Cureus
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Open Access Review Article

Diagnostic Accuracy of Routine Intraoperative Cystoscopy for Detecting Urinary Tract Injuries During Minimally Invasive Hysterectomy for Benign Indications: A Systematic Review

Review began 11/05/2026
Review ended 11/05/2026
Published 11/11/2026

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DOI: 10.7759/cureus.119504

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Abstract

The objective of this systematic review was to evaluate the diagnostic performance of routine intraoperative cystoscopy for detecting ureteral and bladder injuries during minimally invasive hysterectomy for benign indications. A comprehensive literature search was conducted across major biomedical databases, and relevant studies assessing routine cystoscopy during laparoscopic or robotic-assisted hysterectomy were reviewed. Study selection, data extraction, and assessment of methodological quality were performed independently by multiple reviewers. The available evidence showed that routine intraoperative cystoscopy can assist in the identification of urinary tract injuries during surgery. However, its ability to rule out ureteral injury was limited. Injuries that were more likely to be missed included partial ureteral obstructions and thermal injuries that became clinically apparent after surgery, whereas injuries associated with absent ureteral efflux were more often detected intraoperatively. Bladder injuries were generally identifiable when present. Overall, routine intraoperative cystoscopy may facilitate the detection of urinary tract injuries during minimally invasive hysterectomy for benign conditions, but a normal cystoscopic examination does not reliably exclude ureteral injury. Continued postoperative vigilance and further evaluation remain important when urinary tract injury is clinically suspected, particularly in cases where delayed presentation is possible.

Categories: Urology
Keywords: benign gynecologic surgery, bladder injury, diagnostic accuracy, intraoperative cystoscopy, laparoscopic hysterectomy, minimally invasive hysterectomy, robotic-assisted hysterectomy, systematic review, ureteral injury, urinary tract injury

Introduction And Background

Hysterectomy is one of the most frequently performed major gynecological operations in the United States. Over recent decades, minimally invasive approaches, including laparoscopic and robotic-assisted hysterectomy, have increasingly replaced abdominal surgery because of faster recovery, shorter hospital stays, and fewer wound complications [1,2]. However, these approaches are associated with an increased risk of urinary tract injury, making ureteral and bladder injuries important complications of minimally invasive hysterectomy [3,4].

Urinary tract injuries are particularly concerning because delayed recognition can result in substantial morbidity, including urinary fistula, renal dysfunction, readmission, and additional surgical intervention [2,4]. Although some injuries are identified intraoperatively, others remain undetected until the postoperative period. Early recognition is therefore an important patient safety objective [5-7].

Intraoperative cystoscopy enables direct inspection of the bladder and assessment of ureteral efflux to identify potential urinary tract injuries. Routine cystoscopy remains debated because of additional operating time, costs, and potential complications, including urinary tract infection. Furthermore, studies have reported conflicting findings regarding its ability to prevent delayed injury [3,8].

A major limitation of cystoscopy is its potential to miss injuries that do not immediately compromise ureteral patency [1,5]. Partial obstruction and thermal injury may remain undetected despite apparently normal intraoperative findings, particularly during laparoscopic surgery. Consequently, a normal cystoscopic examination does not necessarily exclude urinary tract injury [3,6]. Understanding the diagnostic limitations of cystoscopy is essential for guiding clinical practice and postoperative surveillance.

Previous systematic reviews have examined urinary tract injury rates and the role of routine cystoscopy

across benign gynecological procedures or specifically during laparoscopic hysterectomy [2,6]. However, the diagnostic accuracy of cystoscopy, particularly its ability to identify ureteral and bladder injuries, has not been adequately characterized in minimally invasive hysterectomy for benign indications.

Therefore, we conducted a systematic review to evaluate the diagnostic accuracy of routine intraoperative cystoscopy for detecting ureteral and bladder injuries during laparoscopic and robotic-assisted hysterectomy for benign indications. The primary outcome was the detection of ureteral injury, and the secondary outcome was the detection of bladder injury. We also assessed the certainty of the available evidence to inform clinical interpretation and practice.

Review

Methods

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [9].

Eligibility Criteria

We included women undergoing total laparoscopic, laparoscopy-assisted vaginal, laparoscopic supracervical, or robotic-assisted hysterectomy for benign indications. Studies including malignant or premalignant indications were eligible if at least 90% of participants had benign or premalignant indications or if benign data could be extracted separately. Studies exclusively involving abdominal or vaginal hysterectomy, or mixed-route studies without separately reported minimally invasive procedures, were excluded.

