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The Analysis Study of Safety and Outcome of Ureteroscopy During Pregnancy: A Comprehensive Systematic Review

¹ Adzana Yasadhy Hangga Prasetyo, ² Yosie Yulanda Putra

¹ Dr. Loekmono Hadi Kudus Regional General Hospital, Kudus Regency,
Central Java, Indonesia

² Mayjen H.A Thalib Regional General Hospital, Sungai Penuh City, Jambi,
Indonesia

Correspondence : prasetyohangga@gmail.com

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ABSTRACT

Background: Symptomatic urolithiasis in pregnancy can result in significant morbidity, causing conditions such as renal colic, urinary tract infections, and ureteral obstruction. This systematic review aim to analyze the safety and outcomes of urethroscopy for pregnant women. **Methods:** The study followed PRISMA 2020 guidelines, reviewing English-language publications from 2014 to 2024. Editorials, duplicate reviews from the same journal, and papers lacking a DOI were excluded. The literature search was conducted using PubMed, SagePub, SpringerLink, and Google Scholar. **Result:** A total of 2,172 articles were initially identified through online databases (PubMed, SagePub, SpringerLink, and Google Scholar). After three rounds of screening, eight relevant studies were selected for full-text analysis. **Conclusion:** Ureteroscopy is a safe, effective, and cost-efficient treatment for ureteral calculi during pregnancy. Early intervention minimizes complications, and URS remains a successful option for managing obstructive uropathy. Future research should optimize protocols and assess long-term outcomes for improved care.

Keyword: ureteroscopy, urolithiasis, pregnancy, safety, outcome

INTRODUCTION

The incidence of symptomatic urinary tract stones in pregnant women has been reported to range from 1 in 2000 to 1 in 200, highlighting the varying frequency of this condition among expectant mothers. Symptomatic urolithiasis in pregnancy can result in significant morbidity, causing conditions such as renal colic, urinary tract infections, and ureteral obstruction. These complications not only affect the health of the mother but also pose serious risks to the fetus. The most common complications associated with symptomatic urolithiasis during pregnancy are pre-term delivery and premature rupture of membranes, both of which carry potential long-term health risks for the fetus.^{1,2}

Conservative management is generally favored for treating pregnant women with urolithiasis, as it avoids the risks associated with surgical intervention. When conservative measures such as hydration, analgesia, and antibiotics do not resolve the symptoms, surgical intervention becomes necessary.^{3,4} Among the available surgical options, ureteroscopy (URS) and the insertion

of internal ureteral stents are the most commonly used treatments for symptomatic urolithiasis in pregnancy. The decision to opt for surgical management is influenced by factors such as the severity of symptoms, the size and location of the stone, and the gestational age of the pregnancy. Despite the potential benefits of surgery, it is generally considered a secondary option after conservative management.⁵⁻⁷

With continuous advancements in endoscopic technology and endourological techniques, URS has emerged as the first-line treatment for managing ureteric stones during pregnancy.⁸ The ability of URS to directly visualize and treat stones has made it an increasingly popular option for pregnant women. Recent guidelines, such as those provided by the 2020 European Association of Urology (EAU), recommend URS as a reasonable alternative to other methods.⁹⁻¹¹

Given the increasing use of URS in managing symptomatic urolithiasis during pregnancy, there is a need for a thorough evaluation of its safety, efficacy, and potential

complications. This systematic review aim to analyze the safety and outcomes of urethrosopy for pregnant women.

METHODS

Protocol

The study strictly adhered to the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020 guidelines to ensure methodological rigor and accuracy. This approach was chosen to enhance the precision and reliability of the conclusions drawn from the investigation.

