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REVIEW

Incidence and Risk Factors of Postoperative Urinary Retention in Gynecologic Surgery: A Systematic Review and Meta-Analysis

Anisa Hasanah[1], Ida Maryati[2], Ermiati Ermiati[2]

[1]Faculty of Nursing, Universitas Padjadjaran, Sumedang, West Java, Indonesia; [2]Department of Maternity, Faculty of Nursing, Universitas Padjadjaran, Sumedang, West Java, Indonesia

Correspondence: Ida Maryati, Department of Maternity, Faculty of Nursing, Universitas Padjadjaran, Jl. Raya Bandung-Sumedang KM 21, Hegarmanah, Jatinangor, Sumedang, West Java, 45363, Indonesia, Tel +628122109363, Fax +6222-7795596, Email ida.maryati@unpad.ac.id

Video abstract

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Background: Postoperative urinary retention (POUR) is a frequent complication after gynecologic surgery, with wide variability in reported incidence due to differences in procedures and outcome definitions, and a lack of standardized quantitative synthesis.

Objective: To estimate the incidence of POUR following gynecologic surgery and summarize associated risk factors and preventive strategies.

Methods: A PRISMA-based systematic review and meta-analysis was conducted using PubMed, Scopus, EBSCO, and ScienceDirect. The review protocol was prospectively registered on the Open Science Framework (OSF; DOI: 10.17605/OSF.IO/W8CYR). Random-effects models were applied to estimate pooled incidence, with subgroup analyses by procedure and POUR definition. Associated factors were synthesized narratively.

Results: Thirty-four studies including 20,466 patients were analyzed. The pooled incidence of POUR was 16.1% (95% CI 12.8–20.1; I^2 = 97.3%). Incidence was highest after pelvic organ prolapse surgery (30.9%) and sling/mid-urethral sling procedures (25.3%), and lowest after minimally invasive benign hysterectomy (3.7%). Increased risk was associated with baseline voiding dysfunction, diabetes mellitus, vaginal surgical approach, and opioid exposure, while minimally invasive techniques and selected perioperative strategies were protective.

Conclusion: POUR is a common, procedure-dependent complication of gynecologic surgery. Procedure-specific risk stratification and standardized perioperative pathways are needed to reduce POUR and improve postoperative recovery.

Keywords: postoperative urinary retention, gynecologic surgery, incidence, risk factors, meta-analysis

Introduction

Postoperative urinary retention (POUR) is a clinically significant postoperative complication characterized by the inability to adequately empty the bladder despite sufficient bladder volume or distension.[1] POUR remains a persistent concern across surgical disciplines, with reported incidence rates ranging from 5% to 70%, depending on the type of surgery, anesthetic modality, and diagnostic criteria applied.[1,2] The International Continence Society (ICS) emphasizes the absence of a universally accepted definition for postoperative urinary retention, a limitation that has contributed to substantial heterogeneity in reported incidence rates and outcome assessment across studies.[3]

In gynecologic surgery, the risk of POUR is amplified due to the complexity of pelvic anatomy, the proximity of pelvic autonomic and somatic neural structures involved in micturition, and the wide variability in surgical techniques affecting urethral and bladder-supportive tissues. International evidence reports POUR incidence ranging from 2.5% to 43%, with the highest rates observed following pelvic organ prolapse (POP) reconstruction and mid-urethral sling (MUS) procedures.[4,5] Evidence from Indonesia similarly demonstrates elevated incidence, reaching 29% among POP patients

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undergoing reconstructive surgery.[6] Additionally, a prospective cohort study in Uganda reported a 19.6% incidence of POUR following perineal tear repair, highlighting that POUR is also clinically relevant in less complex gynecologic procedures.[7]

From a clinical perspective, POUR may result in sustained bladder overdistension, detrusor muscle injury, urinary tract infection, postoperative pain, delayed ambulation, prolonged catheterization, and increased length of hospital stay.[1,4,8] A range of perioperative and patient-related risk factors has been consistently implicated, including advanced age, diabetes mellitus, low body mass index, prolonged operative duration, excessive intraoperative fluid administration, opioid exposure, preoperative voiding abnormalities, and vaginal surgical approach.[1,2] Proposed pathophysiological mechanisms underlying POUR include periurethral tissue edema, local inflammatory responses, disruption of pelvic afferent and efferent neural pathways, and pharmacologic suppression of detrusor contractility associated with anesthesia and opioid analgesia.