The index test was routine intraoperative cystoscopy performed at the end of hysterectomy, irrespective of clinical suspicion of injury, with or without a dye or urinary marker. Studies evaluating selective cystoscopy alone were excluded. Studies in which cystoscopy was performed in only a subset of patients without a clearly defined selection criterion were included but considered at high risk of bias for patient selection.

The primary target condition was ureteral injury, and the secondary target condition was bladder injury. Injuries included transection, ligation, kinking, obstruction, thermal injury, perforation, and fistula.

Injuries were confirmed intraoperatively through exploration, ureteral catheterization or stenting, or restoration of ureteral efflux following suture removal, or diagnosed postoperatively through imaging, cystoscopy, reoperation, or clinical presentation. No minimum follow-up duration was required. The duration and method of follow-up after normal cystoscopy were considered during risk-of-bias assessment.

We included retrospective and prospective cohort studies, cross-sectional studies, and relevant arms of randomized or comparative studies from which diagnostic accuracy data could be obtained. Case reports, reviews, editorials, conference abstracts, and database studies without patient-level cystoscopy results were excluded. Only English-language reports were included.

Information Sources and Search Strategy

PubMed/MEDLINE, Scopus, Web of Science Core Collection, and the Cochrane Central Register of Controlled Trials (CENTRAL) were searched from inception to September 20, 2026. The search combined terms for cystoscopy, hysterectomy, and urinary tract injury, including ureteral efflux, patency, and urinary markers such as indigo carmine and fluorescein. The PubMed strategy used Medical Subject Headings (MeSH) and free-text terms and was adapted for each database. No date, language, or study-design filters were applied during the search. The Consensus academic search engine was used as a supplementary source.

Study Selection

Records were imported into Rayyan (Rayyan Systems Inc., Cambridge, MA, USA), and duplicates were removed. Two reviewers independently screened titles and abstracts and assessed potentially eligible full-text reports. Disagreements were resolved by a third investigator. Reasons for full-text exclusion were recorded. When reports described overlapping cohorts, the report with the larger sample and more complete outcome follow-up was selected to avoid duplicate inclusion of participants in the same outcome analysis.

Data Extraction

Two reviewers independently extracted data using a standardized, piloted spreadsheet in Microsoft Excel (Microsoft Corp., Redmond, WA, USA). Disagreements were resolved by a third investigator. Extracted information included study characteristics, surgical approach, indications, concomitant procedures, follow-up, cystoscopy technique, timing, distension medium, dye or urinary marker, positivity criteria, reference standards, and diagnostic accuracy data.

The unit of analysis was the patient. For each target condition, we extracted true-positive (TP), false-positive (FP), false-negative (FN), and true-negative (TN) results. A positive cystoscopy was defined by absent or markedly reduced ureteral efflux or a visible bladder defect, suture, or perforation. TP represented an abnormal cystoscopy with confirmed injury; FP represented an abnormal cystoscopy without confirmed injury; FN represented a normal cystoscopy followed by an injury diagnosis during follow-up; and TN represented a normal cystoscopy without subsequent injury diagnosis.

When TN data were not reported, they were derived from the study denominator and the available injury and diagnostic data, when possible. Data that could neither be reported nor derived were recorded as unavailable. Injuries recognized before cystoscopy were excluded from the primary diagnostic accuracy assessment and examined separately in a sensitivity analysis. Obstruction caused by a suture and relieved following abnormal cystoscopy was classified as TP. Injuries reported as diagnosed intraoperatively without specifying whether they were identified before or during cystoscopy were classified as TP in the primary analysis and examined separately in a worst-case analysis. Studies were identified by the first author's surname and publication year.

Risk of Bias and Applicability

Two reviewers independently assessed risk of bias and applicability using the Quality Assessment of Diagnostic Accuracy Studies 2 (QUADAS-2) tool, with signaling questions adapted to the review question [10]. Particular attention was given to patient selection, verification of negative cystoscopy results, reference standards, and follow-up duration. Disagreements were resolved by a third investigator.

