

DOI: <https://doi.org/10.22141/2307-1257.13.2.2024.454>

I Gede Yogi Prema Ananda , Herman Yudawan, I Gusti Lanang Andi Suharibawa 
Klungkung General Hospital, Semarapura Kauh Klungkung, Bali, Indonesia

Initial experience of percutaneous nephrolithotomy surgery in secondary hospital in Bali

For citation: Počki. 2024;13(2):128-132. doi: 10.22141/2307-1257.13.2.2024.454

Abstract. Background. The formation of kidney stones is the result of the accumulation of crystals within the kidneys. Percutaneous nephrolithotomy (PCNL) is the preferred method for treating stones larger than 2 cm. This study aims to analyse outcomes and experiences of PCNL for kidney stone removal. **Materials and methods.** It was a descriptive study with a cross-sectional design, utilizing secondary data from electronic medical records in Klungkung General Hospital. There are 91 samples collected using total sampling between October 2020 and August 2023. The analysis was conducted using the SPSS Statistics 26. **Results.** The 51–60 age group (38.5 %) exhibited the highest prevalence of patients undergoing PCNL surgery. The most common type of stone was solitary (48.4 % of cases), with an average size of 3.570 ± 1.159 cm. The mean duration of the procedure was 38.630 ± 21.667 minutes, with a single puncture utilized in 68.1 % of cases. The pain levels experienced were generally low, with a mean score of 2 on a 10-point scale. The mean length of hospital stay was 2.330 ± 1.012 days. The outcomes of PCNL in patients with kidney stones were favourable, with a high stone-free rate of 92.3 % and minimal complications. Postoperative complications were infrequent. **Conclusions.** It is suggested that PCNL is an effective and safe procedure for kidney stone removal.

Keywords: percutaneous nephrolithotomy; kidney stone; secondary hospital; stone-free rate

Introduction

The kidney stones, medically known as nephrolithiasis, result from the accumulation of crystals within the kidneys. This disease impacts approximately 12 % of the global population, with higher prevalence in the United States [1, 2]. Kidney stone occurs more frequently in men within the age of 20–49 years [3]. A higher incidence of kidney stones has been observed in men compared to women. The observed difference in urine chemistry is believed to account for a significant proportion of the observed excess risk [4] and it has been associated with an increased risk of end-stage renal failure [5]. The risk factors for kidney stones include male population, hypertension, obesity, diabetes, and lifestyle such as alcohol consumption, opium abuse, and smoking [6]. There are various options for treating patients with nephrolithiasis, such as ureteroscopy, extracorporeal shockwave lithotripsy, and percutaneous nephrolithotomy (PCNL) [7]. PCNL stands as the favoured treatment option for kidney stones [8]. PCNL is the preferred method for treating stones larger than 2 cm, with stone-free rates as

high as 95 %. Additionally, PCNL is also indicated for cases involving partial or complete staghorn calculi. On the contrary, situations where PCNL is not indicated include pregnancy, bleeding disorders, and uncontrolled urinary tract infections [8, 9]. According to AUA guidelines, patients with symptomatic kidney stones larger than 2 cm should be treated with PCNL as the primary treatment option. PCNL has superior stone-free rates compared to other methods like extracorporeal shockwave lithotripsy or ureteroscopy. This method is also less invasive compared to open surgery, laparoscopic, or robotic procedures. It is also less affected by factors related to the kidney stone, such as stone composition, density, and location [10].

Based on data from the Indonesian Ministry of Health (Kemenkes) in 2023, people with kidney disease will reach more than 700,000 people and by 2023 there will be 1.5 million people with kidney failure [11]. The Ministry of Health also explained that there are 12 provinces in Indonesia with high chronic kidney cases, and Bali province is one of them [12]. Klungkung General Hospital is one of the main type B

© 2024. The Authors. This is an open access article under the terms of the Creative Commons Attribution 4.0 International License, CC BY, which allows others to freely distribute the published article, with the obligatory reference to the authors of original works and original publication in this journal.

For correspondence: I Gede Yogi Prema Ananda, MD, Department of Urology, Klungkung General Hospital, Jl. Flamboyan No. 40, Semarapura Kauh Klungkung, Bali 80714, Indonesia; e-mail: igedeyogi636@gmail.com, yogiprema16@gmail.com; phone: +6281338512310

Full list of authors' information is available at the end of the article.

hospitals owned by the Klungkung district government located in Bali. However, the PCNL is a new surgery method used by Klungkung General Hospital in 2020. Hence, this study was conducted to analyse the initial experience of PCNL surgery in Klungkung General Hospital from 2020 until 2023.

