DOI: 10.4081/aiua.2026.16309

REVIEW

Routine versus non-routine postoperative cystography before catheter removal after radical prostatectomy: A systematic review and meta-analysis

Sirin Salsabila [1, 2], Zakaria Aulia Rachman [1, 3], Lukman Hakim [1, 3, 4]

[1] Department of Urology, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia;
[2] Department of Urology, Dr. Soetomo General-Academic Hospital, Surabaya, Indonesia;
[3] Department of Urology, Universitas Airlangga Teaching Hospital, Surabaya, Indonesia;
[4] Department of Medicine, Faculty of Medicine and Health, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia.

Summary *Introduction: Postoperative cystography is commonly performed before urethral catheter removal after radical prostatectomy, but the value of routine imaging remains uncertain. We compared routine with non-routine cystography, focusing on vesicourethral anastomotic leakage and postoperative outcomes.*

Materials and methods: The literature search followed PRISMA guidelines and was carried out in PubMed, Scopus, ScienceDirect, Web of Science, and Google Scholar to find studies evaluating postoperative cystography after radical prostatectomy. Quantitative analyses were performed with Review Manager (RevMan). Risk of bias was evaluated with RoB 2 for randomized trials and ROBINS-I for observational studies.

Results: Five studies were included, with a total of 6,038 patients. In two studies comprising 594 patients, vesicourethral anastomotic leaks were reported less often in the non-routine cystography group than in the routine cystography group (OR 0.13, 95% CI 0.06-0.32; I^2 = 0%). However, two studies found no clear difference in urinary retention between the two strategies (OR 1.09, 95% CI 0.40-2.96; I^2 = 0%). Data on urinary tract infection and catheter dwell time were inconsistently reported and were therefore summarized narratively.

Conclusions: Non-routine cystography may be a reasonable alternative to routine imaging in carefully selected patients without clinical or operative concerns for anastomotic leakage. The lower reported leakage rate should be interpreted cautiously, as it may reflect differences in detection rather than true clinical benefit.

KEY WORDS: *Radical prostatectomy; Postoperative cystography; Vesicourethral anastomotic leakage; Catheter removal; Good Health and Well-Being.*

Submitted 17 September 2026; Accepted 19 September 2026

INTRODUCTION

After robot-assisted, laparoscopic, or open radical prostatectomy, adequate healing of the vesicourethral anastomosis is important before catheter removal (1, 2).

Incomplete healing may result in urinary extravasation, prolonged catheterization, postoperative complications, and delayed recovery (2-4). Routine postoperative cystography has traditionally been used to confirm the integrity of the vesicourethral anastomosis before catheter removal (1, 3). Advances in vesicourethral reconstruction have allowed earlier catheter removal after radical prostatectomy (5). At the same time, the need for routine postoperative cystography has increasingly been questioned, prompting greater interest in selective or omitted imaging in uncomplicated patients (1, 6-8).

A non-routine strategy may omit cystography before planned catheter removal in uncomplicated patients, while reserving imaging for those with recognized risk factors, concerning intraoperative findings, or an abnormal postoperative course (1, 6-8). This approach may simplify postoperative care and reduce unnecessary imaging, radiation exposure, and procedural burden (6, 9). However, an undetected clinically relevant leak may still lead to prolonged or repeat catheterization, acute urinary retention, readmission, or infection (9, 10).

Interpretation of the available evidence remains challenging because studies differ in surgical approach, imaging strategy, timing of catheter removal, definition of leakage, and patient selection (6-11).

This uncertainty is reflected in current EAU guidance, which suggests that postoperative cystography may be most useful in patients at higher risk of anastomotic leakage, including those with lower urinary tract symptoms, a large prostate, previous transurethral resection of the prostate or bladder-neck reconstruction, or an intraoperative leak (1). However, the available evidence remains too heterogeneous to support a recommendation on the routine use of cystography, and the long-term clinical relevance of radiographic leakage remains unclear (1). This raises an important clinical question: does routine cystography provide enough benefit to justify imaging every patient, or can it be safely reserved for selected cases?

Therefore, this study was conducted to compare routine postoperative cystography with selective cystography or no initial cystography before planned catheter removal after primary radical prostatectomy.

Materials and methods

Study design and reporting

This review followed the PRISMA 2020 reporting framework (12). The search strategy was developed using a predefined PICO framework.

The protocol is available in PROSPERO under registration number CRD420261478836.

Search strategy

Potential studies were retrieved through *PubMed*, *Scopus*, *ScienceDirect*, and *Web of Science* in March 2026. *Google Scholar* was also searched to identify potentially relevant gray literature. The search terms used in each database, along with the corresponding number of retrieved records, are summarized in Table 1.

Table 1.
Keywords used in multiple databases.