Data Synthesis

Study characteristics, diagnostic accuracy findings, and methodological limitations were summarized descriptively. Sensitivity and specificity, with exact 95% confidence intervals (CIs), were calculated for individual studies when sufficient data were available. Findings were presented in study-level tables and paired forest plots, where appropriate. No pooled diagnostic accuracy estimates or meta-analyses were performed.

For each target condition, we described the number of injuries detected and missed by cystoscopy, FP findings, and the available follow-up information. Studies with incomplete or nonderivable diagnostic accuracy data were summarized narratively. Findings were interpreted in relation to differences in study design, cystoscopy technique, injury definitions, reference standards, and follow-up.

Sensitivity analyses examined the influence of studies at high risk of bias in two or more QUADAS-2 domains, injuries recognized before cystoscopy, malignant or in situ cases, overlapping cohorts, and injuries reported as diagnosed intraoperatively without specifying whether they were identified by cystoscopy. A leave-one-out analysis was also performed to assess the influence of individual studies. A predominantly malignant robotic cohort was considered separately from the primary analysis.

Where data permitted, findings were described according to the use of dyes or urinary markers and the method of verification of negative cystoscopy results. Formal subgroup comparisons were not performed when the number of studies was insufficient. Analyses were conducted using Python 3 (Python Software Foundation, Wilmington, DE, USA), with NumPy and SciPy for calculations and Matplotlib for figures.

Results

Study Selection

The searches identified 1,068 records, including 1,048 from databases and 20 from the Consensus search engine (Figure *1*). After removing 166 duplicates, 902 records were screened, and 870 were excluded. Of 32 reports sought for full-text retrieval, six could not be retrieved. Eighteen of the 26 assessed reports were excluded because of ineligible study design, population, outcome, language, insufficiently reported surgical routes, or unavailable diagnostic data. Eight studies involving 4,727 women were included [1-8]. Seven studies involving 4,198 women contributed to the ureteral injury outcome, and six studies involving 1,437 women contributed to the bladder injury outcome [1-8]. Two studies from the same institution had overlapping recruitment periods; the larger study was used for ureteral injury and the other for bladder injury to avoid double counting [5,6] (Table *1*).