Materials and methods

This study employs a descriptive cross-sectional design, utilizing secondary data extracted from electronic medical records at Klungkung General Hospital. The data extracted from the medical records includes the patients’ name, date of surgery, age, gender, diagnosis, type of kidney stone, stone size, stone position, anesthesia, comorbidities, duration of surgery, duration of C-arm, number of punctures, intraoperative complication, postoperative complication, postoperative pain scale, stone-free rate, and hospitalization. A total of 91 samples were collected using total sampling between October 2020 and August 2023. The data was analyzed using IBM SPSS Statistics 26 for Windows. This study has passed ethical approval from the local ethics committee Klungkung General Hospital with the registration number 000.9.2/2618/RSUD.

Results

The data of the PCNL surgery in Klungkung General Hospital were shown in the Fig. 1.

Fig. 1 showed that there are 59 of male population (64.8 %) and 32 of female population (35.2 %). The age range was 28 to 78 years, with 91 samples. The mean age was 53.23 ± 10.92 years. The age group with the highest representation was 51 to 60 years, with 35 people (38.5 %) of the population. The age group with the highest proportion of males was 41–50 years old, with 30.5 % of the population or 18 people, while the age group with the highest proportion of females was 51–60 years old, with 59.3 % of the population or 19 people.

Table 1 demonstrated that 48.4 % of the stones were solitary, 11.0 % were multiple, and 40.6 % were staghorn calculi. The stone size ranged from 2.0 to 7.8 cm. The majority of the stones were between 3.0 and 3.9 cm (34.1 %), with a mean stone size of 3.570 ± 1.159 cm. The distribution of kidney stones was 47.3 % right kidney stones, 46.2 % left kidney stones, and 6.6 % bilateral stones. Among all patients

with kidney stones, there were 1.1 % of cases in individuals with obesity, chronic kidney disease (CKD), hepatitis, and anemia. The remaining 95.6 % of patients did not have any comorbidities.

All surgical procedures were conducted under general anesthesia. Table 2 demonstrated that the duration of PCNL surgery ranged from 16 to 100 minutes. The mean time was 38.630 ± 21.667 minutes. The majority of surgeries (44.0 %) were completed within 30 to 60 minutes, while 42.9 % were completed in less than 30 minutes and 13.1 % were completed in more than 60 minutes. The C-arm was utilized for a duration of 20 to 30 seconds in 89 % of PCNL surgeries, while it was employed for more than 30 seconds in the remaining procedures. The mean duration of the C-arm used in PCNL surgery was 24.710 ± 3.848 seconds. Most surgeries (68.1 %) were conducted with a single puncture, while 18.7 % involved a double puncture and 13.2 % a triple puncture. The stone-free rate of PCNL at Klungkung General Hospital was 92.3 %.

Table 3 above indicates that 2.2 % of cases exhibited bleeding as an intraoperative complication. Additionally,

Table 1. Distribution of the stone type, size, location, and comorbidities

Parameters	Frequency	Percentage
Stone type		
Solitary	44	48.4
Multiple	10	11.0
Staghorn	37	40.6
Total	91	100.0
Stone size, cm		
2.0–2.9	30	33.0
3.0–3.9	31	34.1
4.0–4.9	19	20.9
5.0–5.9	7	7.7
6.0–6.9	2	2.2
7.0–7.9	2	2.2
Total	91	100.0
Stone location		
Right	43	47.3
Left	42	46.2
Bilateral	6	6.6
Total	91	100.0
Comorbidities		
Obesity	1	1.1
Chronic kidney disease	1	1.1
Hepatitis	1	1.1
Anaemia	1	1.1
No comorbidity	87	95.6
Total	91	100.0

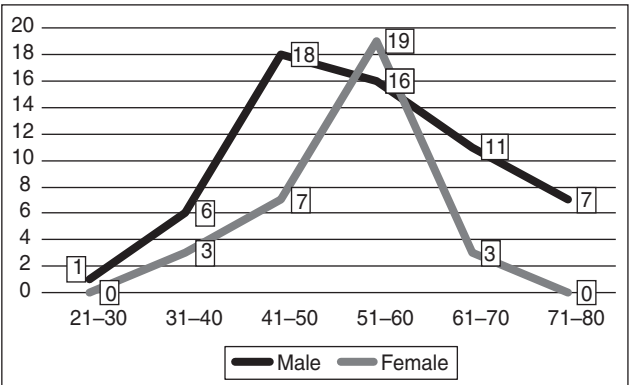


Figure 1. Gender distribution based on age group

1.1 % of cases exhibited sepsis, while 2.2 % exhibited fistula as postoperative complications. The majority of patients (42.2 %) reported pain levels of 2 on the Visual Analog Scale (VAS). While in Fig. 2 below, showing the duration of the average stays in Klungkung General Hospital.