Search-engine	Keywords	Article (n)
PubMed	(((postoperative) OR (post-operative) OR (post-op)) AND ((cystography) OR (cystogram)) AND ((catheter removal) OR (removing catheter)) AND (radical prostatectomy))	50
Scopus		50
Science Direct		468
Web of Science		432
Grey literature		434
	Total	**1434**

Eligibility criteria

Randomized controlled trials and comparative observational studies were eligible if they involved adults undergoing primary radical prostatectomy via robot-assisted, laparoscopic, or open surgery, followed by vesicourethral anastomosis and planned postoperative catheter removal. Studies were required to provide information on at least one predetermined outcome, such as anastomotic leakage, urinary retention, urinary tract infection, or length of catheterization, and to compare standard cystography assessment with either a selective imaging strategy or no initial cystography. For the purposes of this review, non-routine cystography was defined as selective cystography or no cystography.

Only English-language full-text publications were taken into account.

Reports lacking a comparative group were not considered eligible. Excluded studies included case reports, case series, review articles, editorials, letters, animal studies, and abstracts-only articles. Studies falling outside the prespecified population, intervention, comparator, or outcome framework were excluded.

Data extraction

One investigator performed data extraction using a standardized form, and a second investigator independently checked the data. Discrepancies, if any, were discussed. A third investigator was brought in to resolve them. Variables extracted included author, year of publication, study design, surgical approach, cystography strategy, sample size, age, Gleason score, preoperative prostate-specific antigen level, prostate size, previous transurethral resection of prostate, operative time, estimated blood loss, and prespecified clinical outcomes. Outcomes were reported as per the definitions used in the original studies, as differences between studies did not allow reliable retrospective harmonization.

Quality assessment

The Cochrane *Risk of Bias 2* (RoB 2) tool was used to assess the randomized study, while ROBINS-I was used for the non-randomized studies (13, 14). Evaluations were undertaken independently, with any differences in judgement resolved through discussion among the investigators.

Statistical analysis

Review Manager (RevMan) 5.4 was used for quantitative analyses. For dichotomous outcomes, pooled effect estimates were expressed as *odds ratios* (ORs) with corresponding 95% *confidence intervals* (CIs). Statistical heterogeneity was assessed using the Chi-square test and quantified using the I2 statistic. A fixed-effect model was used for dichotomous outcomes because the included studies were considered sufficiently comparable in terms of population, comparison groups, and outcome definitions. Outcomes that could not be pooled, such as catheter dwell time and urinary tract infection, were summarized narratively.

Results

Study selection

The literature search yielded 1,434 records: *PubMed* (50 studies), *Scopus* (50 studies), *ScienceDirect* (468 studies), *Web of Science* (432 studies), and *Google Scholar* (434 studies). After 87 duplicates were removed, 1,347 records underwent title and abstract screening, and 1,315 were excluded at this stage. Full texts were sought for the remaining 32 reports. However, two studies were unavailable, and 30 studies proceeded for eligibility assessment. Of these, 25 were excluded: 11 for unavailable extractable data, 7 for an ineligible study design or a non-comparable intervention strategy, and 7 for not reporting relevant outcomes. Five studies were considered eligible for the systematic review (7, 8, 11, 15, 16). Only three studies were included in the pooled meta-analysis (7, 8, 16). The PRISMA 2020 flow diagram is documented in Figure 1.

Study characteristics

Five studies published between 2000 and 2026 were included, comprising 6,038 patients. Sample sizes ranged from 67 to 5,307 patients. Three studies involved patients undergoing robot-assisted radical prostatectomy, while one included both extraperitoneal laparoscopic and robot-assisted laparoscopic procedures, and one involved open radical retropubic prostatectomy. Routine cystography was compared with non-routine cystography in all studies, with the non-routine strategy comprising selective or no cystography, while *Schuetz et al.* also evaluated transrectal ultrasound cystography as a separate strategy. Within individual studies, age and the reported oncological characteristics appeared generally similar across the-