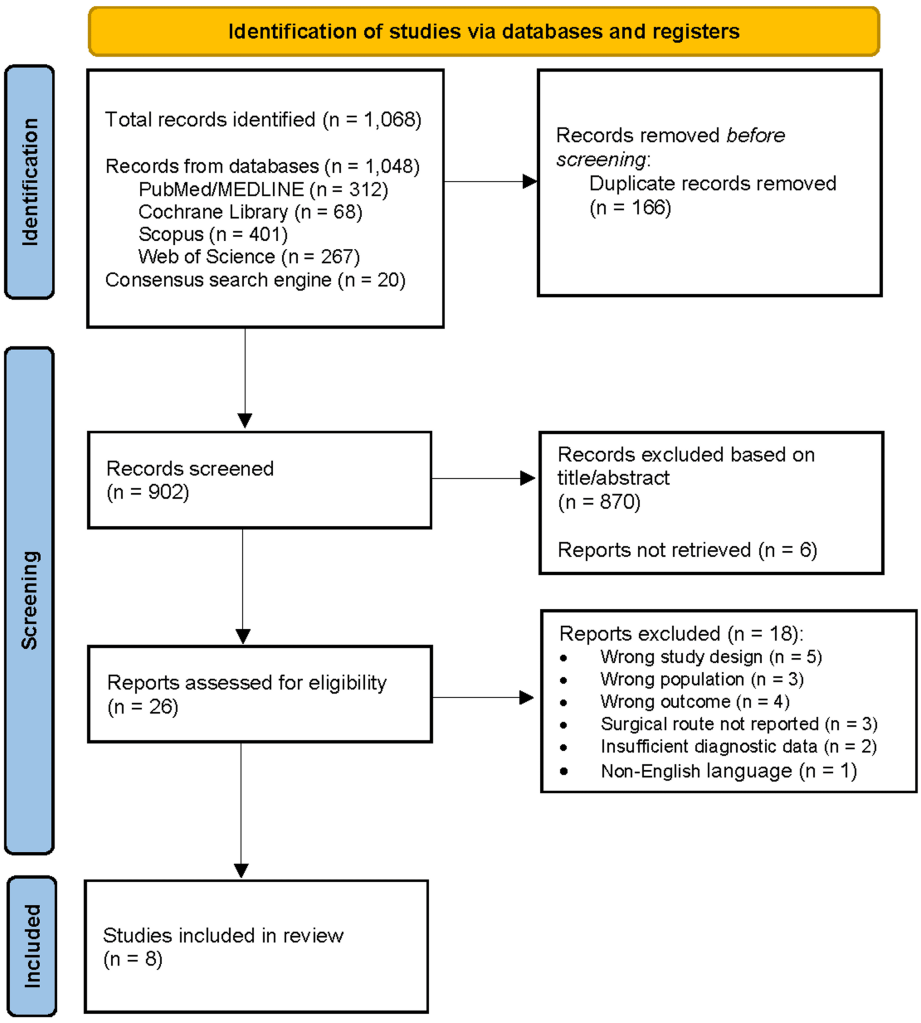


FIGURE 1: PRISMA flow diagram depicting the study selection process for the systematic review

PRISMA flow diagram detailing the study selection process for this systematic review. Following the identification of records through database searching and other sources, duplicates were removed, and the remaining records were screened. Full-text articles were assessed for eligibility, with exclusions documented along with reasons. Studies meeting the inclusion criteria were included in the final synthesis.

PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

Study	Study characteristics	Clinical and demographic data
Ribeiro et al. [1]	USA (New York); retrospective, 1992-1998; mainly TLH, LAVH (7), LSH (1), LH + lymphadenectomy (5), radical (2)	Indications: myoma 83; endometriosis/pain 23; hyperplasia 5. Malignant: 7 (5 endometrial, 2 cervical). N: 118/278. Age: NR. BMI: NR. Follow-up: 6 weeks and 6 months.
Jelovsek et al. [2]	USA (Cleveland); retrospective, consecutive, 2002-2005; TLH	Indications: menorrhagia 70; dysmenorrhea 44; PMB 5; adnexal mass 4; prolapse 2. Malignant: 0. N: 126. Age: 42 ± 8. BMI: 28.2 (median). Follow-up: 6 weeks.
Ko et al. [3]	Taiwan (Taipei); retrospective, 2003-2006; LAVH	Indications: myoma 46; adenomyosis 21; prolapse 4; endometriosis 1; CIN3 7; CIS 1. Malignant: 1 CIS + 7 CIN3. N: 80. Age: 45 ± 8. BMI: NR. Follow-up: 4 weeks.
Lea et al. [4]	Canada (Québec); prospective observational, 2016-2017; laparoscopic hysterectomy	Indications: fibroids 18; pain/endometriosis 6; AUB 4; HSIL 2. Malignant: 2 HSIL. N: 30. Age: 47 ± 5. BMI: 24.5 ± 4. Follow-up: 2 months.
Roy et al. [6]	Canada (Montréal); 2 centers; retrospective, 2012-2018; TLH	Indications: fibroids 30%; bleeding 23%; other 47%. Malignant: 0. N: 524/531. Age: 45. BMI: 29. Follow-up: 30 days (84% seen).
Choudhary et al. [5]	India (Ahmedabad); retrospective, consecutive, 2017-2019; TLH	Indications: adenomyosis 50; hyperplasia 47; leiomyoma 43; ovarian 3. Malignant: 4 (AUB-M). N: 150. Age: 43.1 ± 5.7. BMI: 21.2 ± 3.3. Follow-up: NR.
Kantarcı et al. [8]	Turkey (İzmir); retrospective, 2022-2025; TLH	Indications: benign (not itemized). Malignant: 0. N: 3,170. Age: NR. BMI: NR. Follow-up: ≥30 days + POD1 renal US.
İnan et al. [7]	Turkey (İzmir); prospective comparative, 2021-2024; laparoscopic hysterectomy	Indications: myoma 263; AUB 87; endometriosis/CPP 81; hyperplasia 56; prolapse 42. Malignant: 0 (108 premalignant). N: 529/1,260. Age: ≈50.7 (derived). BMI: ≈24.7 (derived). Follow-up: NR.

TABLE 1: Characteristics of studies evaluating intraoperative cystoscopy during laparoscopic hysterectomy

Study characteristics and clinical and demographic data of included studies evaluating intraoperative cystoscopy during laparoscopic hysterectomy, including study design, setting, surgical approach, indications for hysterectomy, malignant or premalignant diagnoses, sample size, age, BMI, and follow-up duration. Values are reported as presented in the original studies; derived values are identified accordingly. Sample sizes are shown as reported, including screened or eligible denominators where applicable.