A total of 75 (83 %) of the patients were hospitalized for a period of two days, while the shortest hospital stays were four days (1 %) and eight days (1 %), with the mean duration of hospitalization being 2.330 ± 1.012 days.

Discussion

Kidney stones, also known as nephrolithiasis, are urological conditions involving the creation and intermittent passage of crystals along the urinary tract [13]. The prevalence of kidney stones was estimated to be 10.1 % globally [14]. In this study, the highest prevalence of kidney stones (38.5 %) was observed in individuals aged 51 to 60 years, with a mean age of 53.23 ± 10.92 years. For comparison, a study by Chen et al. [14] reported the highest prevalence in males over the age of 60, at 17.8 %. A study by Moftakhar et al. [15] indicated that the highest prevalence was observed in women aged 40–50 years old, with a prevalence rate of 40.47 %. The average age of the population was 52.15 years old. Study by Karakeçi et al. [9] had a mean age of 46.76 ± 14.09 years old. Another study by Kumar et al. [16] reported an average age of 40.9 ± 15.1 years, with 65.5 % of the population being male. The differences of age ranges and genders of the patients illustrate the varying effects of the treatment.

The stone size was found to range from 2.0 to 7.8 cm. The majority of the stones (34.1 %) were between 3.0 and

3.9 cm in size, with a mean stone size of 3.570 ± 1.159 cm. In percentage terms, 40.6 % of the stones were staghorn, 48.4 % were solitary stones, and 11.0 % were multiple stones. Additionally, 1.1 % of the subjects exhibited comorbidities including obesity, CKD, hepatitis, and anemia. The study by Karakeçi et al. [9] reported a mean stone size of 2.93 ± 0.71 cm, with 38.4 % solitary stones and 61.6 % multiple stones. A study by Reimer et al. [17] had a stone size ranging between 0.4 and 1.5 cm with the average size of 0.88 ± 0.29 cm. In a study by Kumar et al. [16], the mean size of the stones was 2.18 ± 0.72 cm with 11.5 % of the patients exhibited staghorn calculi and 85.1 % of the patients exhibited hydronephrosis. Another study by Doykov et al. [18] had an average stone size of 1.229 ± 0.615 cm, with 69.3 % patients having solitary stone, 20.9 % having multiple stones, and 9.8 % having staghorn calculi, while 58.9 % patients exhibited hydronephrosis.

Table 3. Distribution of the intraoperative complications, the postoperative complications, and the postoperative pain score on VAS

Parameters	Frequency	Percentage
Intraoperative complications		
No complications	89	97.8
Bleeding	2	2.2
Total	91	100.0
Postoperative complications		
No complications	88	96.7
Sepsis	1	1.1
Fistula	2	2.2
Total	91	100.0
Postoperative pain (VAS)		
1	21	23.1
2	42	46.2
3	28	30.8
Total	91	100.0

Table 2. Distribution of the duration of surgery, the duration C-arm, the number of punctures, the stone-free rate of PCNL

Parameters	Frequency	Percentage
Duration of surgery, minutes		
< 30	39	42.9
30–60	40	44.0
> 60	12	13.1
Total	91	100.0
Duration of C-arm, seconds		
20–30	81	89.0
> 30	10	11.0
Total	91	100.0
Number of punctures		
Single	62	68.1
Double	17	18.7
Triple	12	13.2
Total	91	100.0
Stone-free rate		
Free	84	92.3
Not free	7	7.7