Criteria for Eligibility

This systematic review aim to analyze the safety and outcomes of urethrosopy for pregnant women based on literature from the past decade. The review aimed to provide insights to improve patient treatment strategies, with an emphasis on the significance of key findings in the reviewed studies. Inclusion criteria for the study included: 1) Papers published in English, and 2) Papers published between 2014 and 2024. Exclusion criteria were: 1) Editorials, 2) Papers without a DOI, 3)

Previously published review articles, and 4) Duplicate entries in journals..

Search Strategy

The keywords used for this research are ureteroscopy, urolithiasis, pregnancy, safety, outcome. The Boolean MeSH keywords inputted on databases for this research are:
("ureteroscopy"[MeSH Terms] OR "ureteroscopy"[All Fields] OR "ureteroscopies"[All Fields]) AND ("urolithiasis"[MeSH Terms] OR "urolithiasis"[All Fields]) AND ("pregnancy"[MeSH Terms] OR "pregnancy"[All Fields] OR "pregnancies"[All Fields] OR "pregnancy s"[All Fields]) AND ("safety"[MeSH Terms] OR "safety"[All Fields] OR "safeties"[All Fields])) OR ("outcome"[All Fields] OR "outcomes"[All Fields]).

Data retrieval

Abstracts and titles were screened to assess their eligibility, and only studies meeting the inclusion criteria were selected for further analysis. Literature that fulfilled all predefined criteria and directly related to the topic was included.

Studies that did not meet these criteria were excluded. Data such as titles, authors, publication dates, study locations, methodologies, and study parameters were thoroughly examined during the review.

Quality Assessment and Data Synthesis

Each author independently assessed the titles and abstracts of the

selected studies to identify those for further exploration. Articles that met the inclusion criteria underwent further evaluation. Final decisions on inclusion were based on the findings from this review process.

Table 1. Article Search Strategy

Database	Keywords	Hits
Pubmed	("ureteroscopy"[MeSH Terms] OR "ureteroscopy"[All Fields] OR "ureteroscopies"[All Fields]) AND ("urolithiasis"[MeSH Terms] OR "urolithiasis"[All Fields]) AND ("pregnancy"[MeSH Terms] OR "pregnancy"[All Fields] OR "pregnancies"[All Fields] OR "pregnancy s"[All Fields]) AND ("safety"[MeSH Terms] OR "safety"[All Fields] OR "safeties"[All Fields])) OR ("outcome"[All Fields] OR "outcomes"[All Fields])	466
Springer Link	((((ureteroscopy) AND (urolithiasis)) AND (pregnancy)) AND (safety)) OR (outcome)	402
Sagepub	((((ureteroscopy) AND (urolithiasis)) AND (pregnancy)) AND (safety)) OR (outcome)	500
Google Scholar	((((ureteroscopy) AND (urolithiasis)) AND (pregnancy)) AND (safety)) OR (outcome)	804

Table 2. JBI *Critical appraisal of Study*

Parameters	Juliebo-Jones (2023)	Shalaby (2021)	Zhang (2016)	Wymer (2015)	Buttice (2017)	Teleb (2014)	Tan (2018)	Channa (2022)
1. Bias related to temporal precedence								
clear in the study what is the “cause” and what is the “effect” (ie, there is no confusion about which variable comes first)?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Bias related to selection and allocation								
Was there a control group?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3. Bias related to confounding factors								
Were participants included in any comparisons similar?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4. Bias related to administration of intervention/exposure								
Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	No.	No.	No.	No.	No.	No.	No.	No.
5. Bias related to assessment, detection, and measurement of the outcome								
Were there multiple measurements of the outcome, both pre and post the intervention/exposure?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Were the outcomes of participants included in any comparisons measured in the same way?	No.	No.	No.	No.	No.	No.	No.	No.
Were outcomes measured in a reliable way?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6. Bias related to participant retention								
Was follow-up complete and, if not, were differences between groups in terms of their follow-up adequately described and analyzed?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7. Statistical conclusion validity								
Was appropriate statistical analysis used?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