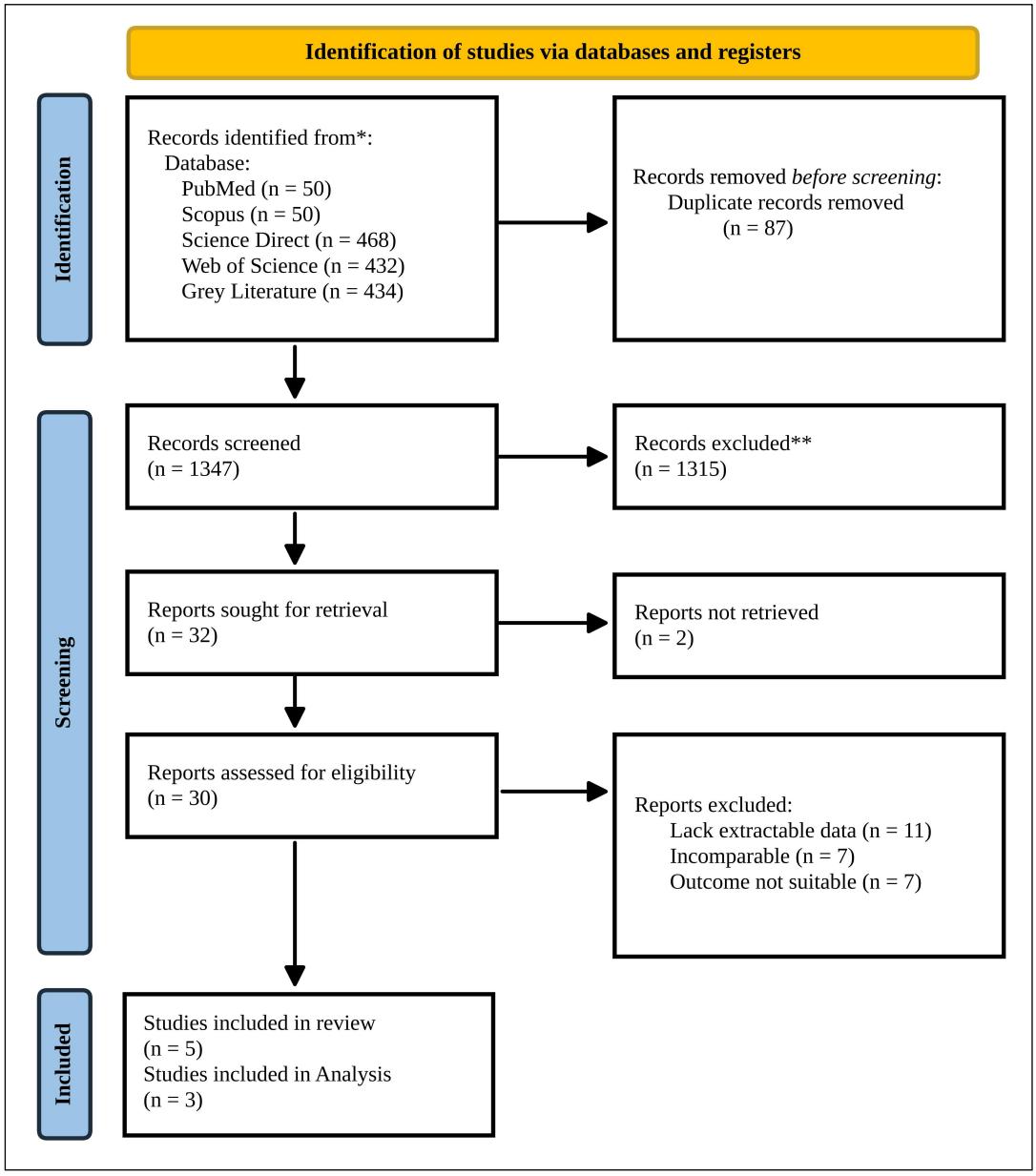


Figure 1. *PRISMA flow diagram for article screening.*

comparison groups. However, some variation was observed in perioperative characteristics. Operative duration was longer in the routine cystography group reported by *Krausewitz et al.* and slightly longer in the X-ray cystography group reported by *Schuetz et al.* In the latter study, estimated blood loss was highest among patients undergoing transrectal ultrasound cystography.

The reporting of baseline characteristics was not consistent across studies. *Guru et al.* did not report prostate-specific antigen levels or prostate size. Information on prior transurethral resection of the prostate was unavailable in three studies, and estimated blood loss was not reported by *Krausewitz et al.* In addition, subgroup-specific age and Gleason score data for the routine and selective cystography groups were unavailable in *Krausewitz et al.* Therefore, the reported values represented the combined cystography cohort. Detailed baseline characteristics are presented in Table 2.

Risk of bias assessment

Four comparative observational studies were evaluated using ROBINS-I and had an overall moderate risk of bias. The main concerns were related to confounding and participant selection, while the classification of interventions was associated with a low risk of bias in three of the four studies. No study had a serious or critical risk of bias. The detailed ROBINS-I assessment is presented in Table 3.

The randomized study by *Verawuttipol and Srinualnad* was evaluated using the Cochrane RoB 2 framework. Deviations from planned interventions, the randomization procedure, and the choice of the reported outcome all had a low risk of bias. Some concerns remained about missing outcome data and outcome measurement because information addressing these domains was limited. Overall, the study was judged to have some concerns regarding risk of bias. The RoB 2 assessment is presented in Figure 2.

Table 2.
Baseline characteristics of the included studies.

Included studies	Study type	Technique	Group	Total patients	Age	Gleason score	PSA *	Prostate size (g or ml)	Prior TURP	Operative time (min)	Estimated blood loss (ml)
Souto, et al (2000)	Non-randomized comparative cohort	Radical retropubic prostatectomy	Cystography	42	63 (51-74)	NA	12.5 (1.7-50)	NA	NA	NA	NA
			No/selective cystography	25		NA		NA	NA	NA	NA
Guru, et al (2007)	Prospective cohort study	RARP	Cystography	40	59 (42-72)	7 (6-9)	NA	NA	1/40	264 (100-589)	263 (50-800)
			No/selective cystography	40	59 (49-70)	7 (6-9)	NA	NA	0/40	286 (190-492)	237 (20-900)
Verawuttipol & Srinualnad, (2010)	RCT	ELRP and ERALRP	Cystography	35	64.7 ± 1.4	NA	24.5 ± 8.8	44.5 g ± 3.2	NA	168.7 ± 9.3	510 ± 87.8
			No/selective cystography	35	63.9 ± 1.3	NA	19.0 ± 5.3	40.9 g ± 2.7	NA	167 ± 10.9	451.4 ± 53.2
Krausewitz, et al (2023)	Retrospective cohort study	RARP	Routine Cystography	265	66.7 ± 6.6 †	7.32 (6-10) †‡	13.6 ± 24	45.7 ml ± 26	13/320	163 ± 45	NA
			Selective cystography	55							
			No cystography	194	67.7 ± 6.6	7.21 (6-10) ‡	11.36 ± 14	45 ml ± 18.8	3/194	136 ± 33	NA
Schuetz, et al (2026)	Retrospective cohort study	RARP	Cystography	1643	64 (59-68)	7.09 (6-10) ‡	7.0 (4.9-10.5)	39 ml (30-52)	NA	165 (145-190)	200 (100-350)
			TRUS Cystogram	861	63 (59-68)	7.10 (6-10) ‡	5.8 (5.8-8.7)	39 ml (30-50)	NA	160 (140-183)	300 (150-400)
			No/selective cystography	2803	63 (58-68)	7.07 (6-10) ‡	6.8 (4.7-10.4)	39 ml (30-50)	NA	160 (140-181)	200 (100-300)