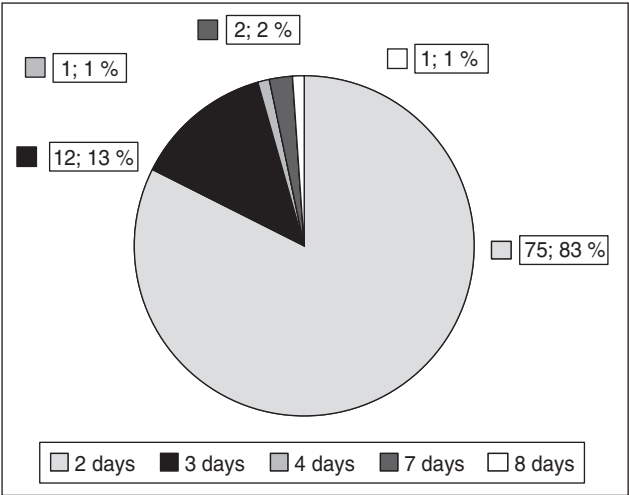


Figure 2. Duration of hospital stay

PCNL represents the gold standard of therapy for large kidney stones [19]. Patients with symptomatic kidney stones larger than 2 cm should be treated with PCNL as the primary treatment option [10]. In this study, the duration of PCNL surgery ranged from 16 to 100 minutes. The duration of surgical procedures may vary for a number of reasons, including differences in surgical techniques, patient characteristics, the complexity of the procedure, the experience of the surgeon, and the equipment used. The majority of surgeries (44.0 %) were completed within 30 to 60 minutes, while 42.9 % were completed in less than 30 minutes and 13.1 % were completed in more than 60 minutes. The average time for the surgery was 38.630 ± 21.667 minutes. The study by Karakeçi et al. [9] had a duration of 75.55 ± 21.50 minutes. Study by Thapa et al. [20] had a duration between 25 and 103 minutes. Meanwhile, a study in India by Kumar et al. [16] had an average duration of 77.4 ± 25.1 minutes. Another study by Doykov et al. [18] had an average of 61.91 ± 26.29 minutes and study by Wishahi et al. [21] had an average of 72.1 ± 14.9 minutes.

Moreover, in this study, 68.1 % of the surgery were done with single puncture, 18.7 % with double punctures, and 13.2 % with triple punctures. As a comparison, Kumar et al. [16] reported that 90.8 % of the surgeries were conducted with a single puncture, while the remaining 9.2 % were conducted with multiple punctures. The stone-free rate in this study was 92.3 %. Study by Wishahi et al. [21] had a stone-free rate of 85 % from 40 patients. There were 2.5 % cases with bleeding and 7.5 % cases with perforation as its intraoperative complication. Study by Atmoko et al. [22] had 62.6 % from 345 patients and study by Chen et al. [23] had 71.8 % from 39 patients.

According to the data, there were 2.2 % cases with bleeding as intraoperative complications. In this study, there were 1.1 % cases with sepsis and 2.2 % with fistula as postoperative complications. In comparison, a study by Karakeçi et al. [9] had 10.4 % patients with fever, 2.3 % needing blood transfusion, and 2.3 % with stone streets. Majority of the patients (42.2 %) in this study experienced pain in the scale of 2 of VAS. The duration of hospital stays in this study averaged 2.330 ± 1.012 days, with 82.4 % of the patients staying in hospital for 2 days. Study by Karakeçi et al. [9] averaged 4.57 ± 2.10 days of hospital stay. Meanwhile, the length of hospital stays in a study by Wishahi et al. [21] averaged 3.4 ± 1.1 days.

This study was subject to several limitations. No data was available on the clinical symptoms and signs of the patients. Additionally, the puncture site was not documented in an appropriate manner. The study only included a postoperative pain scale, which prevented the researchers from making comparisons between the alleviation or exaggeration of pain before and after the procedure.

Conclusions

This study aims to know the PCNL outcomes in patients with kidney stones were to analyze the initial experience of PCNL surgery in Klungkung General Hospital and assess the success rates and complications associated with the procedure. The study demonstrated favorable results, with a

high stone-free rate of 92.3 % and minimal complications. The average surgery duration was relatively short at 38.63 minutes, and postoperative complications were infrequent. The findings suggest that PCNL is an effective and safe procedure for kidney stone removal. The study recommended regular follow-up evaluations for patients and highlighted the need for further research to investigate potential correlations between different variables in PCNL outcomes.

This is the inaugural study on PCNL at Klungkung General Hospital. The data generated in this study can be utilized for further research on PCNL. Furthermore, the data can be used to evaluate the performance of PCNL at Klungkung General Hospital over the past three years. It is recommended that future evaluations of data on PCNL should be done on an annual basis in order to facilitate the tracking of records. It is also important to note that PCNL surgery must place particular attention on the technique of puncture, tract dilatation, and the energy used to fragment stones. The analytical research must be conducted to study the correlation of certain variables, such as the duration of surgery and the stone-free rate, the duration of surgery and complications, or the number of punctures and postoperative pain.