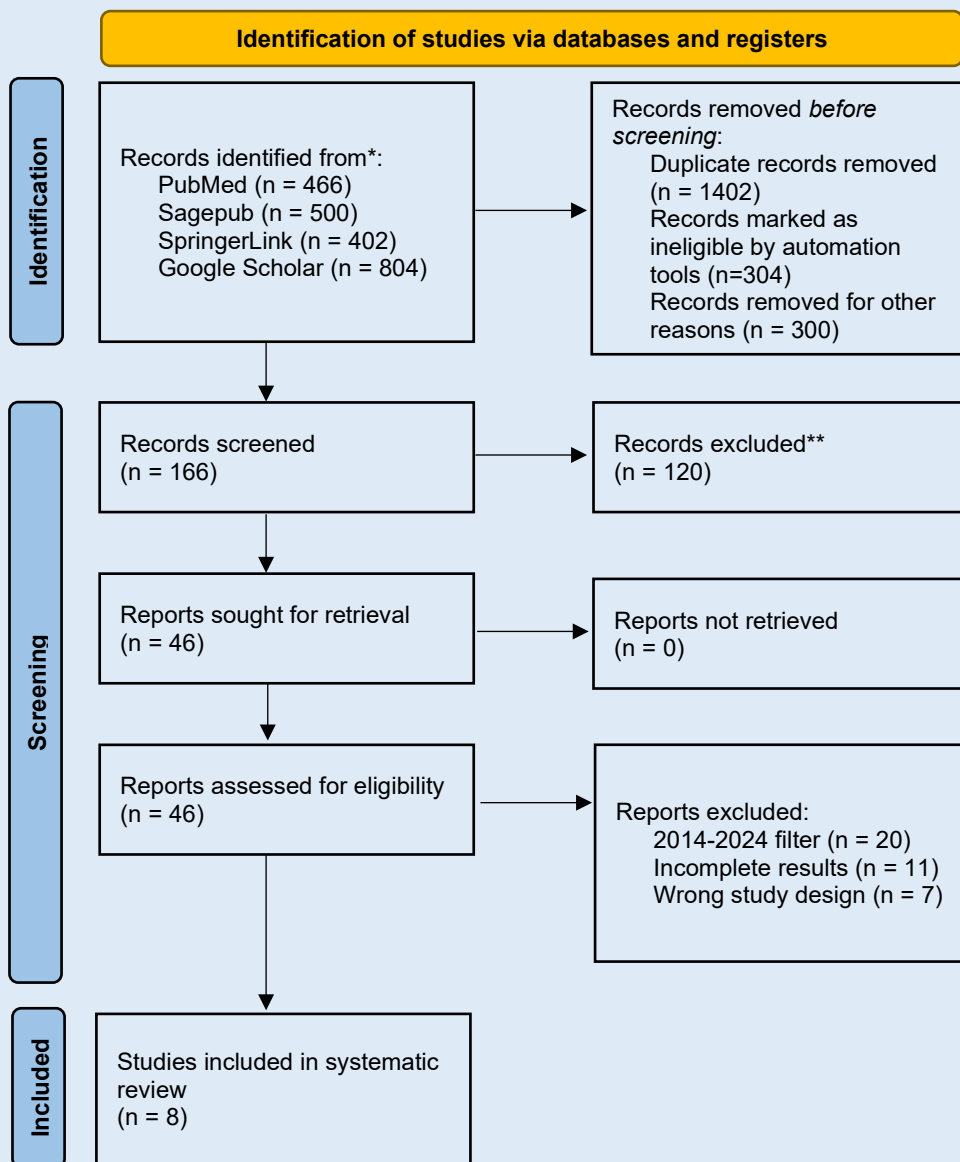


Figure 1. Article search flowchar

RESULT

The initial number of articles retrieved from online databases (PubMed, SagePub, SpringerLink, and Google Scholar) is 2,172 articles. After conducting three levels of screening, eight articles that directly relate to the current systematic review have been chosen for further assessment through full-text reading and analysis. Table 3 presents the selected literature included in this analysis.