NR, not reported; TLH, total laparoscopic hysterectomy; LAVH, laparoscopically assisted vaginal hysterectomy; LSH, laparoscopic supracervical hysterectomy; LH, laparoscopic hysterectomy; PMB, postmenopausal bleeding; AUB, abnormal uterine bleeding; CIN3, cervical intraepithelial neoplasia grade 3; CIS, carcinoma in situ; HSIL, high-grade squamous intraepithelial lesion; CPP, chronic pelvic pain; AUB-M, abnormal uterine bleeding associated with malignancy; POD1, postoperative day 1; BMI, body mass index.

Characteristics of Included Studies

The eight studies were conducted in the United States, Canada, Turkey, Taiwan, and India [1-8]. Six were retrospective cohorts, one was a prospective observational study, and one was a prospective comparative study. Surgical approaches included total laparoscopic hysterectomy, laparoscopic hysterectomy without further specification, laparoscopy-assisted vaginal hysterectomy, and mixed laparoscopic procedures [1-8]. No eligible study of robotic-assisted hysterectomy for benign indications was identified. Three studies included small numbers of malignant or premalignant cases [2,5,6] (Table *2*).

Study	Index test: cystoscopy, timing, medium, and positive criteria	Management, reference standard, and injuries identified before cystoscopy
Ribeiro et al. [1]	Rigid transurethral cystoscope; after cuff closure and McCall; IV indigo carmine. Positive: absent ureteral efflux.	Ureteral dissection; suture/band removal. Reference: clinical visits at 6 weeks and 6 months. Injuries before cystoscopy: none described.
Jelovsek et al. [2]	70° 25-F cystoscope; end of procedure; sterile water and IV indigo carmine. Positive: absent spill or dye leak.	Stent passage; suture removal. Reference: record review ≤6 weeks. Injuries before cystoscopy: 2 cystotomies.
Ko et al. [3]	70° cystoscope + bilateral ureteral catheterization; after LAVH; medium/dye NR. Positive: absent efflux, failed catheterization, or bladder defect.	Repair; repeat cystoscopy. Reference: clinical follow-up ≤4 weeks. Injuries before cystoscopy: 2 suspected ureteral injuries (not confirmed).
Lea et al. [4]	Transurethral cystoscope; after cuff suturing; IV sodium fluorescein 10% (25 mg). Positive: absent colored jet and turbulence.	Cuff suture removal. Reference: prospective 2-month follow-up. Injuries before cystoscopy: none.
Roy et al. [6]	Cystoscope NR; end of TLH; no dye (indigo carmine unavailable). Positive: absent or weak ureteral flow.	Urology consultation, cannulation, ureterolysis, or suture removal. Reference: chart review ≤30 days. Injuries before cystoscopy: 7 (4 cystotomies, 3 ureteral).
Choudhary et al. [5]	Cystoscope NR; after TLH; oral phenazopyridine. Positive: absent spill.	Retrograde pyelography; stent or reimplantation. Reference: clinical assessment for urinary leak; duration NR. Injuries before cystoscopy: none described.
İnan et al. [7]	5 mm optic transurethral cystoscope; after LH; CO_2 at 8 mmHg or saline 250 mL; furosemide if no jet within 1 min. Positive: no jet after furosemide or bladder abnormality.	Laparoscopic re-exploration; suture revision. Reference: clinical assessment; duration NR. Injuries before cystoscopy: none described.
Kantarcı et al. [8]	Cystoscope NR; end of operation; medium/dye NR. Positive: absent or abnormal ureteral jet.	Repair ± DJ stent or reimplantation. Reference: POD1 renal US in all patients + CT/RPG; follow-up ≥30 days. Injuries before cystoscopy: unclear.

TABLE 2: Intraoperative cystoscopy protocols and reference standards in included studies

Details of the intraoperative cystoscopy protocols, including cystoscope type, timing, contrast medium or dye, and criteria for a positive test; subsequent management; reference standards and follow-up; and urinary tract injuries identified before cystoscopy.

NR, not reported; TLH, total laparoscopic hysterectomy; LAVH, laparoscopically assisted vaginal hysterectomy; LH, laparoscopic hysterectomy; CO_2, carbon dioxide; DJ, double-J; RPG, retrograde pyelography; CT, computed tomography; POD1, postoperative day 1.