Despite the growing volume of literature examining POUR incidence and its associated risk factors, existing studies exhibit marked methodological variability. Differences in POUR definitions, study design, surgical populations, and outcome reporting substantially limit direct comparison and synthesis of findings across studies. Moreover, to date, no comprehensive review has systematically integrated quantitative evidence across contemporary gynecologic surgical approaches—including vaginal, laparoscopic, robotic, prolapse repair, and sling procedures—while simultaneously evaluating both incidence and selected risk factors using meta-analytic methods.

Accordingly, a systematic review with meta-analysis is warranted to provide a consolidated and quantitative synthesis of available evidence on the incidence and risk factors of postoperative urinary retention following gynecologic surgery. Such an approach is essential to inform perioperative care strategies, support early identification of patients at increased risk, guide voiding protocols, and ultimately optimize postoperative outcomes.

Methods

Study Design and Reporting

This systematic review and meta-analysis was conducted in accordance with the PRISMA guidelines, using a predefined methodology established prior to study selection and data extraction to minimize reporting bias.

Outcomes

The primary outcome was the incidence of postoperative urinary retention (POUR) following gynecologic surgery. Secondary outcomes included patient-, surgical-, anesthetic-, and perioperative-related risk factors, as well as the effects of selected preventive interventions or voiding protocols.

Search Strategy

A comprehensive literature search was performed in PubMed, Scopus, EBSCO, and ScienceDirect using MeSH terms and free-text keywords related to POUR, risk factors, incidence, and gynecologic surgery. Reference lists of eligible studies were manually screened for additional relevant articles.

Eligibility Criteria

Eligible studies included original research involving adult women undergoing gynecologic surgery that reported POUR incidence, associated risk factors, or intervention outcomes with extractable quantitative data. Editorials, reviews, case reports, non-gynecologic studies, animal studies, and conference abstracts without sufficient data were excluded.

Study Selection and Data Extraction

Two reviewers independently screened studies, assessed full texts, and extracted data using a standardized form. Discrepancies were resolved by consensus or third-party adjudication. Extracted data included study characteristics, surgical type, POUR definition, incidence data, and reported effect estimates.

Quality Assessment

Methodological quality was independently assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Tools, with disagreements resolved by consensus.

Data Synthesis and Analysis

Random-effects meta-analyses were performed using Comprehensive Meta-Analysis (CMA) software (version 3) for outcomes reported by at least three studies with comparable definitions and data, including pooled POUR incidence. Heterogeneity was assessed using the I^2 statistic, and subgroup analyses were conducted by surgical category and POUR definition when applicable. Potential publication bias was evaluated using visual inspection of funnel plots and Egger's regression test when sufficient studies were available. Outcomes unsuitable for pooling were synthesized narratively using structured tables and thematic grouping.

