

Treatment of Kidney Stones Using Minimally Invasive Methods: A Study at Can Gio District Medical Center in Ho Chi Minh City, Vietnam

Ho My Duyen Phan

Student, Vo Truong Toan University
Hau Giang Province 95000, Vietnam

Publication Date: 2025/02/15

Abstract: This study aimed to evaluate the efficacy and complications of minimally invasive interventions in the treatment of kidney stones at Can Gio District Medical Center, Ho Chi Minh City from 2010 to 2023. Data were collected from patients treated with methods including extracorporeal shock wave lithotripsy (ESWL), flexible ureteroscopy with laser lithotripsy, laparoscopic stone removal, and percutaneous nephrolithotomy (PCNL) using various techniques (standard, mini perc, and micro perc). The results indicated that among 1,000 cases treated with ESWL, the stone-free rate was 76% after the first session, 87% after the second, and 92% after the third session, with a complication rate of only 1%, including renal colic, hematuria, and urinary infections. For 167 PCNL cases, the stone-free rate immediately after surgery was 90.3%, and 64% at four weeks as confirmed by X-ray and ultrasound, with an overall complication rate of 6.3% and an average blood loss of 0.8-1.54 g/dl. The recently introduced ultra-mini PCNL technique showed promising results in terms of high stone clearance, low invasiveness, and minimal blood loss, though data remain limited. Among 106 cases treated with flexible ureteroscopy, the immediate postoperative stone-free rate ranged from 52% to 54%, increasing to 72% to 75% after three months, with an overall complication rate of 8.75%, including urinary infections, hematuria, and postoperative pain. In conclusion, minimally invasive techniques have become the standard in kidney stone treatment, offering high efficacy, low complication rates, and significant improvements in patients' quality of life.

Keywords: Treatment Methods; Minimally Invasive Methods; Kidney Stones.

How to Cite: Ho My Duyen Phan (2025). Treatment of Kidney Stones Using Minimally Invasive Methods: A Study at Can Gio District Medical Center in Ho Chi Minh City, Vietnam. *International Journal of Innovative Science and Research Technology*, 10(2), 36-40. <https://doi.org/10.5281/zenodo.14874178>

I. INTRODUCTION

Urinary stones are a prevalent and significant health issue in Ho Chi Minh City, Vietnam, affecting a large proportion of the population. At Can Gio District Medical Center, urinary stones represent approximately 40% of all patients seeking medical consultation for urinary disorders, making it a critical condition to address. Given the high incidence of urinary stones, it is crucial to continuously review and develop treatment techniques to improve patient outcomes and ensure the most effective management strategies are implemented.

The management of urinary stones follows established treatment guidelines outlined by major urological associations such as the American Urological Association, the Asian Urological Association, and the European Urological Association. These guidelines recommend a stepwise approach to treatment, starting with minimally invasive techniques and progressing to more invasive procedures when necessary. Open surgery is considered a last resort and is only

employed when other treatment methods have proven ineffective or are not suitable for the patient's condition [6]. This structured approach is designed to minimize patient risk and recovery time while maximizing treatment success.

Globally, urological surgery has evolved with advancements in medical technology, leading to a shift towards minimally invasive techniques for the treatment of urinary stones. This trend is not only consistent with global medical progress but also aligns with the increasing demands of patients who seek less invasive and quicker recovery options. Minimally invasive procedures, such as ESWL, flexible ureteroscopy, and PCNL, have become preferred options due to their effectiveness, reduced recovery time, and minimal risk of complications. These techniques represent a significant advancement over traditional open surgery, offering patients a safer and more comfortable treatment experience. Each treatment method for urinary stones serves a specific role in the overall management strategy, and selecting the most appropriate technique depends on various factors, including stone size, location, composition, and patient-

specific characteristics. For example, smaller stones located in the upper urinary tract may be treated effectively with ESWL or flexible ureteroscopy, while larger stones or those located in less accessible areas may require more invasive procedures like PCNL. The advantage of minimally invasive procedures is that they allow for effective treatment with reduced risk and faster recovery, making them the preferred approach for most patients.