Cystoscopy techniques varied [1-8]. Intravenous indigo carmine, intravenous sodium fluorescein, and oral phenazopyridine were used in some studies, whereas others used no dye [1-7]. One study incorporated ureteral catheterization, and another used carbon dioxide or saline distension with furosemide when ureteral efflux was absent [7,8]. One study did not report the cystoscopy technique [5]. Follow-up after normal cystoscopy ranged from four weeks to six months and was generally based on clinical assessment or chart review [1-8]. Only one study actively verified all negative results using routine postoperative renal ultrasonography [8]. Reported ureteral injury prevalence ranged from 0% to 6.7% [1-8].

Risk of Bias and Applicability

Three studies had high risk of bias in patient selection because of selective inclusion or incomplete records [2,5,6]. The reference standard was unclear or at high risk of bias in seven studies, primarily because women with normal cystoscopy were followed clinically, potentially missing asymptomatic injuries [1-7]. One study also had high risk of bias in reference standard and flow and timing because of limited follow-up and missing postoperative data [8]. Applicability concerns were identified in studies involving mixed procedures, malignant indications, or additional ureteral catheterization [2,5,6,8].

Diagnostic Findings for Ureteral Injury

Across the studies contributing to the ureteral injury outcome, 41 injuries were reported, of which 18 were identified by intraoperative cystoscopy [1,2,4-8]. Study-level sensitivity ranged from 25% to 100% where estimable. The lowest reported sensitivities were in studies identifying one of four injuries and eight of 25 injuries, respectively. Two studies reported detection of all identified injuries, although each had very few cases.

Among women without ureteral injury, 14 FP results were reported [1,2,5-7]. Thirteen occurred in one study that used no dye and did not specify a waiting time for ureteral efflux [5]. Study-level specificity ranged from 97.5% to 100% where estimable [1,2,4-7].

Missed injuries included suture-related obstruction, ureteral stricture or kinking, complete ureteral defects, complex injuries, thermal injury, partial obstruction, microtrauma, and complete transection [1,2,4-8]. In one study, postoperative imaging and ureteroscopy identified several injuries despite normal intraoperative cystoscopy, including thermal injuries presenting around postoperative day 10. Other missed injuries included thermal necrosis with urinary leakage and partial obstruction with hydronephrosis detected on postoperative day 13. Conversely, obstruction caused by vaginal-cuff or hemostatic sutures that abolished ureteral efflux was detected and relieved intraoperatively in all four studies reporting this finding.

Eight injuries in one study were described as diagnosed intraoperatively without specifying whether cystoscopy identified them. They were classified as detected injuries in the primary analysis and examined separately in a worst-case sensitivity analysis.

Diagnostic Findings for Bladder Injury

Six studies involving 1,437 women contributed to the bladder injury outcome [1-6]. Seven bladder injuries were identified during cystoscopy, and none was reported as missed [1-6]. No FP results were reported [1-6]. Six additional bladder injuries were recognized by surgeons before cystoscopy and were excluded from the diagnostic assessment [1-6]. The small number of injuries limits the certainty of conclusions regarding bladder injury detection.

Publication Bias

Publication bias was assessed for the included studies, and the findings are summarized in Table *3*. Overall, the assessment did not identify evidence suggestive of substantial publication bias; however, the results should be interpreted in the context of the limited number and heterogeneity of the available studies.

Study	Risk of bias (patient selection; index test; reference standard; flow and timing)	Applicability (patient selection; index test; reference standard)	Main reasons
Ribeiro et al. [1]	High; Low; Unclear; Low	High; Low; Low	Only 118/278 had cystoscopy; mixed procedures and 7 malignant cases
Jelovsek et al. [2]	Low; Low; Unclear; Low	Low; Low; Low	Negatives followed by record review only
Ko et al. [3]	Unclear; Low; Unclear; Unclear	Low; High; Low	Selection unclear; ureteral catheterization added; 4-week follow-up
Choudhary et al. [5]	Low; Unclear; Unclear; Unclear	Unclear; Low; Low	4 malignant cases; follow-up not described; numerical inconsistencies
Lea et al. [4]	Low; Low; Unclear; Low	Low; Low; Low	Symptom-driven detection of delayed injury
Roy et al. [6]	Low; Unclear; High; High	Low; Low; Low	No dye, undefined threshold; 30-day chart review; 16% without follow-up data
İnan et al. [7]	High; Low; Unclear; Unclear	Low; Low; Low	58% of screened patients excluded; follow-up duration not stated
Kantarcı et al. [8]	High; Unclear; Low; Unclear	Low; Unclear; Low	Selective inclusion; unclear if intraoperative injuries were cystoscopy-detected; FP not reported