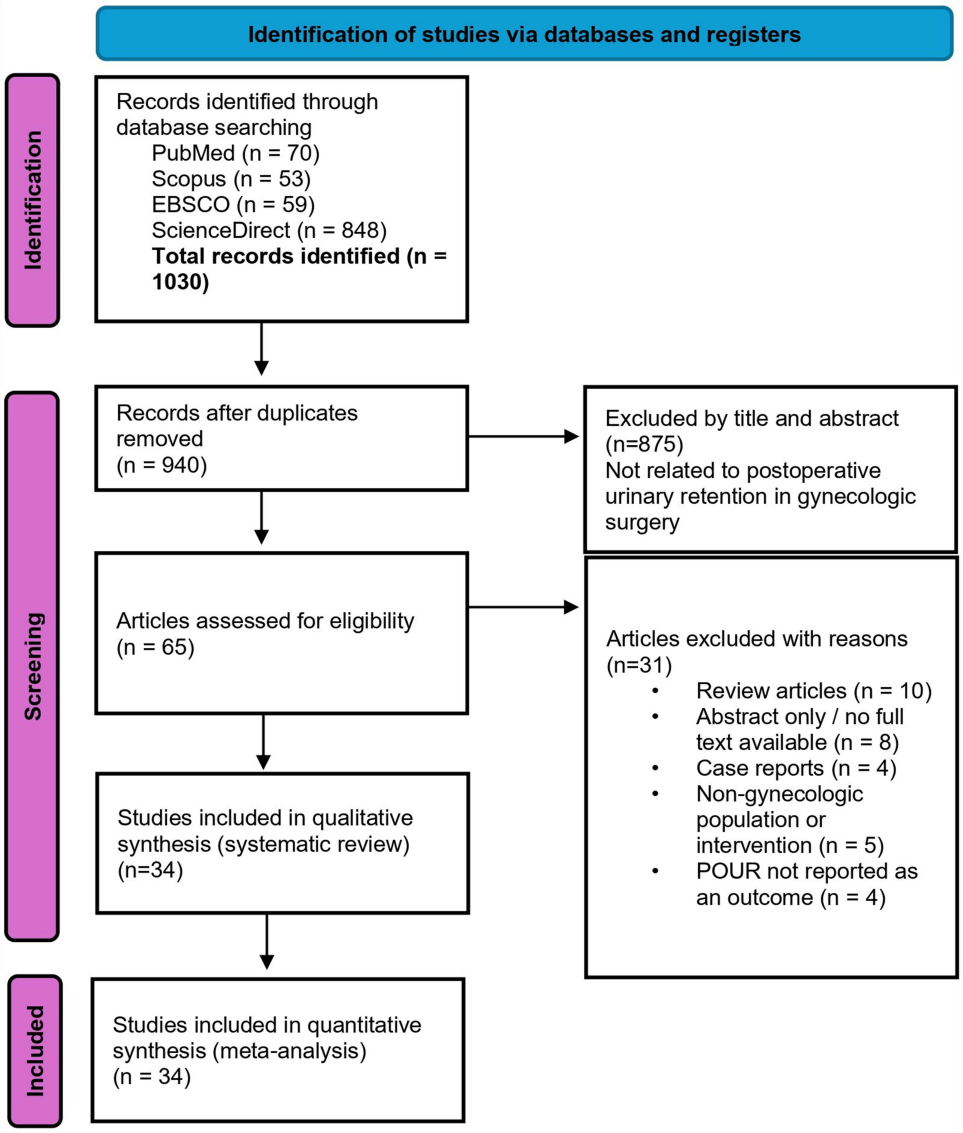

Figure 1 PRISMA Flow Diagram for the literature review on the Incidence and Risk Factors of Postoperative Urinary Retention in Gynecologic Surgery.

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Table 1 Characteristics and Incidence of Postoperative Urinary Retention (POUR) in Included Studies (n=34)