RCT: randomized controlled trial; RARP: Robot-Assisted Radical Prostatectomy; ELRP: Extraperitoneal Laparoscopic Radical Prostatectomy; ERALRP: Extraperitoneal Robot-Assisted Laparoscopic Radical Prostatectomy; NA: not available.
**: ng/mL.*
†: Baseline values in Krausewitz et al. (2023) are presented for the combined cystography group (CG; n = 320), consisting of routine cystography (n = 265) and selective cystography (n = 55), because subgroup-specific values for routine and selective cystography were not separately reported.
‡: Postoperative Gleason score was estimated as a weighted mean from categorical data, excluding unclassified cases.

Table 3.
Risk-of-bias assessment of the non-randomized studies using ROBINS-I.

Study	Design	Bias due to confounding	Bias in selection of participants into the study	Bias in measurement of interventions	Bias due to departures from intended interventions	Bias due to missing data	Bias in measurement of outcomes	Bias in selection of the reported result	Overall bias
Guru et al, 2007	Prospective cohort	Moderate	Moderate	Low	Moderate	Low	Moderate	Moderate	Moderate
Krausewitz et al, 2023	Retrospective cohort	Moderate	Moderate	Low	Low	Low	Moderate	Moderate	Moderate
Schuetz et al, 2026	Retrospective cohort	Moderate	Moderate	Low	Moderate	Moderate	Moderate	Moderate	Moderate
Souto et al, 2000	Non-randomized comparative cohort	Moderate	Moderate	Moderate	Moderate	Moderate	Low	Moderate	Moderate

Figure 2.
Risk-of-bias assessment of the randomized study by Verawuttipol and Srinualnad using the Cochrane Risk of Bias tool.

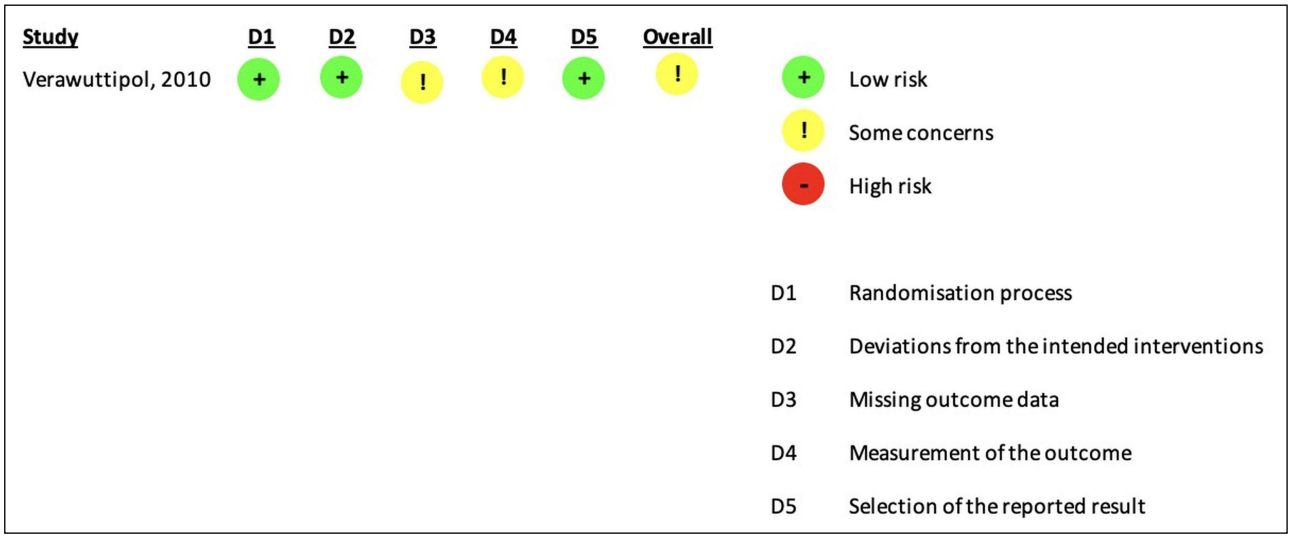


Table 4.
Outcomes reported across the included studies.