Table 3. The literature included in this study

No.	Author	Origin	Method	Sample	Result
1.	Juliebo-Jones, et al. ¹² (2023)	Multicenter	Retrospective cohort	87	A study of 87 pregnant patients undergoing 96 ureteroscopy (URS) procedures showed that 60% were performed in the third trimester, with 58% completed using local anesthesia and light sedation. In the last decade, this approach succeeded in 97% of cases, with spinal anesthesia used by patient choice in the remainder. Ureteral calculi were identified in 57% of patients, with 88% undergoing fragmentation or extraction, while the rest received stent placement for postpartum clearance. The mean operative time was 33 minutes, and the average hospital stay was 2.2 days. Complication rates were low, with intraoperative complications at 2% and postoperative complications improving from 11% overall to 6% in the last decade, mostly minor. Exit strategies included stent placement in 42%, catheter insertion in 23%, and no device in 35%.
2.	Shalaby, et al. ¹³ (2021)	Multicenter	Retrospective cohort	111	In a study of 111 pregnant patients (mean age 27.4 years, mean renal RI 0.78), ultrasound diagnosed stones in 46.8%, while 90% showed altered lower ureteral jets, 86.5% of

					whom had URS-confirmed ureteric stones. The stone-free rate (SFR) was 95.8%, with no severe urologic, fetal, or obstetric complications. Premature delivery occurred in 9% of cases and was significantly associated with postoperative urinary tract infection and uterine contractions ($p < 0.0001$). At three months, all patients had resolved hydronephrosis. Postoperative follow-up was needed in 15.3% of cases.
3.	Zhang, et al. ¹⁴ (2016)	China	Retrospective cohort	117	Among 117 pregnant patients with persistent renal colic or hydronephrosis, 31 underwent ureteroscopic double-J (DJ) stent insertion due to the absence of urinary calculi, while 86 received ureteroscopic lithotripsy (URSL) with DJ stent placement for ureteral calculi. Ureteroscopy identified stones in 27.9% of patients undetected by ultrasound. Complete stone fragmentation was achieved in 84.9% of cases. Complications included threatened abortion in 10.3% (significantly higher in Group C, $p < 0.05$) and one case of urosepsis, all resolved with conservative management and no adverse postpartum outcomes.

4.	Wymer, et al. ¹⁵ (2015)	USA	Retrospective cohort	100	Ureteroscopy was found to be both less costly and more effective than serial stenting for managing urolithiasis during pregnancy, regardless of gestational age (GA) at diagnosis. The incremental cost ranged from −\$74,469 at 12 weeks to −\$7631 at 36 weeks of gestation, while the incremental effectiveness declined from 0.49 to 0.05 quality-adjusted life years over the same period. The net monetary benefit of ureteroscopy decreased as the diagnosis was made later in pregnancy.
5.	Buttice, et al. ¹⁶ (2017)	Italy	Retrospective cohort	208	Summary: In a study of 208 pregnant patients with unresolved renal colic, no stones were identified in 36.1% through ultrasound (US) and diagnostic ureteroscopy (URS). Among the remaining 133 patients, 22.6% had stones detected only during URS despite negative US findings. Fever at initial presentation was linked to higher risks of sepsis and premature uterine contractions (PUC), and lower serum magnesium levels were associated with increased PUC risk. Delays in intervention significantly correlated with higher risks of sepsis and PUC. The type of

