1 as a new independent risk factor. Anal sphincter function and voiding function depend on the integrity of the pelvic autonomic plexus and muscles. Incisions on the anterior side of the anus are closer to the urethral anatomy, which means that damage to the muscles and connective tissues near the urethra can occur more easily. Surgical management of an anal fistula near position 1 may result in movement of the inferior hypogastric plexus, leading to injury, which is a combination of the sympathetic and parasympathetic nerves. Injury to parasympathetic splanchnic nerves may result in urinary dysfunction. However, the axons of the nerves are not destroyed during surgery, allowing most patients to recover normal bladder function after a period [24, 25]. Therefore, when patients have a fistula at position 1 or have an affliction on the anterior side of the anorectum that requires surgical treatment, surgeons are advised to pay more attention to the surgical technique, avoiding large tears in the anal sphincter that could damage the nerves and lead to further postoperative complications.

Urological disease history

Similar to previous studies [9, 26], this study identified a history of urological diseases as an independent risk factor for POUR following radical surgery for anal fistula. Chang [11] identified benign prostatic hyperplasia (BPH) as a risk factor for POUR after elective spine surgery. Patients with urological diseases may experience slower recovery of bladder function postoperatively. BPH is a urologic condition that is particularly common among middle-aged and older male patients. Among the cases reviewed in this study, 66% of patients with a history of urologic disease had BPH. A subset of patients were diagnosed with BPH when they underwent a urinary ultrasound after developing POUR. BPH can cause mechanical urethral obstruction to some extent, increasing the likelihood of postoperative urination difficulties.

For clinicians, it is crucial to thoroughly inquire about the patient's history of urological diseases or abnormal urination before surgery. For patients with urological diseases, monitoring postoperative bladder capacity is essential. If recurrent urinary retention occurs or if symptoms of difficulty urinating or discomfort persist after discharge, timely consultation with a urologist for further examination and systematic treatment is recommended.

Type of fistula

Multivariate analysis indicated that patients with a high anal fistula were more likely to experience POUR. Previous studies on POUR following anal fistula surgery have rarely analyzed fistula classification as a factor. This may be due to the low incidence of high anal fistulas and the low success rate of surgery, making data collection and analysis challenging.

The causes of POUR due to high anal fistulae are complex. (1) High anal fistulas involve a larger infection range around the anus and are more complex than low anal fistulas. This increased complexity is accompanied by increases in the number of surgical incisions, involving the perianal quadrant, as is the risk of nerve and blood vessel damage. (2) Seton management for high anal fistulas is strongly recommended in China [27], and the efficacy rate is up to 90% [28]. Owing to the seton, more hemostatic gauze is packed inside the anus of patients postoperatively to prevent bleeding. And, seton stimulation can cause involuntary spasm of the anal sphincter, potentially leading to more intense pain. Compaction with the anal canal and pain stimulation can excite the sympathetic nerves, inhibiting detrusor muscle contraction while tightening the IUS, making it difficult to expel urine. (3) For patients with complex high anal fistulas, doctors may advise a residue-free diet or enteral nutrition fluids to reduced frequency of defecation, along with intravenous rehydration, which may cause patients to produce a large amount of urine. (4) Owing to pain or intravenous rehydration effects, patient mobility may be limited, preventing affected patients from standing or walking. However, many patients are uncomfortable with urinating in bed or are reluctant to urinate in a shared hospital room, which can eventually result in overdistension of the bladder and a decrease in the contractility of the bladder muscles, thereby leading to POUR.

According to the above analysis, there are important considerations for clinicians. During the perioperative period, the intravenous fluid volume of high anal fistulas should be restricted to avoid excessive fluid administration, leading to overstretching of the bladder [3, 17, 29]. Additionally, early standing can help patients urinate more easily [30, 31], but patients with severe complex high anal fistulas should not be forced to stand or move excessively to avoid increasing spasms of the anal sphincter, leading to intensified postoperative pain or bleeding. Most importantly, doctors should advise patients to undergo surgery as early as possible to avoid an increase in the extent of anal fistula infection, which can lead to further complications.