No	Study (Author, Year)	Country	Study Design	Sample Size (N)	POUR Incidence (%)	Associated Factors (Risk / Protective)
1	Alas (2019a)[9]	USA	Retrospective review	177	48.9	Age <55 years, diabetes mellitus, cystocele ≥ stage 2 (risk)
2	Alas (2019b)[10]	USA	RCT	58	86.2	High baseline PVR, low Qmax, increased EBL (risk)
3	Anglim (2022)[11]	Canada	Retrospective cohort	700	43.0	Prolonged operative time, high EBL, large IV fluid volume (risk)
4	Behbehani (2020)[12]	USA	Retrospective cohort	441	21.0	Longer operative duration, perioperative opioid use (risk)
5	Bekos (2020)[13]	Austria	Retrospective study	176	31.8	Prolapse hysterectomy, low BMI (risk)
6	Bodker (2003)[14]	Denmark	Prospective study	284	9.2	Surgical approach (laparotomy > laparoscopy) (risk)
7	Chapman (2021)[15]	USA	RCT (multicenter)	119	8.8 vs 25.8	Perioperative tamsulosin (protective vs placebo)
8	Chong (2018)[16]	USA	Retrospective cohort	235	10.6	Retrograde voiding trial, discharge with Foley catheter (risk)
9	De Lima (2024)[17]	USA	Retrospective cohort	1974	24.8 vs 18.3	Sugammadex (protective), high glycopyrrolate dose (risk)
10	Delgado (2021)[18]	USA	Retrospective cohort	197	3.0	Advanced age, higher EBL (risk)
11	Foster (2007)[19]	USA	RCT	55	47	Backfill voiding method (protective for discharge)
12	Gabriel (2012)[20]	France/ Germany	Retrospective case series	221	4.6	Advanced age (risk of persistent retention)
13	Ghezzi (2007)[5]	Italy	Prospective cohort	233	21.0	Vaginal approach vs laparoscopy (risk)
14	Hwang (2022)[21]	South Korea	Prospective pilot study	99	27.3	Low BMI, low voiding VAS score (risk)
15	Ishino (2022)[22]	USA	Retrospective cohort	1977	2.0	Active voiding trial, history of retention (risk)
16	Le Neveu (2025)[23]	USA	RCT	203	2.0	Robotic approach, younger age (protective)
17	Leffelman (2025)[24]	USA	RCT	161	18.6	Preoperative tamsulosin (no significant effect)
18	Loo (2020)[25]	Taiwan	Retrospective analysis	110	10.9	Age >71 years, POPDI-6 ≥13, urinary hesitancy (risk)
19	McLarty (2025)[26]	USA	Retrospective cohort	2665	31.1	Vaginal approach, concomitant hysterectomy, high EBL (risk)
20	Morey (2006)[27]	USA	Retrospective multicenter	504	11.0 vs 18.3	Transobturator approach (protective vs transabdominal)
21	Nguyen (2024)[28]	Australia	Nested cohort study	289	5.9	Older age, obstetric history (risk)
22	Pham (2010)[29]	USA	Retrospective review	107	22.0 vs 5.0	Preoperative Valsalva voiding (risk vs detrusor voiding)
23	Ripperda (2016)[30]	USA	Multicenter case–control	464	21.8	Charlson Comorbidity Index ≥1, Valsalva voiding (risk)
24	Salin (2007)[31]	France	Retrospective review	100	20.0	Older age (risk), higher preoperative Qmax (protective)
25	Samimi (2020)[32]	USA	Retrospective cohort	4743	0.06	Unconditional voiding protocol (protective)
26	Shah (2025)[33]	USA	Interrupted time series	119	0.0	Liberal voiding protocol (protective)
27	Siedhoff (2020)[34]	USA	Retrospective cohort	652	3.8	Laparotomy vs MIS, low surgeon volume (risk)
28	Steinberg (2010)[35]	USA	Retrospective analysis	142	34.0	Combined anterior–posterior repair, retropubic sling (risk)
29	Sun (2025)[36]	Taiwan	Retrospective study	866	20.8	Older age, prior hysterectomy, MUCP <30 cmH_2O (risk)
30	Wagar (2024)[37]	USA	Retrospective analysis	115	44.3	Backfill method (protective for resolution), low BMI (risk)
31	Wong (2017)[38]	USA	Retrospective case–control	352	11.4	Cervical descent (Point C) (risk)
32	Yu (2025)[39]	China	Retrospective cohort	1261	26.0	Surgical type (non-MUS), longer hospital stay (risk)
33	Zhang (2021)[40]	Canada	Retrospective cohort	501	36.3	Preoperative PVR >200 mL, voiding dysfunction symptoms (risk)
34	Zhang (2025)[41]	China	Retrospective study	166	15.0	Early pelvic floor muscle training (protective)

Abbreviations: POUR, postoperative urinary retention; RCT, randomized controlled trial; PVR, post-void residual volume; Qmax, maximum urinary flow rate; EBL, estimated blood loss; IV, intravenous; BMI, body mass index; VAS, visual analogue scale; POPDI-6, Pelvic Organ Prolapse Distress Inventory-6; MIS, minimally invasive surgery; MUCP, maximal urethral closure pressure; MUS, mid-urethral sling.

Protocol Registration

The review protocol was not registered in PROSPERO. However, it was prospectively registered on the Open Science Framework (OSF) prior to data extraction and followed a predefined methodology in accordance with PRISMA recommendations (DOI: 10.17605/OSF.IO/W8CYR).