Study	VUAL * (nRC)	VUAL * (RC)	Urinary retention * (nRC)	Urinary retention * (RC)	Urinary tract infection * (nRC)	Urinary tract infection * (RC)	Catheter dwell time (days) (nRC)	Catheter dwell time (days) (RC)	Follow up
Souto, et al (2000)	NA	12	1	2 ‡	NA	NA	14	NA	RC: 13.7 months (5–27) nRC: 16.4 months (6–22)
Guru, et al (2007)	1	3	0	0	0	0	11	11	6–18 months
Verawuttipol & Srinualnad, (2010)	NA	4	0	1	NA	NA	7.0 ± 0.0 †	7.8 ± 0.4 †	POD 14 and 28
Krausewitz, et al (2023)	5	39	7	6	6	11	NA	NA	30 days
Schuetz, et al (2026)	NA	NA	NA	NA	NA	NA	10 (IQR 5–12)	X-ray: § 5 (IQR 5–12) TRUS cystogram: 5 (IQR 5–11)	6 months and 1 year

*: *Events reported.*
†: *Mean ± SD.*
‡: *In Souto et al., urinary retention was reported among 30 patients without extravasation who underwent early catheter removal, rather than the entire cystography group of 42 patients.*
§: *In Schuetz et al., the routine cystography group included X-ray cystography and TRUS cystography. Catheter dwell time is presented separately because a combined median and IQR were not reported.*
RC: routine cystography; nRC: no/selective cystography; VUAL: vesicourethral anastomotic leakage; NA: not available; TRUS: transrectal ultrasound; IQR: interquartile range; POD: post-operative day.

Clinical outcome data

The clinical outcomes reported across the included studies are shown in Table 4. Meta-analyses were performed for vesicourethral anastomotic leakage and urinary retention. Catheter dwell time and urinary tract infection were summarized narratively because the available data could not be reliably pooled. Two studies contributed data on anastomotic leakage, two on urinary retention, four reported catheter dwell time, and two reported urinary tract infection.

Vesicourethral anastomotic leakage (VUAL)

Two studies involving 594 patients reported *vesicourethral anastomotic leakage* (VUAL) (7, 8). VUAL occurred in 6 of 289 patients in the non-routine cystography group and 42 of 305 patients in the routine cystography group. The fixed-effect meta-analysis demonstrated significantly fewer VUAL events in patients managed with non-routine cystography than in those undergoing routine cystography (OR 0.13, 95% CI 0.06-0.32; $p < 0.00001$). No statistical heterogeneity was detected ($I^2 = 0\%$).

Urinary retention

Two studies involving 569 patients evaluated postoperative urinary retention (7, 16). Urinary retention occurred in 8 of 274 patients in the non-routine cystography group and 8 of 295 patients in the routine cystography group. The fixed-effect analysis showed no significant difference

Figure 3.
Forest plot comparing vesicourethral anastomotic leakage between non-routine cystography and routine cystography.

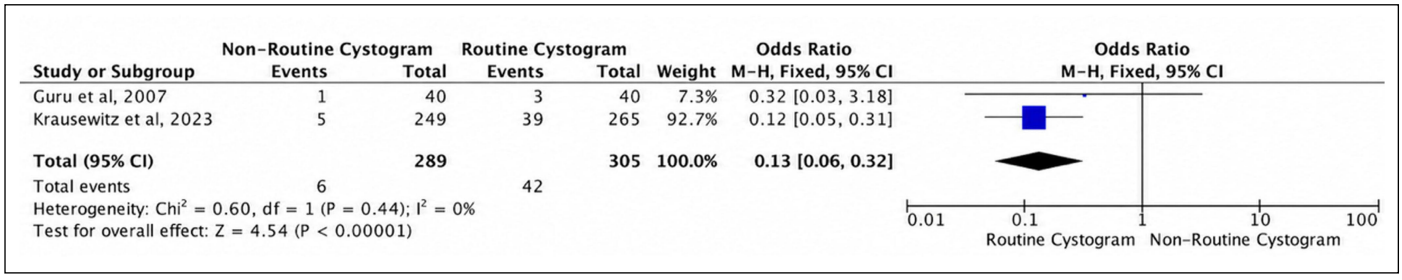
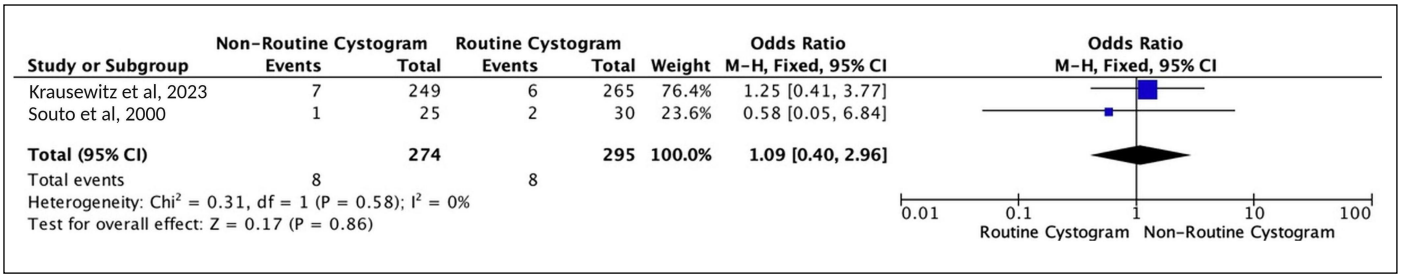