The guidelines set forth by the 2015 European Association of Urology and the American Urological Association emphasize the importance of individualized

treatment plans. The choice of intervention is influenced by factors such as the location of the stones within the renal calyces, their size, hardness (as assessed by Hounsfield units on CT scans), and the patient's overall health condition and risk factors. For example, stones in the renal pelvis may be more amenable to ESWL, while larger or more complex stones in the calyces may require a more invasive approach like PCNL. The decision-making process takes into account not only the characteristics of the stones but also the patient's personal health, including any underlying medical conditions that may influence the choice of treatment [6][9].

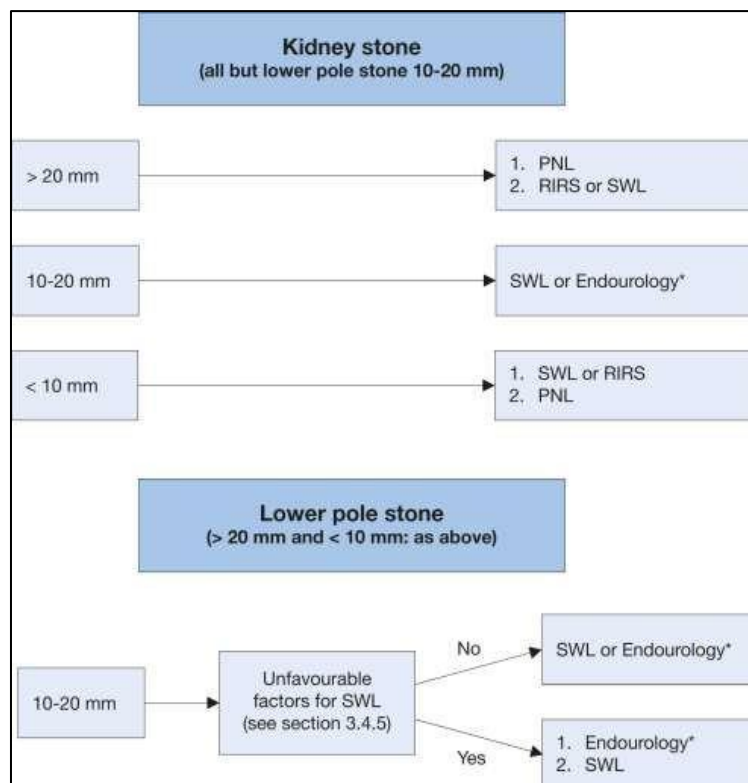


Fig 1: Treatment Protocol for Urinary Stones According to the 2022 European Association of Urology Guidelines
Source: A. Skolarikos, A. Neisius, A. Petřík et al. [6]

Ultimately, the treatment of urinary stones is becoming increasingly personalized, with a growing emphasis on minimally invasive techniques that offer patients effective outcomes with fewer complications. As urological surgery continues to evolve, it is expected that the range of available treatment options will expand, providing even more effective solutions for those suffering from this common condition. By adhering to evidence-based guidelines and embracing new technological advancements, healthcare providers can ensure the best possible care for patients with urinary stones.

In response to the growing demands and expectations of patients, Can Gio District Medical Center has made significant investments in advanced technology to treat urinary stones. The medical center has equipped itself with a wide array of state-of-the-art minimally invasive treatment options, ensuring that patients have access to the most up-to-date and effective therapies available. This comprehensive range of technologies enables the medical team to offer

tailored treatment plans for a variety of urinary stone conditions, which is crucial in providing personalized care that aligns with the latest advancements in the field of urology. Furthermore, the hospital has not only implemented these advanced techniques but has also witnessed a consistent increase in the number of cases treated over time. This steady rise in patient volume is a testament to the effectiveness and reliability of the treatment methods being employed. The medical center's commitment to patient care is reflected in its growing reputation as a leading institution for urinary stone management in the region. In addition to providing high-quality clinical care, Can Gio District Medical Center places a strong emphasis on research and scientific validation. The institution conducts extensive studies on the various minimally invasive techniques it employs, carefully collecting data to ensure that each method is effective, safe, and aligned with current best practices. This evidence-based approach allows the hospital to continuously refine and improve its

treatment protocols, ensuring that patients receive the most effective and scientifically validated care possible.