					anesthesia used had no impact on PUC rates.
6.	Teleb, et al. ¹⁷ (2014)	Egypt	Retrospective cohort	43	In a study of pregnant women with obstructing ureteric stones, ultrasound identified stones in 68% of group 1 and 76% of group 2. Group 1 had 9 mid-ureteric and 13 lower ureteric stones, while group 2 had 7 mid-ureteric and 14 distal ureteric stones. No perioperative fetal complications occurred, and all pregnancies went to full term. Postoperative urinary tract infections (UTIs) were reported in 4 patients in group 1 and 2 in group 2, with JJ stent exchange required in 7 group 1 patients
7.	Tan, et al. ¹⁸ (2018)	China	Retrospective cohort	53	In a comparison of double-J (DJ) stent retention and ureteroscopy lithotripsy for managing ureteral calculi during pregnancy, DJ stents were successfully inserted in 83.3% of 30 patients, with a complication rate of 16%. The mean operating time, cost, and hospitalization duration for the DJ group were 20.6 minutes, 1632 yuan, and 1.3 days, respectively. Ureteroscopy lithotripsy was successfully performed in 87.0% of 23 patients, with a 10% complication rate. The ureteroscopy group had longer mean operating time (41.5 minutes), higher costs (2792 yuan), and

					longer hospitalization (6 days).
8.	Channa, et al. ¹⁹ (2022)	Pakistan	Retrospective cohort	33	In a study of 33 pregnant patients (gestation period: 8–33 weeks) with renal colic, ureterorenoscopy was performed for stones located on the right side (18 cases), left side (13 cases), and bilaterally (2 cases). Symptoms included hematuria (6 patients), nausea/vomiting (18 patients), acute urinary retention (2 patients), and oliguria due to bilateral obstruction (1 patient). Stone clearance was achieved in 85% of patients, while in 15%, the stones were pushed back to relieve obstruction.

Juliebø-Jones, et al.¹² (2023) support that URS during pregnancy is safe with appropriate protocols and multidisciplinary management.

Shalaby, et al.¹³ (2021) showed that combined Doppler US detection of elevated renal RI and absent ureteral jet is effective for diagnosing obstructive stones, and URS offers a safe, efficient treatment for refractory cases.

Zhang, et al.¹⁴ (2016) showed that early ureteroscopy is a safe and effective treatment for persistent colic, potentially reducing preterm birth risks.

Wymer, et al.¹⁵ (2015) suggest ureteroscopy is most advantageous when performed early in pregnancy and remains cost-effective across all scenarios.

Buttice, et al.¹⁶ (2017) highlight URS as a safe option for managing unresolved renal colic in pregnancy, emphasizing the importance of timely surgical intervention to minimize complications.

Tan, et al.¹⁸ (2018) showed that both urethrosopy and double j stent were found to be effective and

safe for managing ureteral calculi in pregnancy.

Channa, et al.¹⁹ (2022) found that uretrorenoscopy is concluded to be a safe and effective first-line treatment for calculus obstructive uropathy during pregnancy.

DISCUSSION

Ureteroscopy (URS) has become a widely accepted and effective treatment for managing ureteral calculi during pregnancy, providing both safety and satisfactory outcomes when conservative approaches fail. Over the years, studies have demonstrated that URS is a reliable intervention, especially in the presence of obstructive uropathy and persistent renal colic, which are common complications during pregnancy. The procedure allows for direct visualization and treatment of stones, offering a definitive solution compared to temporary measures like stenting.²⁰

One of the key factors influencing the safety and efficacy of URS is the accuracy of diagnostic imaging. Studies such as those by Shalaby et al. (2021) and Buttice et al. (2017) have highlighted the importance of combining ultrasound

with diagnostic ureteroscopy to improve detection rates. While ultrasound is often used to diagnose urolithiasis, it may miss certain stones, especially those located in the distal ureter. Ureteroscopy, however, has been found to detect additional stones that ultrasound may overlook, ensuring more comprehensive treatment. This diagnostic advantage is essential for pregnant patients, as proper identification of the stones determines the course of treatment.^{13,16}