Figure 4.
Forest plot comparing urinary retention between non-routine cystography and routine cystography.



between non-routine cystography and routine cystography groups (OR 1.09, 95% CI 0.40-2.96; p = 0.86). No statistical heterogeneity was detected (I^2 = 0%). In the remaining studies, Verawuttipol and Srinualnad reported no urinary retention in the non-routine group and one event in the routine group, while Guru et al. reported no events in either group (8, 15).

Urinary tract infection (UTI)

Urinary tract infection was reported in two studies. Guru et al. observed no UTI events in either the routine or non-routine cystography group (8). In *Krausewitz et al.*, UTI occurred in 6 of 249 patients managed with non-routine cystography (2/55 in the selective cystography group and 4/194 in the no-cystography group) and 11 of 265 patients undergoing routine cystography (7). Given the limited number of studies and inconsistent reporting, these data were not pooled and were summarized descriptively. Overall, no clear difference in postoperative UTI was apparent between the two strategies.

Catheter dwell time

Catheter dwell time was reported in four studies, although complete comparative data were not available in all studies. *Guru et al.* reported an identical catheter dwell time of 11 days in both groups (8). *Verawuttipol* and *Srinualnad* reported a shorter dwell time in the non-routine cystography group than in the routine cystography group (7.0 ± 0.0 *vs* 7.8 ± 0.4 days) (15). In contrast, *Schuetz et al.* reported a longer dwell time with non-routine cystography (median 10 days (IQR 5-12) *vs* 5 days (IQR 5-12) with X-ray cystography and 5 days (IQR 5-11) with TRUS cystography) (11). *Souto et al.* reported a catheter dwell time of 14 days in the non-routine group, but corresponding data for the routine cystography group were not available (16). Because of differences in reporting and insufficient variance data in some studies, catheter dwell time was synthesized narratively. Overall, the available evidence did not show a consistent difference in catheter dwell time between routine and non-routine cystography.

Follow up

Follow-up duration varied across studies. *Verawuttipol* and *Srinualnad* evaluated patients on postoperative days 14 and 28, while *Krausewitz et al.* evaluated postoperative complications and readmissions within 30 days after RARP (7, 15). *Guru et al.* followed patients for at least 6 months after catheter removal, with some patients followed for up to 18 months (8). *Schuetz et al.* reported functional outcomes at 6 months and 1 year (11). *Souto et al*. assessed complications and continence at a mean follow-up of 13.7 months (range 5-27) in the early-removal cystography group and 16.4 months (range 6-22) in the no-cystography group (16). Because follow-up duration and outcome definitions varied across studies, pooled assessment of continence recovery, bladder-neck contracture, delayed collections, and readmission was not possible.

Discussion

The findings suggest that after uncomplicated radical prostatectomy, a non-routine strategy for postoperative cystography, such as selective cystography or no cystography, may be a reasonable option. However, the available evidence is insufficient to support a policy of completely avoiding imaging. There was no clear difference in urinary retention between the two strategies, and evidence regarding urinary tract infection and catheter dwell time was limited and inconsistent. It is important to note that the lower leakage rate seen when routine imaging is omitted seems more related to differences in leak detection rather than indicating that avoiding cystography actually helps with healing at the surgical site.

The leakage result requires the greatest caution. Cystography is a diagnostic test, not an intervention that prevents leakage. In *Guru et al.* and *Krausewitz et al.*, patients undergoing routine imaging were systematically examined for contrast extravasation, whereas leaks in the non-routine groups were more likely to be recorded only when symptoms or postoperative findings triggered evaluation (7, 8). The analysis showed that small, asymptomatic radiographic leaks were more easily identified in the routine monitoring group. It is important to view the pooled *odds ratio* (OR) not as a direct measure of cystography's effect on leakage rates, but rather as a comparison of abnormalities recorded across different surveillance methods. Additionally, although the absence of statistical heterogeneity suggests some consistency among the studies, it does not rule out potential bias that could influence outcomes across all studies.

The difference between radiographic and clinically significant leaks is important to understand. Often, small leaks can resolve on their own with ongoing catheter drainage. Detecting these minor leaks is only beneficial if it leads to a change in management or helps prevent significant harm. Prior studies suggest that radiographic leakage may delay early continence recovery but has less influence on continence at 1 year, whereas higher-grade leaks are more likely to require intervention (17, 18). Removing a catheter in the presence of an undetected substantial leak may lead to abdominal pain, readmission, or the need for catheter reinsertion (9). The included studies did not use standardized leak grades and could not reliably separate minor extravasation from clinically consequential leakage.