The integration of cutting-edge technologies and a research-driven approach to patient care ensures that Can Gio District Medical Center remains at the forefront of urinary stone treatment. By prioritizing both innovation and scientific validation, the hospital is able to provide a high standard of care while continually adapting to the evolving needs of its patients. With its comprehensive array of minimally invasive treatment options and commitment to research, Can Gio District Medical Center is well-positioned to meet the increasing demands for effective urinary stone management in the years to come.

II. SUBJECTS AND METHODS

This study meticulously extracted and analyzed data from patients who visited Can Gio District Medical Center for consultation and treatment of urinary stones between January 2010 and December 2023. The patient data was closely monitored and recorded by our research team throughout this period, ensuring a comprehensive understanding of the treatment outcomes. The patients included in this study underwent various minimally invasive interventions, each designed to address different types of urinary stone conditions based on factors such as stone size, location, and patient-specific characteristics.

The treatment modalities employed in this study encompass a broad spectrum of advanced minimally invasive techniques, reflecting the medical center's commitment to utilizing cutting-edge technology for optimal patient care. These techniques included ESWL, a non-invasive procedure that uses shock waves to break down stones into smaller fragments, making them easier to pass through the urinary tract. Additionally, patients were treated with flexible ureteroscopy combined with laser lithotripsy, which allows for the direct visualization and fragmentation of stones within the urinary system, offering precision and minimal tissue damage.

Furthermore, the study also covered laparoscopic stone removal, a minimally invasive surgical procedure that involves small incisions and the use of a camera to guide the removal of stones. Standard PCNL was utilized for patients with larger stones, employing a small incision and a nephroscope to directly access the kidneys and remove the stones. The study also included cases where mini-PCNL, utilizing a small-caliber instrument set, was applied to reduce invasiveness and improve recovery times while still effectively removing stones. In cases involving very small stones or more complex situations, micro-PCNL, utilizing ultra-small instrument sets, was employed to further minimize tissue trauma and enhance patient outcomes.

III. RESULTS

This study examined the effectiveness and safety of various lithotripsy methods, with a focus on ESWL, flexible ureteroscopy with laser lithotripsy, and PCNL.

On average, the study performed 15 to 25 ESWL cases per day. In evaluating 1,000 ESWL cases involving stones ranging in size from 10 to 20 mm, the study found the stone-free rates after the first, second, and third sessions to be 76%, 87%, and 92%, respectively. These results suggest that the success rate of ESWL increases with subsequent sessions, highlighting the efficacy of this treatment for medium-sized stones. Furthermore, the study recorded an overall complication rate of 1%, which included renal colic requiring medication, macroscopic hematuria, urinary tract infections necessitating hospitalization, and renal parenchymal injuries identified through CT scans. These findings suggest that while the complication rate for ESWL is low, careful monitoring is necessary, especially for potential renal injuries and infections.

In terms of flexible ureteroscopy with laser lithotripsy, the study analyzed data from 106 patients with an average stone size of 10.75 mm (ranging from 6 to 22 mm). Of these, 96 patients had stones located in the lower calyx. The stone-free rate immediately after surgery was between 52-54%, while the rate increased to 72-75% three months post-surgery. This technique demonstrated a lower immediate stone-free rate compared to ESWL, but it still yielded a substantial stone-free rate over time, suggesting its effectiveness in treating upper urinary tract stones. However, the study also reported a higher complication rate of 8.75%, which included urinary tract infections, sepsis, macroscopic hematuria, and severe postoperative pain. The increased complication rate reflects the more invasive nature of ureteroscopy compared to ESWL but is still considered manageable within the scope of clinical practice.