Results

Study Selection, Quality Assessment, and Study Characteristics

The literature search identified 1030 records, of which 940 unique articles were screened after duplicate removal. Following full-text assessment of 65 studies, 34 studies met the inclusion criteria and were included in the systematic review (Figure 1). Methodological quality, assessed using the Joanna Briggs Institute Critical Appraisal Tools, was overall acceptable.

The included 34 studies, published between 2003 and 2025, involved 20466 patients undergoing gynecologic surgery and were predominantly conducted in the United States, with additional studies from Europe and Asia. Most studies were observational, with a smaller number of randomized controlled trials evaluating perioperative interventions. Surgical procedures included benign hysterectomy, pelvic organ prolapse surgery, mid-urethral sling procedures, and gynecologic oncology surgery, with sample sizes ranging from 55 to 4743 patients. Reported POUR incidence ranged widely (0–86.2%), reflecting heterogeneity in procedures and outcome definitions (Table 1).

Postoperative Urinary Retention Incidence

The pooled cumulative incidence of postoperative urinary retention following gynecologic surgery was 16.1% (95% CI 12.8–20.1), with substantial variability across surgical procedures and outcome definitions, reaching the highest incidence after pelvic organ prolapse surgery and when POUR was defined as failure of a voiding trial (Table 2). The forest plot illustrates marked between-study heterogeneity, with incidence estimates ranging from near zero to over 80%, supporting the use of a random-effects model (I^2 = 97.3%) (Figure 2).

Publication Bias

Funnel plot inspection suggested mild asymmetry (Figure 3), which was supported by a significant Egger's regression test (p = 0.005). However, the classic fail-safe N indicated that 4206 missing studies would be required to nullify the pooled estimate, supporting the robustness of the findings.

Table 2 Pooled Cumulative Incidence of Postoperative Urinary Retention (POUR) Following Gynecologic Surgery (n=34)

Analysis	No. of Studies	Cumulative Incidence of POUR, % (95% CI)	Sample Size (n)	I^2 (%)
Overall	34	16.1 (12.8–20.1)	20,466	97.3
Subgroup by procedure				
Pelvic organ prolapse (POP) surgery	8	30.9 (25.2–37.2)	6422	95.4
Benign hysterectomy	9	3.7 (1.4–9.6)	10,202	98.4
Gynecologic oncology surgery	4	12.7 (3.8–34.9)	791	96.9
Sling / mid-urethral sling (MUS)	6	25.3 (15.4–38.6)	1394	94.0
Subgroup by POUR definition				
Failed voiding trial	12	27.7 (21.5–34.9)	6247	95.8
Re-catheterization	9	7.9 (4.1–14.6)	11,240	98.5
Post-void residual (PVR) ≥ 100 mL	3	14.6 (12.2–17.4)	721	45.1
Post-void residual (PVR) ≥ 200 mL	3	10.6 (1.5–48.3)	601	97.9

Notes: Estimates were derived using a random-effects model. I^2 indicates between-study heterogeneity.
Abbreviations: POUR, postoperative urinary retention; POP, pelvic organ prolapse; MUS, mid-urethral sling; PVR, post-void residual volume; CI, confidence interval.