TABLE 3: QUADAS-2 risk of bias and applicability assessments

Quality assessment of included studies using the QUADAS-2 tool. Risk of bias was assessed in four domains: patient selection, index test, reference standard, and flow and timing. Applicability concerns were assessed for patient selection, index test, and reference standard. Each domain was rated as low, high, or unclear risk of bias or concern regarding applicability. Main reasons for judgments are summarized. İnan [7] contributed bladder outcomes only; this study and Kantarcı [8] included overlapping cohorts.

FP, false positive; QUADAS-2, Quality Assessment of Diagnostic Accuracy Studies-2; NR, not reported.

Discussion

This review suggests that routine intraoperative cystoscopy is a useful adjunct for detecting urinary tract injuries during minimally invasive hysterectomy, particularly bladder injuries and ureteral obstruction associated with absent ureteral efflux. However, a normal cystoscopic examination does not reliably exclude ureteral injury, as delayed thermal, ischemic, and partial obstructive injuries may not be apparent intraoperatively [10-14].

Our findings are consistent with the AAGL Advancing Minimally Invasive Gynecology Worldwide practice guideline, which reported that most, but not all, lower urinary tract injuries are detected by intraoperative cystoscopy and estimated a sensitivity of approximately 80%-90% for ureteral trauma [10,11]. Injuries related to energy-based devices may remain undetected despite normal cystoscopic findings [11,12].

Previous observational data have also demonstrated that routine cystoscopy improves intraoperative recognition of urinary tract injury during benign hysterectomy, allowing immediate correction and potentially reducing morbidity associated with delayed diagnosis [11-14].

Importantly, the injuries most commonly missed in the included studies were thermal injuries, partial obstructions, and delayed ureteral necrosis, whereas suture-related ureteral obstruction causing absent ureteral jets was frequently identified and corrected intraoperatively. These findings support continued postoperative surveillance when urinary tract injury is clinically suspected despite normal cystoscopy [10,13].

Limitations

This review addressed a focused clinical question using a comprehensive search of four databases and a supplementary source. Study selection, data extraction, and risk-of-bias assessment were performed independently in duplicate, with third-investigator arbitration. Explicit rules were used to classify injuries and interpret cystoscopy findings, and certainty of evidence was assessed.

Several limitations should be considered. The evidence base was small, with eight studies and 41 ureteral injuries, and no eligible robotic-assisted hysterectomy studies, limiting generalizability. Most studies were retrospective, and follow-up of women with normal cystoscopy was primarily clinical, potentially resulting in missed asymptomatic injuries and overestimation of sensitivity. Studies varied in cystoscopy techniques, positivity criteria, and follow-up duration. Two studies from the same institution had overlapping populations. In the largest study, the timing and method of detection were unclear for eight injuries; alternative assumptions and exclusion of studies with incomplete cystoscopy could substantially reduce sensitivity. Some studies included small numbers of malignant cases, although their exclusion did not change the conclusions. Finally, trial registries and gray literature were not searched, reference lists were not systematically screened, six potentially relevant reports could not be retrieved, and non-English reports were excluded. These factors may have resulted in missed evidence.

Conclusions

Routine intraoperative cystoscopy during laparoscopic hysterectomy for benign indications may help identify bladder injury and ureteral obstruction but cannot reliably exclude ureteral injury. Its limitations in detecting partial obstruction and thermal or devascularization injuries should be considered when interpreting normal cystoscopic findings. Cystoscopy should therefore be regarded as an adjunct to, rather than a substitute for, clinical assessment and appropriate postoperative evaluation. Further prospective studies are needed to clarify its diagnostic performance and applicability to robotic-assisted hysterectomy.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Disclosures

AI use statement: The authors used Copilot as follows: language polishing in Methods. The authors confirm that they have reviewed and verified all AI-assisted content and take full responsibility for the work. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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