Postoperative pain

The region surrounding the anus is richly innervated, making patients particularly sensitive to pain following proctology surgery. Anal fistula, an infection-related disease, is more prone to postoperative inflammatory responses and edema. Inflammation, edema, friction from dressing changes, and stimulation from packing materials in the anal canal can all lead to persistent severe perianal pain. The patients in this study reported that perianal pain worsened during urination, often leading to interrupted urination due to perianal pain and subsequently developing a fear of urination due to the anticipation of pain. Research by Toyonaga [3] has indicated that postoperative pain is an independent risk factor for POUR after surgery to treat benign proctology disease, and prophylactic analgesia can reduce the incidence of POUR. Pain not only inhibits the initiation of the micturition reflex [31] but also, since the nerves affecting the anus originate from the pudendal nerve and the muscles in the anal area are closely related to those in the urethral area, anal pain can lead to spasms of the urethral sphincter and pelvic floor [32], thereby causing difficulty urinating and eventually leading to urinary retention.

Since pain is a risk factor for POUR, the choice of postoperative analgesic medication is very important. Some studies [8, 33] suggest that the use of epidural analgesia, long-acting local anesthetics, and systemic analgesics of high doses of opioid medications may weaken the bladder reflex, increasing the likelihood of urinary retention. Therefore, such an analgesic approach should be avoided. Instead, a multimodal approach combining short-acting local anesthetics and nonsteroidal anti-inflammatory drugs should be used to minimize the dosage while achieving optimal pain relief.

Postoperative anxiety

This study identified a GAD-7 score ≥ 5, which has rarely been studied, as an independent risk factor for POUR. Anxiety can affect the normal function of pelvic floor muscles, causing them to be in a continuous state of contraction and leading to difficulty urinating. Persistent nervous tension might lead to autonomic dysfunction, resulting in POUR. In animal studies, adrenocorticotropin-releasing factor (CRF) receptor expression was upregulated in Barrington's study of stress-exposed male rats. CRF contributes to the stress response by stimulating the release of ACTH, which has an inhibitory effect on the urination pathway, from the pituitary gland [34, 35]. Tammela [9] suggested that anxiety is a cause of POUR. Moreover, a study by Jing on benign gynecological surgeries [36] suggested that patients with mild preoperative anxiety had a 4.226-fold greater incidence of POUR than patients without anxiety, and patients with moderate to severe preoperative anxiety had a 5.698-fold greater incidence of POUR. Hence, postoperative assessment of patients' anxiety should be performed. When a patient's anxiety affects quality of life and recovery, psychological counseling or psychiatric treatment should be provided if necessary.

Sex differences

Sex-related differences in POUR are controversial. Some studies [5, 6] have suggested that males are more prone to urinary retention than females are, whereas other studies [30, 37, 38] have reported no significant difference in the incidence of POUR between sexes; however, Toyonaga's study [3] identified female sex as an independent risk factor for POUR. According to the data reviewed in this study, there was no significant difference in the sex ratio between the POUR group and the non-POUR group. Anatomically, the male pelvic plexus is closer to the lower end of the rectum and longer than the female pelvic plexus is, which may increase the risk of traction injury during surgery [24, 39]. Additionally, common conditions in middle-aged and older men, such as BPH, may increase their susceptibility to POUR. However, in our clinical observations, approximately 20% of male patients (especially older men) refused catheterization in favor of oral medication (alpha-adrenergic antagonists such as tamsulosin) when experiencing significant symptoms of urinary retention, whereas only a very small number of female patients were unwilling to undergo catheterization, making them more likely to be defined as having POUR. The combined effects of these sex differences might explain why no sex-based differences in POUR incidence were observed in the present study.