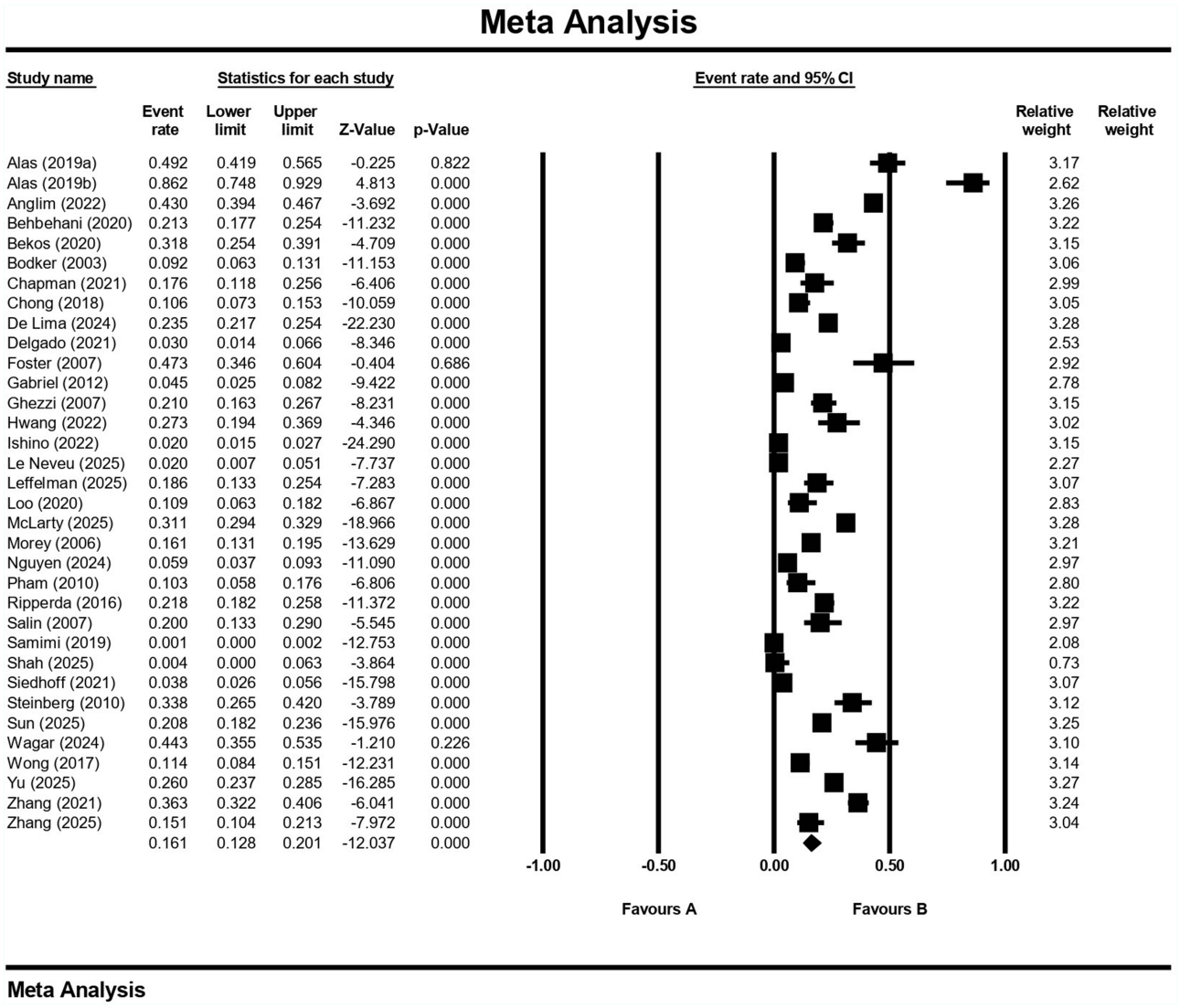

Figure 2 Forest plot of pooled cumulative incidence of postoperative urinary retention following gynecologic surgery.
Notes: Event rate indicates cumulative incidence of postoperative urinary retention; pooled estimates were derived using a random-effects model ($\tau^2 = 0.569$; $I^2 = 97.3\%$; $Q = 1207.6$, $df = 33$, $p < 0.001$).

Factors Associated with Postoperative Urinary Retention

Postoperative urinary retention was associated with patient, surgical, and perioperative factors, while several pharmacologic, minimally invasive, and voiding-related strategies were protective; due to substantial heterogeneity in definitions and effect measures, associated factors were synthesized narratively without quantitative meta-analysis (Table 3).

Discussion

This systematic review and meta-analysis demonstrate that postoperative urinary retention (POUR) remains a frequent and clinically relevant complication following gynecologic surgery, with a pooled cumulative incidence of 16.1%, albeit with substantial variability across procedures and outcome definitions. The highest incidence was consistently observed following pelvic organ prolapse (POP) surgery and sling or mid-urethral sling (MUS) procedures, whereas ambulatory minimally invasive hysterectomy was associated with markedly lower rates. These findings corroborate prior evidence indicating that the degree of pelvic tissue manipulation and neural disruption—particularly in vaginal and reconstructive surgery—plays a central role in postoperative voiding dysfunction.[5,35,40] Importantly, the elevated risk observed in these