The success rate of ureteroscopy in pregnant patients has been reported to be very high, with stone-free rates (SFR) reaching as high as 95.8% in some studies.¹³ Ureteroscopic lithotripsy, used to fragment and remove stones, achieves successful results in the majority of cases, reducing the need for additional interventions. Zhang et al. (2016) demonstrated that 84.9% of patients experienced complete stone fragmentation during URS, showcasing its high efficacy. By providing a definitive solution, URS significantly reduces the likelihood of recurrent procedures, which is particularly important for pregnant

women who may face increased risks with repeated interventions.¹⁴

While the procedure is generally safe, complications do occur, but they tend to be minor. For example, Juliebø-Jones et al. (2023) reported low intraoperative (2%) and postoperative (6%) complication rates. Additionally, the incidence of severe urological, fetal, or obstetric complications remains minimal, reinforcing the safety of the procedure when appropriate protocols are followed.¹² This is supported by other studies such as Wymer et al. (2015), which emphasized that complications can be minimized when URS is performed by experienced multidisciplinary teams with proper anesthetic and procedural management.¹⁵

The timing of the procedure is a crucial factor that can impact both maternal and fetal outcomes. Wymer et al. (2015) found that early intervention with URS is more cost-effective and results in better quality-adjusted life years, particularly when compared to serial stenting.¹⁵ On the other hand, delaying the intervention is associated with increased risks of complications, including urosepsis

and premature uterine contractions (PUC), as highlighted by Buttice et al. (2017). Timely surgical management, therefore, plays a key role in reducing the risk of these adverse outcomes.¹⁶

In terms of cost-effectiveness, several studies have shown that while URS may require higher upfront costs and longer hospital stays compared to other methods like double-J (DJ) stent placement, it remains more cost-effective in the long term. Wymer et al. (2015) demonstrated that the net monetary benefit of URS decreased as the diagnosis was made later in pregnancy, underscoring the importance of early intervention. Despite the initial higher costs, URS may reduce the need for repeated hospitalizations or additional treatments, making it a financially viable option for managing urolithiasis during pregnancy.¹⁵

Double-J stenting remains a commonly used alternative for managing ureteral calculi during pregnancy, but studies suggest that URS generally offers better outcomes. Tan et al. (2018) compared DJ stent retention and URS lithotripsy and found that while both methods were effective, URS provided more

definitive results. DJ stenting, while less invasive and associated with a shorter procedure time, often requires further intervention after delivery, whereas URS eliminates the need for additional procedures, offering a one-time solution. Furthermore, the complication rates for both methods are relatively low, with only a small percentage of patients requiring postoperative follow-up or experiencing complications.¹⁸

Fetal safety during the procedure is a primary concern in managing ureteral stones during pregnancy. Fortunately, studies consistently report no significant fetal complications associated with URS. For instance, Teleb et al. (2014) and Juliebø-Jones et al. (2023) found no perioperative fetal harm, and all pregnancies went to full term.^{12,17} However, the risk of premature delivery remains a concern, with Shalaby et al. (2021) reporting a 9% incidence of premature delivery, which was associated with postoperative complications like urinary tract infections and uterine contractions. These findings highlight the importance of minimizing the time between diagnosis and

intervention to reduce risks to both the mother and fetus.¹³

The advancements in ureteroscopic techniques, including improvements in anesthesia and lithotripsy methods, have contributed significantly to the safety and effectiveness of the procedure. Juliebø-Jones et al. (2023) reported that the introduction of spinal anesthesia and light sedation in more recent studies has enhanced patient comfort and reduced complication rates. Additionally, the use of intracorporeal lithotripsy has improved the success rates of stone fragmentation, further solidifying the role of URS as a definitive treatment for ureteral calculi in pregnant patients.¹²

CONCLUSION

Ureteroscopy is a safe, effective, and cost-efficient treatment for ureteral calculi during pregnancy. Early intervention minimizes complications, and URS remains a successful option for managing obstructive uropathy. Future research should optimize protocols and assess long-term outcomes for improved care.

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