Urinary retention is discussed in four out of five included studies. The pooled analysis of *Krausewitz et al.* and *Souto et al.* showed no significant difference in postoperative urinary retention between routine and non-routine cystography (7, 16). However, the wide confidence interval suggests that the true difference between the two strategies remains uncertain. In the randomized controlled study by *Verawuttipol* and *Srinualnad*, urinary retention did not occur in the non-routine group, while one event was recorded in the routine group. *Guru et al.* reported no urinary retention events in either group (8, 15). The findings from *Souto et al.* should be interpreted with additional caution because urinary retention in the routine cystography group was reported only among patients without extravasation who underwent early catheter removal, rather than the entire cystography cohort (16). Retention may also be influenced by the timing of catheter removal and peri-anastomotic or bladder-neck factors (6, 16). Therefore, the decision to perform cystog-

raphy and the timing of catheter removal should be considered related but distinct components of postoperative management.

Urinary tract infection was reported sparsely and inconsistently. *Guru et al.* recorded no events in either group, while *Krausewitz et al.* reported 6 events among 249 patients in the non-routine cystography group and 11 events among 265 patients in the routine cystography group (7, 8). Because only two studies reported UTI and one study had no events in either group, these data were summarized narratively rather than pooled. Therefore, the available evidence does not indicate a clear difference in postoperative UTI between routine and non-routine cystography. Future studies should distinguish symptomatic, culture-confirmed infection before and after catheter removal.

Catheter dwell time could not be pooled due to differences in reporting and insufficient variance data in some studies. *Verawuttipol and Srinualnad* found shorter catheter dwell time without routine cystography, whereas *Schuetz et al.* reported a longer dwell time in the non-routine group (11, 15). While *Souto et al.* only reported catheter dwell time in the non-routine group, *Guru et al.* reported similar catheter durations between groups (8, 16). Overall, the available studies showed no consistent pattern in catheter dwell time between routine and non-routine cystography. These differences may reflect variation in institutional protocols, imaging strategies, patient selection, and decisions regarding catheter removal.

This pattern is consistent with previous reports suggesting that catheter removal without routine cystography may be feasible in selected patients after uncomplicated robot-assisted radical prostatectomy. In a series of 230 patients undergoing RARP, 90% underwent catheter removal on postoperative day 7 (6). Given the low rate of cystographically detected leakage, the authors concluded that routine cystography may not be necessary in uncomplicated cases and suggested selective imaging in patients with bladder-neck reconstruction, previous TURP, a wide bladder neck, or an intraoperative leak (6). However, the timing of catheter removal should remain individualized because it is influenced by surgical technique, intraoperative assessment of anastomotic integrity, and local postoperative protocols.

A selective imaging approach may be reasonable for clinical practice. Cystography is a useful tool when there is a higher likelihood of detecting a significant leak. This might include situations such as encountering an intraoperative leak, managing a challenging anastomosis, performing bladder-neck reconstruction, or dealing with previous *transurethral resections of the prostate* (TURP) (1, 6). A large prostate, significant lower urinary tract symptoms, abnormal drain output or creatinine levels, inadequate catheter drainage, and related symptoms, such as pelvic pain or fever, are additional factors that may increase the pretest probability (1, 2, 9). This is consistent with the current EAU guideline, which identifies several features associated with a higher risk of anastomotic leakage. However, the EAU does not provide a recommendation on routine cystography because the available evidence is heterogeneous and the long-term clinical significance of leakage remains uncertain (1).

This review includes both randomized and comparative observational studies and summarizes the available evidence while considering outcomes beyond radiographic leakage. Several limitations should be considered, particularly the limited number of eligible studies and the difficulty of interpreting pooled results when selective imaging and complete omission of cystography are combined despite their different clinical implications. Four of the studies did not use randomization, and their surveillance methods varied. The studies also differed in how they defined outcomes, performed imaging, timed catheter removal, applied surgical techniques, and in follow-up duration, which ranged from 14 days after surgery to 27 months. Because of these differences, directly comparing short- and long-term postoperative outcomes across the studies is challenging. Urinary tract infection and catheter dwell time were narratively described due to sparse and inconsistent reporting, while urinary retention data were limited. It was also challenging to assess subgroup effects and publication bias due to the small number of studies. Studies reported insufficient data on other clinically significant outcomes, including symptomatic leakage, readmission, radiation exposure, cost, patient pain, quality of life, and resource use.

Future studies should compare a risk-based imaging approach with routine cystography and focus on outcomes that are more meaningful in clinical practice, rather than on radiographic leakage alone. Multicenter pragmatic trials or prospective cohort studies would be particularly valuable if they use standardized leak grading and consistently report clinically meaningful outcomes, including catheter reinsertion, symptomatic leakage, urinoma or drainage procedures, readmission, urinary retention, culture-confirmed infection, catheter duration,

Declarations

Ethical approval and consent to participate: *Not applicable; this systematic review and meta-analysis used previously published, aggregate-level data and involved no direct patient contact or original human-participant data collection.*

Consent for publication: *Not applicable.*

Availability of data and material: *The datasets analyzed in this systematic review and meta-analysis are derived from the included published studies, which are cited in the reference list. Extracted data supporting the findings of this review are available from the corresponding author upon reasonable request.*

Competing interests: *The authors declare no competing interests.*

Funding: *The authors received no specific funding for this work.*

Authors' contributions: *SS: conceptualization, study design, methodology, literature search, study selection, data extraction, data analysis, risk of bias assessment, and writing—original draft. ZAR: study design, supervision, resolution of discrepancies, and critical revision of the manuscript. LH: study design, supervision, resolution of discrepancies, and critical revision of the manuscript. All authors read and approved the final manuscript.*

Acknowledgments: *None.*

continence, anastomotic stricture, patient-reported burden, and cost. Grouping outcomes by intraoperative leak testing, bladder-neck reconstruction, prior TURP, surgical approach, and planned timing of catheter removal may also help identify patients in whom postoperative imaging provides the greatest clinical value.