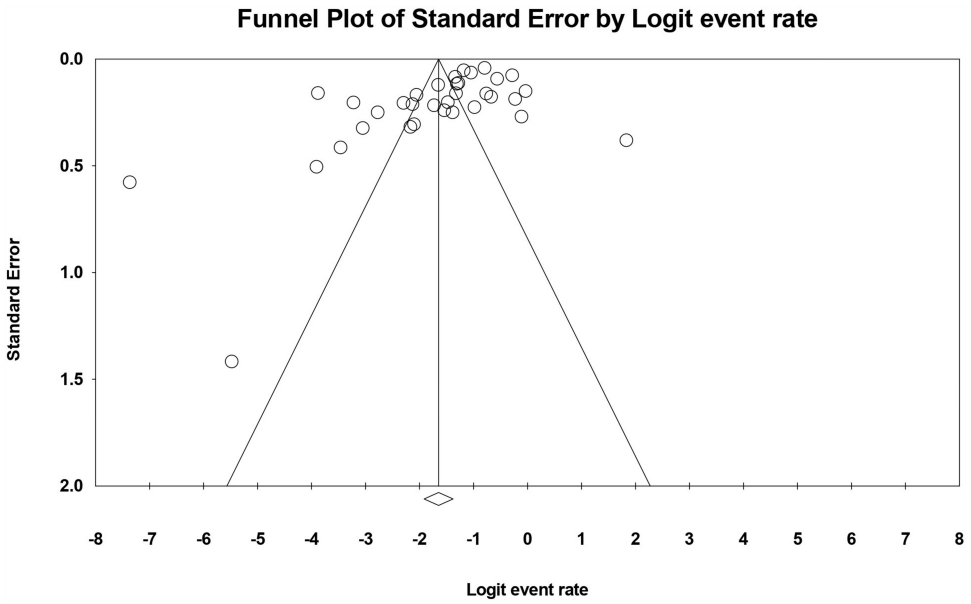

Figure 3 Funnel plot for pooled incidence of POUR.
Notes: Funnel plot showed asymmetry; Egger's test was significant (p = 0.005), with a large fail-safe N (4206).

procedures may also reflect underlying baseline conditions, such as pelvic organ prolapse, which is a common indication for vaginal reconstructive surgery.[11,13]

Patient-related and functional factors were strongly implicated in POUR risk. Age demonstrated a context-dependent effect, with younger age increasing risk in outpatient POP surgery and older age associated with prolonged retention in MUS, radical endometriosis, and oncologic procedures.[9,20,36] These divergent patterns likely reflect age-related differences in bladder compliance, detrusor reserve, and compensatory capacity. Diabetes mellitus emerged as a consistent predictor of POUR, supporting established evidence that diabetic autonomic neuropathy impairs parasympathetic regulation of detrusor contraction, resulting in reduced bladder sensation and increased post-void residual

Table 3 Factors Associated with Postoperative Urinary Retention (POUR) Following Gynecologic Surgery (n=34)

Domain	Factor	Direction of Association	Representative Studies	Notes
Patient-related factors	Advanced age	Increased risk	Alas 2019a;[9] Gabriel 2012;[20] Sun 2025[36]	Risk thresholds varied across studies
	Diabetes mellitus	Increased risk	Alas 2019a[9]	Identified in multivariable analysis
	High baseline PVR	Increased risk	Alas 2019b;[10] Zhang 2021[40]	Different PVR cut-offs (≥100–200 mL)
	Low Qmax	Increased risk	Alas 2019b;[10] Salin 2007[31]	Reflects baseline voiding dysfunction
	Prior urinary retention	Increased risk	Ishino 2022[22]	Strong predictor of recurrent POUR
Surgical factors	Pelvic organ prolapse surgery	Increased risk	McLarty 2025;[26] Bekos 2020[13]	Higher complexity and pelvic floor disruption
	Vaginal surgical approach	Increased risk	Ghezzi 2007;[5] McLarty 2025[26]	Compared with laparoscopic/ robotic
	Sling / MUS procedures	Increased risk	Steinberg 2010;[35] Ripperda 2016[30]	Functional urethral obstruction
	Longer operative duration	Increased risk	Anglim 2022;[11] Behbehani 2020[12]	Surrogate for surgical complexity
	Increased estimated blood loss	Increased risk	Anglim 2022;[11] Delgado 2021[18]	Often coexists with longer surgery

(*Continued*)

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Table 3 (Continued).