Strengths and limitations

This was a cross-sectional, retrospective, nonrandomized study. First, the generalizability of the results may be limited because of the single-center nature and the specificity of the surgical approach. Second, VAS and GAD-7 scores were recorded on the basis of patient recall during telephone follow-up, which may have introduced recall bias. Third, the past medical history data collected were based on the patient-reported history, and the definition of POUR was not validated with objective examinations such as ultrasound, which may have led to an underestimation of the incidence of POUR. Fourth, the study did not account for women's greater acceptance of catheterization, which may have affected the study findings. Future research should explore: (1) specific urological conditions contributing to POUR and develop tailored preventive strategies; (2) advanced surgical approaches for anterior anal fistulas and high anal fistulas to avoid damage to nerves and sphincters; and (3) the mechanism by which pain and anxiety contribute to POUR. An advantage of this study lies in the availability of data from many patients with high anal fistulas. Additionally, patients with high anal fistulas have a higher degree of surgical complexity. According to detailed surgical data, the study factors were comprehensive and included less frequently analyzed factors such as the location of surgical incisions, the number of cutting setons and loose draining setons, and postoperative anxiety, making this study highly innovative.

Conclusion

POUR is a significant complication that occurs after radical surgery for anal fistula, and it particularly affects patients with urological disease, high anal fistula, and incisions at position 1. Therefore, surgeons should be vigilant about POUR in high-risk patients. Optimizing surgical methods, management of perioperative fluid management, monitoring of bladder capacity, and management of postoperative pain and anxiety can mitigate POUR risk, improve recovery times, and increase patient satisfaction. Further studies are needed to refine surgical methods to avoid nerve damage, and standardize POUR prevention and management protocols.

Author contributions

Chen Li and Ningyuan Liu contributed equally to this work. Chen Li and Ningyuan Liu designed the research study. Chen Li, Zichen Huang, Zijian Wei, Keyi Li and Sangyu Ye contributed to the data collection. Chen Li analyzed the data and wrote the first draft of the manuscript. Chen Li, Ningyuan Liu and Wenxiao Hou commented on previous versions of the manuscript, while Lihua Zheng assisted in the study design and manuscript review. All authors have thoroughly reviewed and approved the final version of the manuscript.

Funding

This study was funded by National High Level Hospital Clinical Research Funding-2022-NHLHCRF-LX-0221.

Data availability

The datasets used and analyzed during this study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Ethical approval for this study (2022-KY-121-2) was provided by the Ethical Committee of the China-Japan Friendship Hospital on 15 July 2022.This study was conducted in accordance with the ethical standards of China-Japan Friendship Hospital, the Declaration of Helsinki of the World Medical Association, the International Ethical Guidelines for Health-related Research Involving Humans (2016) and China's Measures for Ethical Review of Biomedical Research Involving Human Beings (2016). The need for informed consent was waived by the Ethical Committee of the China-Japan Friendship Hospital.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 8 April 2024 / Accepted: 24 September 2024
Published online: 14 October 2024