For PCNL, three methods were used with progressively reduced invasiveness: standard PCNL, PCNL with a small tract, and PCNL with an ultra-small tract. The study specifically highlighted the use of the small tract PCNL method, performed on over 167 patients at Can Gio District Medical Center. These patients had an average stone size of 22.6 mm, which is larger than the stones typically treated with ESWL or ureteroscopy. Blood loss was measured by hemoglobin change, ranging from 0.8 to 1.54 g/dL, suggesting a relatively low level of hemorrhagic complications. The overall complication rate for this method was 6.3%, which is moderate compared to the other techniques. The immediate stone-free rate, measured via fluoroscopy, was 90.3%, demonstrating the high efficacy of this method. Four weeks post-surgery, the stone-free rate on KUB X-ray was 74%, with 64% of patients showing no residual stones on both KUB and ultrasound. These results indicate that PCNL with a small tract is highly effective for large kidney stones, although follow-up monitoring is essential to detect any residual stones.

In cases where residual stones were observed on KUB X-rays, most of the remaining stones were located in the lower calyx (58%), followed by the upper calyx (37%), and a small percentage in the middle calyx (1%). Residual stones smaller than 4 mm did not require further intervention within 12 weeks after surgery, suggesting that small stone fragments can be monitored conservatively. However, for stones larger than 4 mm, 26% of patients required additional treatment, emphasizing the need for follow-up interventions for larger residual stones.

Overall, this study illustrates the effectiveness and varying complication rates of different minimally invasive lithotripsy techniques. The choice of method depends on factors such as stone size, location, and the patient's overall health. The findings also emphasize the importance of post-operative monitoring to ensure optimal outcomes and address any residual stones or complications that may arise. The trend towards less invasive procedures, such as small tract PCNL and flexible ureteroscopy, reflects the evolving landscape of urology, with techniques being continually refined to improve patient safety, reduce recovery times, and enhance treatment success rates.

IV. DISCUSSION

The flexible ureteroscopy with laser lithotripsy technique is a minimally invasive procedure that does not cause renal parenchymal damage. However, the equipment is quite expensive, and the cost of surgery is high. Each flexible scope can be used for approximately 20-35 patients, and while the stone access rate and stone-free rate after surgery are still limited, this technique holds great promise as flexible ureteroscopy equipment continues to improve.

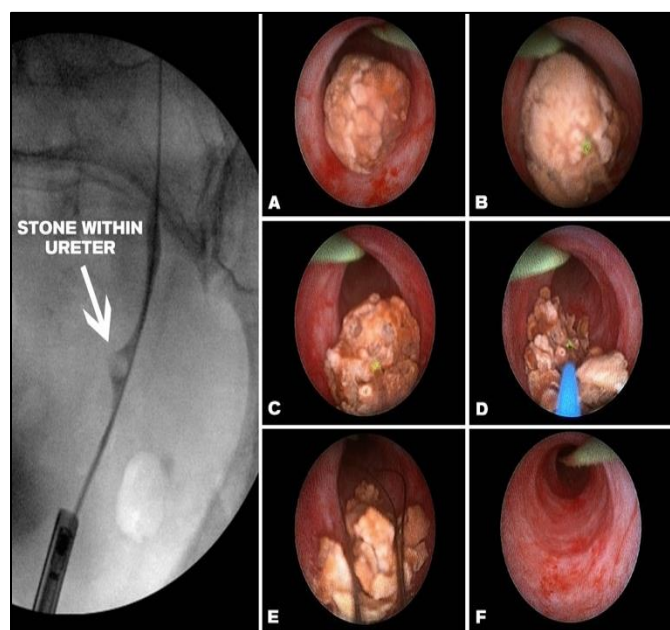


Fig 2: Uretoroscopy with Laser Lithotripsy Technique
(A: Stone initially visualized through scope; B: Preparing to laser stone; C & D: Laser pulverizing stone; E: Removal of stone fragments with basket; F: Ureter now stone-free)
Source: Urologic Surgeons of Washington [10]

For this technique, several key considerations were noted during the surgery, including: the angle of the renal pelvis and lower calyx, the diameter of the calyceal neck, the length of the calyx containing stones, and the proper use and maintenance of the flexible ureteroscope to ensure both sterility and longevity, which helps reduce treatment costs for patients [2][3][7][8].