References

1. Alelign T, Petros B. *Kidney Stone Disease: An Update on Current Concepts*. *Adv Urol*. 2018 Feb 4;2018:3068365. doi: 10.1155/2018/3068365.
2. Mishra NK. *Renal Calculi (Kidney Stones) and its Therapy*. *IGJPS*. 2019;9(1):1-4. doi: 10.35652/IGJPS.2019.9101.
3. Edvardsson VO, Indridason OS, Haraldsson G, Kjartansson O, Pálsson R. *Temporal trends in the incidence of kidney stone disease*. *Kidney Int*. 2013 Jan;83(1):146-152. doi: 10.1038/ki.2012.320.
4. Ferraro PM, Taylor EN, Curhan GC. *Factors associated with sex differences in the risk of kidney stones*. *Nephrol Dial Transplant*. 2023 Jan 23;38(1):177-183. doi: 10.1093/ndt/gfac037.
5. Sigurjonsdottir VK, Runolfsdottir HL, Indridason OS, Pálsson R, Edvardsson VO. *Impact of nephrolithiasis on kidney function*. *BMC Nephrol*. 2015 Aug 28;16:149. doi: 10.1186/s12882-015-0126-1.
6. Khalili P, Jamali Z, Sadeghi T, et al. *Risk factors of kidney stone disease: a cross-sectional study in the southeast of Iran*. *BMC Urol*. 2021 Oct 8;21(1):141. doi: 10.1186/s12894-021-00905-5.
7. NICE Guideline - Renal and ureteric stones: assessment and management: NICE (2019) *Renal and ureteric stones: assessment and management*. *BJU Int*. 2019 Feb;123(2):220-232. doi: 10.1111/bju.14654.
8. Ganpule AP, Vijayakumar M, Malpani A, Desai MR. *Percutaneous nephrolithotomy (PCNL) a critical review*. *Int J Surg*. 2016 Dec;36(Pt D):660-664. doi: 10.1016/j.ijssu.2016.11.028.
9. Karakoç O, Karakeçi A, Özcan T, et al. *Comparison of retrograde intrarenal surgery and percutaneous nephrolithotomy for the treatment of renal stones greater than 2 cm*. *Turk J Urol*. 2015 Jun;41(2):73-77. doi: 10.5152/tud.2015.97957.
10. Assimos D, Krambeck A, Miller NL, et al. *Surgical Management of Stones: American Urological Association/Endourological Society Guideline, part I*. *J Urol*. 2016 Oct;196(4):1153-1160. doi: 10.1016/j.juro.2016.05.090.
11. Professor of the University of Indonesia encourage kidney transplantation for late-stage treatment: cheaper and better quality of

life. Available from: <https://fk.ui.ac.id/infosehat/guru-besar-ui-do-rong-transplantasi-ginjal-untuk-pengobatan-tahap-akhir-lebih-murah-dan-kualitas-hidup-lebih-baik/>. Indonesian.

12. Firdaus A. Ministry of Health: 12 Indonesian provinces have the highest number of chronic kidney cases. Available from: <https://www.antaranews.com/berita/3429303/kemenkes-12-provin-si-ri-tempati-angka-tertinggi-kasus-ginjal-kronis>. Indonesian.

13. Stamatelou K, Goldfarb DS. Epidemiology of Kidney Stones. *Healthcare (Basel)*. 2023 Feb 2;11(3):424. doi: 10.3390/healthcare11030424.

14. Chen Z, Prosperi M, Bird VY. Prevalence of kidney stones in the USA: The National Health and Nutrition Evaluation Survey. *Journal of Clinical Urology*. 2018;12(4):296-302. doi: 10.1177/2051415818813820.

15. Moftakhar L, Jafari F, Ghoddusi Johari M, Rezaeianzadeh R, Hosseini SV, Rezaeianzadeh A. Prevalence and risk factors of kidney stone disease in population aged 40-70 years old in Kharameh cohort study: a cross-sectional population-based study in southern Iran. *BMC Urol*. 2022 Dec 19;22(1):205. doi: 10.1186/s12894-022-01161-x.

16. Kumar S, Karthikeyan VS, Mallya A, Keshavamurthy R. Outcomes of second-look percutaneous nephrolithotomy in renal calculi-a single centre experience. *Turk J Urol*. 2018 Sep;44(5):406-410. doi: 10.5152/tud.2018.76299.

17. Reimer RP, Klein K, Rinneburger M, et al. Manual kidney stone size measurements in computed tomography are most accurate using multiplanar image reformations and bone window settings. *Sci Rep*. 2021 Aug 12;11(1):16437. doi: 10.1038/s41598-021-95962-z.