References

1. Geller EJ. Prevention and management of postoperative urinary retention after urogynecologic surgery. Int J Womens Health. 2014;6:829–38. https://doi.org/10.2147/ijwh.S55383.
2. Vogel JD, Johnson EK, Morris AM, Paquette IM, Saclarides TJ, Feingold DL, et al. Clinical practice Guideline for the management of Anorectal Abscess, Fistula-in-Ano, and Rectovaginal Fistula. Dis Colon Rectum. 2016;59(12):1117–33. https://doi.org/10.1097/dcr.0000000000000733.
3. Toyonaga T, Matsushima M, Sogawa N, Jiang SF, Matsumura N, Shimojima Y, et al. Postoperative urinary retention after surgery for benign anorectal disease: potential risk factors and strategy for prevention. Int J Colorectal Dis. 2006;21(7):676–82. https://doi.org/10.1007/s00384-005-0077-2.
4. Jeong HY, Song SG, Lee JK. Predictors of postoperative urinary retention after semiclosed hemorrhoidectomy. Ann Coloproctol. 2022;38(1):53–9. https://doi.org/10.3393/ac.2021.00304.0043.
5. Crystal RF, Hopping RA. Early postoperative complications of anorectal surgery. Dis Colon Rectum. 1974;17(3):336–41. https://doi.org/10.1007/bf02586977.
6. Zaheer S, Reilly WT, Pemberton JH, Ilstrup D. Urinary retention after operations for benign anorectal diseases. Dis Colon Rectum. 1998;41(6):696–704. https://doi.org/10.1007/bf02236255.
7. Keita H, Diouf E, Tubach F, Brouwer T, Dahmani S, Mantz J, et al. Predictive factors of early postoperative urinary retention in the postanesthesia care unit. Anesth Analg. 2005;101(2):592–6. https://doi.org/10.1213/01.Ane.0000159165.90094.40.
8. Baldini G, Bagry H, Aprikian A, Carli F. Postoperative urinary retention: anesthetic and perioperative considerations. Anesthesiology. 2009;110(5):1139–57. https://doi.org/10.1097/ALN.0b013e31819f7aea.
9. Tammela T. Postoperative urinary retention–why the patient cannot void. Scand J Urol Nephrol Suppl. 1995;175:75–7.
10. Wittig L, Carlson KV, Andrews JM, Crump RT, Baverstock RJ. Diabetic bladder dysfunction:a review. Urology. 2019;123:1–6. https://doi.org/10.1016/j.urology.2018.10.010.
11. Chang Y, Chi KY, Tai TW, Cheng YS, Lee PH, Huang CC, et al. Risk factors for postoperative urinary retention following elective spine surgery: a meta-analysis. Spine J. 2021;21(11):1802–11. https://doi.org/10.1016/j.spinee.2021.05.009.
12. Lee SY, Kang SB, Kim DW, Oh HK, Ihn MH. Risk factors and preventive measures for acute urinary retention after rectal cancer surgery. World J Surg. 2015;39(1):275–82. https://doi.org/10.1007/s00268-014-2767-9.
13. Hansen BS, Søreide E, Warland AM, Nilsen OB. Risk factors of post-operative urinary retention in hospitalised patients. Acta Anaesthesiol Scand. 2011;55(5):545–8. https://doi.org/10.1111/j.1399-6576.2011.02416.x.
14. Scott AJ, Mason SE, Langdon AJ, Patel B, Mayer E, Moorthy K, et al. Prospective risk factor analysis for the development of post-operative urinary Retention following ambulatory general surgery. World J Surg. 2018;42(12):3874–9. https://doi.org/10.1007/s00268-018-4697-4.
15. Changchien CR, Yeh CY, Huang ST, Hsieh ML, Chen JS, Tang R. Postoperative urinary retention after primary colorectal cancer resection via laparotomy: a prospective study of 2,355 consecutive patients. Dis Colon Rectum. 2007;50(10):1688–96. https://doi.org/10.1007/s10350-007-0305-7.
16. Toritani K, Watanabe J, Suwa Y, Suzuki S, Nakagawa K, Suwa H, et al. The risk factors for urinary dysfunction after autonomic nerve-preserving rectal cancer surgery: a multicenter retrospective study at Yokohama Clinical Oncology Group (YCOG1307). Int J Colorectal Dis. 2019;34(10):1697–703. https://doi.org/10.1007/s00384-019-03374-3.
17. Tsubaki M, Hasimoto R, Sunagawa M. Relationship between surgical procedure and spontaneous urination after rectal cancer surgery. Asian J Surg. 2005;28(1):34–7. https://doi.org/10.1016/s1015-9584(09)60255-4.
18. Zheng L, Shi Y, Zhi C, Yu Q, Li X, Wu S, et al. Loose combined cutting seton for patients with high intersphincteric fistula: a retrospective study. Ann Transl Med. 2020;8(19):1236. https://doi.org/10.21037/atm-20-6123.
19. Frischer JS, Rymeski B. Complications in colorectal surgery. Semin Pediatr Surg. 2016;25(6):380–7. https://doi.org/10.1053/j.sempedsurg.2016.10.008.