Standard PCNL is becoming increasingly common in the treatment of kidney stones, gradually replacing open surgery. This technique has undergone numerous improvements to further reduce invasiveness and renal parenchymal damage. Since the 1980s, standard PCNL with a tract diameter ranging from 24-32 F has been the standard treatment for kidney stones larger than 20 mm. Subsequently, this technique has been progressively refined, with smaller tract sizes, reducing from 24 F to 18 F, 16 F, 8 F, and even ultra-small tracts below 6 F. Several studies comparing the outcomes of flexible ureteroscopy with laser lithotripsy to PCNL with small tract have reported no statistically significant differences in complication rates such as urinary infections, bleeding, and postoperative inflammatory response syndrome. However, the overall stone-free rate with PCNL is approximately 10% higher than that with flexible ureteroscopy. Flexible ureteroscopy is preferred in cases of solitary kidney due to its higher safety profile [1][2][7][8].

There are three techniques or effects that can help increase the success rate, reduce surgical time, and improve the stone-free rate after PCNL: preoperative localization of stones using MSCT to enhance accuracy when puncturing the kidney or stone site, especially in cases of mild hydronephrosis, stones in diverticula, or stones in the calyces with no communication with the renal pelvis; the whirlpool effect during stone removal; and adjusting the laser energy and frequency during lithotripsy.

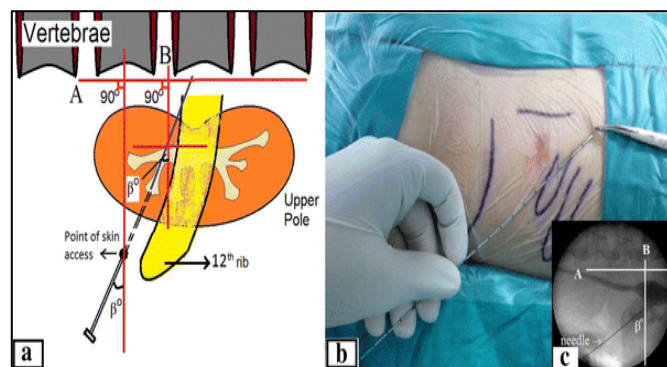


Fig 3: Calculation of the Renal Puncture Needle Length based on MSCT

Source: N.K. Hatipoglu, M.N. Bodakci, N. Penbegül et al. [11]

Each minimally invasive treatment method for kidney stones has its own advantages and limitations in the overall treatment protocol for kidney stones. Combining multiple minimally invasive methods to treat kidney stones can increase the success rate and stone-free rate, thus meeting treatment goals. Approaching treatment through a stepwise process, from minimally invasive to more invasive, is a

common strategy. For example: ESWL is typically the first choice, and if it fails, flexible ureteroscopy, micro-PCNL, and then mini-PCNL can be considered, with standard PCNL as the last option [4][5][9].

Another example involves stone locations that are inaccessible by RIRS: such as parenchymal stones, stones in cysts, stones in the calyces with no communication with the renal pelvis, or large stone burdens that cannot be completely resolved with a single technique. In such cases, combining 2-3 methods can be an effective solution for the patient.

V. CONCLUSION

The treatment of kidney stones using minimally invasive methods has become an integral and progressively more important aspect of urological care. This shift in treatment paradigms is largely driven by the growing number of patients seeking effective, less traumatic solutions for managing kidney stones. As the demand for faster recovery times, reduced hospital stays, and fewer complications continues to rise, minimally invasive techniques have emerged as the preferred choice for many urologists and patients alike.