Conclusions

A non-routine approach to postoperative cystography may be a reasonable alternative to routine imaging before catheter removal after radical prostatectomy in carefully selected patients without clinical or operative concerns for anastomotic leakage. The lower rate of vesicourethral anastomotic leakage within the non-routine cystography group requires careful interpretation, as it may reflect differences in leak detection rather than a true clinical benefit. Given the limited and heterogeneous evidence, including variation in follow-up duration, cystography should be used selectively according to individual clinical risk factors. Further prospective studies are needed to define which patients can safely avoid routine imaging.

References

1. Cornford P, et al. EAU-EANM-ESTRO-ESUR-ISUP-SIOG guidelines on prostate cancer. Arnhem, The Netherlands: EAU Guidelines Office; 2026.

2. Tyritzis SI, Katafigiotis IS, Constantinides CA. All you need to know about urethrovesical anastomotic urinary leakage following radical prostatectomy. J Urol 2012; 188:369-76.

3. Ramsden AR, Chodak GW. Can leakage at the vesico-urethral anastomosis be predicted after radical retropubic prostatectomy? BJU Int 2004; 93:503-6.

4. Özveren B, Karsiyakali N, Özgen MB, Türkeri LN. Checking vesicourethral anastomosis for urinary extravasation during radical prostatectomy: is it still necessary in the robotic era? A prospective, randomized case-control study. World J Urol 2024; 42.

5. Gratzke C, et al. Early catheter removal after robot-assisted radical prostatectomy: surgical technique and outcomes for the Aalst technique (ECaRemA study). Eur Urol 2016; 69:917-23.

6. Yadav R, Bansal S, Gupta NP. Selective indication for check cystogram before catheter removal following robot assisted radical prostatectomy. Indian J Urol 2016; 32:120-3.

7. Krausewitz P, Farzat M, Ellinger J, Ritter M. Omitting routine cystography after RARP: analysis of complications and readmission rates in suprapubic and transurethral drained patients. Int J Urol 2023; 30:211-8.

8. Guru KA, Seereiter PJ, Sfakianos JP, et al. Is a cystogram necessary after robot-assisted radical prostatectomy? Urol Oncol 2007; 25:465-7.

9. Würnschimmel C, Panagl V, Mattei A, Fankhauser CD. Assessment of the anastomosis after radical prostatectomy: a review of available diagnostic methods. Urol Int 2022; 106:1091-4.

10. Tillier CN, van Muilekom HAM, Bloos-van der Hulst J, et al. Vesico-urethral anastomosis (VUA) evaluation of short- and long-term outcome after robot-assisted laparoscopic radical prostatectomy (RARP): selective cystogram to improve outcome. J Robot Surg 2017; 11:441-6.

11. Schuetz H, et al. Transrectal ultrasound-cystogram versus X-ray-cystogram versus no cystogram: high volume retrospective study. Prostate Int 2026; 14.

12. Page MJ, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021; 372:n71.

13. Sterne JAC, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. BMJ 2019; 366.

14. Sterne JAC, et al. ROBINS-I: a tool for assessing risk of bias in non-randomised studies of interventions. BMJ 2016; 355.

15. Verawuttipol P, Srinualnad S. Randomized control trial; in cases of extra-peritoneal approach of either laparoscopic radical prostatectomy or robotic assisted laparoscopic radical prostatectomy. Is routine cystography necessary? Insight Urol 2010; 31:15-20.

16. Souto CA, Telöken C, Souto JC, et al. Experience with early catheter removal after radical retropubic prostatectomy. J Urol 2000; 163:865-6.

17. Patil N, et al. Evaluating and grading cystographic leakage: correlation with clinical outcomes in patients undergoing robotic prostatectomy. BJU Int 2009; 103:1108-10.

18. Fiorello N, et al. Urinary leakage after robot-assisted radical prostatectomy: is always predictive of functional results? Urol Int 2025; 109:68-73.

Correspondence

Lukman Hakim (Corresponding Author)
lukman-h@fk.unair.ac.id

Department of Urology, Faculty of Medicine, Universitas Airlangga,
Jalan Mayjend Moestopo 6-8, Surabaya 60286, Indonesia

Sirin Salsabila
sirinsalsa@gmail.com

Zakaria Aulia Rachman
zakariaaulia04@gmail.com

Department of Urology, Faculty of Medicine, Universitas Airlangga
and Universitas Airlangga Teaching Hospital, Surabaya, Indonesia