20. Barone JG, Cummings KB. Etiology of acute urinary retention following benign anorectal surgery. Am Surg. 1994;60(3):210–1.
21. Pompeius R. Detrusor inhibition induced from anal region in man. Acta Chir Scand Suppl. 1966;361:1–54.
22. Knight SL, Edirisinghe N, Leaker B, Susser J, Craggs MD. Conditional neuromodulation of neurogenic detrusor overactivity using transrectal stimulation in patients with spinal cord injury: a proof of principle study. Neurourol Urodyn. 2018;37(1):385–93. https://doi.org/10.1002/nau.23310.
23. Kunitake H, Poylin V. Complications following anorectal surgery. Clin Colon Rectal Surg. 2016;29(1):14–21. https://doi.org/10.1055/s-0035-1568145.
24. Mundy AR. An anatomical explanation for bladder dysfunction following rectal and uterine surgery. Br J Urol. 1982;54(5):501–4. https://doi.org/10.1111/j.1464-410x.1982.tb13575.x.
25. Haim N, Wexner SD. Rectal Cancer-Associated urinary dysfunction: a review. Curr Bladder Dysfunct Rep. 2015;10(2):118–24. https://doi.org/10.1007/s11884-015-0298-3.
26. Huang L, Yin Y, Liao Y, Liu J, Zhu K, Yuan X, et al. Risk factors for postoperative urinary retention in patients undergoing colorectal surgery: a systematic review and meta-analysis. Int J Colorectal Dis. 2022;37(12):2409–20. https://doi.org/10.1007/s00384-022-04281-w.
27. Clinical Guidelines Committee CSBoCMDA. Consensus of Chinese experts on the diagnosis and treatment of anal fistula (2020). Chin J Gastrointest Surg. 2020;23(12):8.
28. Rosen DR, Kaiser AM. Definitive seton management for transsphincteric fistula-in-ano: harm or charm? Colorectal Dis. 2016;18(5):488–95. https://doi.org/10.1111/codi.13120.
29. Lee TH, Kwak JM, Yu DY, Yang KS, Baek SJ, Kim J, et al. Lower incidence of postoperative urinary Retention in Robotic Total Mesorectal Excision for low rectal Cancer compared with laparoscopic surgery. Dig Surg. 2022;39(2–3):75–82. https://doi.org/10.1159/000522229.
30. Stallard S, Prescott S. Postoperative urinary retention in general surgical patients. Br J Surg. 1988;75(11):1141–3. https://doi.org/10.1002/bjs.1800751128.
31. Tammela T, Kontturi M, Lukkarinen O. Postoperative urinary retention. I. Incidence and predisposing factors. Scand J Urol Nephrol. 1986;20(3):197–201. https://doi.org/10.3109/00365598609024494.
32. Nevo A, Haidar A-M, Navaratnam A, Humphreys M. Urinary Retention following non-urologic surgery. Curr Bladder Dysfunct Rep. 2019;14(3):157–67. https://doi.org/10.1007/s11884-019-00518-7.
33. Panicker JN, Game X, Khan S, Kessler TM, Gonzales G, Elneil S, et al. The possible role of opiates in women with chronic urinary retention: observations from a prospective clinical study. J Urol. 2012;188(2):480–4. https://doi.org/10.1016/j.juro.2012.04.011.
34. Pavcovich LA, Valentino RJ. Central regulation of micturition in the rat the corticotropin-releasing hormone from Barrington's nucleus. Neurosci Lett. 1995;196(3):185–8. https://doi.org/10.1016/0304-3940(95)11873-u.
35. Wood SK, Baez MA, Bhatnagar S, Valentino RJ. Social stress-induced bladder dysfunction: potential role of corticotropin-releasing factor. Am J Physiol Regul Integr Comp Physiol. 2009;296(5):R1671–8. https://doi.org/10.1152/ajpregu.91013.2008.
36. Jing Y, Fang C, Jingfeng Q, Xin X, Yinshu G. Analysis on the influencing factors of postoperative urinary retention after gynecological benign diseases. Beijing Med J. 2023;45(09):795–8. https://doi.org/10.15932/j.0253-9713.2023.09.011.
37. Prasad ML, Abcarian H. Urinary retention following operations for benign anorectal diseases. Dis Colon Rectum. 1978;21(7):490–2. https://doi.org/10.1007/bf02586733.
38. Petros JG, Bradley TM. Factors influencing postoperative urinary retention in patients undergoing surgery for benign anorectal disease. Am J Surg. 1990;159(4):374–6. https://doi.org/10.1016/s0002-9610(05)81274-7.
39. Alkatout I, Wedel T, Pape J, Possover M, Dhanawat J, Review. Pelvic nerves - from anatomy and physiology to clinical applications. Transl Neurosci. 2021;12(1):362–78. https://doi.org/10.1515/tnsci-2020-0184.

Publisher's note