Domain	Factor	Direction of Association	Representative Studies	Notes
Perioperative factors	Perioperative opioid use	Increased risk	Behbehani 2020[12]	Dose-dependent effect
	High IV fluid volume	Increased risk	Anglim 2022[10]	Bladder overdistension
	Active or retrograde voiding trial	Increased detection of POUR	Chong 2018;[16] Ishino 2022[22]	Outcome-definition dependent
Protective factors / interventions	Minimally invasive / robotic approach	Reduced risk	Bodker 2003;[14] Le Neveu 2025[23]	Compared with laparotomy or vaginal
	Perioperative tamsulosin	Reduced risk	Chapman 2021[15]	RCT evidence
	Sugammadex (vs neostigmine)	Reduced risk	De Lima 2024[17]	Pharmacologic effect on detrusor function
	Early pelvic floor muscle training	Reduced risk	Zhang 2025[41]	Postoperative rehabilitation
	Liberal or unconditional voiding protocols	Reduced risk	Samimi 2019;[32] Shah 2025[33]	Facilitates safe discharge

Abbreviations: POUR, postoperative urinary retention; PVR, post-void residual volume; Qmax, maximum urinary flow rate; IV, intravenous; MUS, mid-urethral sling; RCT, randomized controlled trial.

volumes.[42,43] In line with this mechanism, abnormal preoperative voiding parameters—including elevated PVR, Valsalva voiding patterns, and low Qmax—were repeatedly associated with postoperative retention,[29,31,40] consistent with International Continence Society guidance identifying patients with baseline voiding dysfunction as a high-risk population.[3]

Several perioperative factors appeared potentially modifiable. Perioperative opioid exposure demonstrated a consistent dose-dependent association with POUR, likely mediated by μ-opioid receptor–induced suppression of detrusor contractility and increased urethral sphincter tone.[2,12] In contrast, anesthetic modality alone showed inconsistent associations, suggesting that surgical manipulation and postoperative analgesic strategies may exert greater influence on postoperative voiding than anesthesia type itself. Preventive strategies such as perioperative alpha-blockers, sugammadex use, early pelvic floor muscle training, and liberal or backfill-assisted voiding protocols were associated with reduced POUR incidence or facilitated discharge in selected populations,[15,17,34,41] although their effectiveness appeared procedure-specific.

Assessment of reporting bias suggested the presence of possible small-study effects, as indicated by funnel plot asymmetry and a statistically significant Egger's regression test. However, the large classic fail-safe N indicates that a substantial number of hypothetical unpublished studies would be required to negate the observed pooled incidence estimate. Taken together, these findings suggest that although publication bias or small-study effects cannot be entirely excluded, the overall conclusions regarding the incidence and procedural variability of POUR are robust and unlikely to be materially altered.

Collectively, these findings support a multifactorial conceptual model of POUR in which baseline bladder dysfunction, procedure-related pelvic and neural injury, and perioperative modifiers interact to overwhelm postoperative voiding capacity. Recognition of these interacting domains may facilitate more precise perioperative risk stratification and individualized management pathways.

Limitations

Marked heterogeneity in POUR definitions and assessment methods, along with predominantly observational study designs, limited comparability and precluded quantitative synthesis of associated risk factors. Additionally, evidence of small-study effects underscores the need for cautious interpretation of pooled estimates, particularly given the clinical and methodological diversity of included studies.

Conclusion

Postoperative urinary retention is a frequent, procedure-dependent complication of gynecologic surgery, with highest risk after vaginal and reconstructive procedures and lowest after minimally invasive hysterectomy, underscoring the importance of targeted risk stratification and standardized prevention strategies. Part of the observed risk in these procedures may also relate to underlying baseline pelvic floor conditions, such as pelvic organ prolapse, which are common indications for reconstructive surgery.

Data Sharing Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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Disclosure

The authors declare no conflicts of interest in this work.

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