Minimally invasive methods, which include approaches such as ESWL, flexible ureteroscopy with laser lithotripsy, and PCNL, offer significant advantages over traditional open surgical methods. These techniques involve smaller incisions, or sometimes none at all, reducing the risk of infection, blood loss, and other complications commonly associated with open surgery. Moreover, they allow for faster patient recovery and a quicker return to normal activities, which is increasingly important in today's fast-paced society.

Furthermore, the integration of multiple minimally invasive techniques has been shown to significantly improve the overall success rate in treating kidney stones. By combining these techniques, urologists are able to tailor the treatment plan to the specific needs of each patient, addressing factors such as stone size, location, and composition. This personalized approach not only enhances the chances of successful stone removal but also helps minimize the likelihood of residual stones, which could require further treatment.

As technology continues to advance, the ability to combine different minimally invasive techniques in a cohesive and strategic manner holds great promise for improving outcomes and patient satisfaction. With continued research and innovation, the role of minimally invasive methods in the treatment of kidney stones will undoubtedly continue to expand, further solidifying their place as the gold standard in modern urological care.

REFERENCES

- [1]. V.A. Nguyen, N.C. Nguyen. "Initial evaluation of the effectiveness and safety of percutaneous nephrolithotomy using the mini-perc LUT machine". *Ho Chi Minh City Medical Journal*, Vol. 20(2), pp. 126-130, 2016.
- [2]. G. Atis, C. Gurbuz, O. Arikan et al. "Retrograde intrarenal surgery for the treatment of renal stones in patients with a solitary kidney". *Urology*, Vol. 82(2), pp. 290-294, August 2013.
- [3]. T.B. Phan. Study on the role of flexible ureteroscopy in the treatment of upper urinary tract stones [Doctoral Thesis in Medicine]. Ho Chi Minh City: University of Medicine and Pharmacy, 2015.
- [4]. F. Eisenberger, G. Fuchs, K. Miller, P. Bub, J. Rassweiler. "Extracorporeal shockwave lithotripsy (ESWL) and endourology: an ideal combination for the treatment of kidney stones". *World Journal of Urology*, Vol. 3, pp. 41-47, 1985.
- [5]. P.C.H. Nguyen, T.B. Phan, T.K. Le. "Mini percutaneous nephrolithotomy: The first experiences". *Ho Chi Minh City Medical Journal*, Vol. 20(2), pp. 110-113, 2016.
- [6]. A. Skolarikos, A. Neisius, A. Petřík et al. Guidelines on Urolithiasis. Arnheim: European Association of Urology, 2022.
- [7]. T. Knoll, J.P. Jessen, P. Honeck, G.W. Norrdahl. "Flexible ureterorenoscopy versus miniaturized PNL for solitary renal calculi of 10-30mm size". *World Journal of Urology*, Vol. 29, pp. 755-759, 2011.
- [8]. M. Schoenthaler, K. Wilhelm, S. Hein. "Ultra-mini PCNL versus flexible ureteroscopy: a matched analysis of treatment costs in patients with renal stones 10-20 mm". *World Journal of Urology*, Vol. 38, pp. 55-58, 2015.
- [9]. V.T. Vu. "Treatment of urinary stones using minimally invasive methods". Summary of research and technical improvements over 10 years at Binh Dan Hospital, p. 151. Ho Chi Minh City: Binh Dan Hospital, 2000.
- [10]. Urologic Surgeons of Washington. Ureteroscopy with Laser Lithotripsy for The Treatment of Kidney Stones. Online: <https://www.dcuurology.net/procedures/ureteroscopy-with-laser-lithotripsy.php>, accessed on January 10, 2025.
- [11]. N.K. Hatipoglu, M.N. Bodakci, N. Penbegül et al. "Monoplanar access technique for percutaneous nephrolithotomy". *Urolithiasis*. Vol. 41, pp. 257-263, 2013.