18. Doykov M, Kostov G, Doykova K. Factors Affecting Residual Stone Rate, Operative Duration, and Complications in Patients Un-

dergoing Minimally Invasive Percutaneous Nephrolithotomy. *Medicina (Kaunas)*. 2022 Mar 13;58(3):422. doi: 10.3390/medicina58030422.

19. Sabler IM, Katafigiotis I, Gofrit ON, Duvdevani M. Present indications and techniques of percutaneous nephrolithotomy: What the future holds? *Asian J Urol*. 2018 Oct;5(4):287-294. doi: 10.1016/j.ajur.2018.08.004.

20. Thapa BB, Niranjana V. Mini PCNL Over Standard PCNL: What Makes it Better? *Surg J (N Y)*. 2020 Feb 12;6(1):e19-e23. doi: 10.1055/s-0040-1701225.

21. Wishahi M, El Feel A, Elkhoully A, et al. Concerns about stone free rate and procedure events of percutaneous nephrolithotripsy (PCNL) for 2-4 cm kidney stones by standard-PCNL vs mini-PCNL-comparative randomised study. *BMC Urol*. 2023 May 19;23(1):96. doi: 10.1186/s12894-023-01270-1.

22. Atmoko W, Birowo P, Rasyid N. Factors affecting stone free rate of primary percutaneous nephrolithotomy on staghorn calculi: a single center experience of 15 years. *F1000Res*. 2016 Aug 30;5:2106. doi: 10.12688/f1000research.9509.2.

23. Chen P, Wei TT, Huang EY, et al. Comparison of stone-free rate between percutaneous nephrolithotomy and retrograde intrarenal surgery. *J Chin Med Assoc*. 2023 May 1;86(5):485-488. doi: 10.1097/JCMA.0000000000000913.

Received 05.04.2024

Revised 14.04.2024

Accepted 25.04.2024 ■

Information about authors

I Gede Yogi Prema Ananda, MD, Department of Urology, Klungkung General Hospital, Semarapura Kauh Klungkung, Bali, Indonesia; e-mail: igedeyogi636@gmail.com, yogiprema16@gmail.com; phone: +6281338512310; <https://orcid.org/0009-0002-5692-1725>

Herman Yudawan, Urologist, Department of Urology, Klungkung General Hospital, Semarapura Kauh Klungkung, Bali, Indonesia; e-mail: hermanyudawan@gmail.com

I Gusti Lanang Andi Suharibawa, Urologist, Department of Urology, Klungkung General Hospital, Semarapura Kauh Klungkung, Bali, Indonesia; e-mail: lanangandi@gmail.com; <https://orcid.org/0000-0002-0980-1256>

Conflicts of interests. Authors declare the absence of any conflicts of interests and own financial interest that might be construed to influence the results or interpretation of the manuscript.

I Gede Yogi Prema Ananda, Herman Yudawan, I Gusti Lanang Andi Suharibawa
Klungkung General Hospital, Semarapura Kauh Klungkung, Bali, Indonesia

Досвід використання черезшкірної нефролітомії в лікарні вторинної допомоги на Бали

Резюме. Актуальність. Утворення каменів у нирках є результатом накопичення кристалів. Черезшкірна нефролітомія (ЧШНЛ) є кращим методом лікування при каменях розміром понад 2 см. **Мета:** проаналізувати результати й досвід використання ЧШНЛ при видаленні каменів у нирках. **Матеріали та методи.** Це було описове дослідження з перехресним дизайном, у якому використано вторинні дані з електронних медичних записів лікарні загального профілю (Клункунг, Індонезія). У період із жовтня 2020 року по серпень 2023 року за допомогою методу загальної вибірки проаналізовано 91 випадок. Аналіз проводився з використанням пакета SPSS Statistics 26. **Результати.** Найчастіше ЧШНЛ виконували у віковій групі 51–60 років (38,5 % пацієнтів). Найпоширенішим типом каменю був оди-

ночний (48,4 %) із середнім розміром $3,570 \pm 1,159$ см. Середня тривалість процедури становила $38,630 \pm 21,667$ хв, одноразову пункцію застосовували в 68,1 % випадків. Рівень відчутного болю загалом був низьким, із середньою оцінкою 2 бали за 10-бальною шкалою. Середня тривалість перебування в лікарні становила $2,330 \pm 1,012$ дня. Результати ЧШНЛ у пацієнтів із сечокам'яною хворобою були сприятливими, з високим показником повного видалення каменів (92,3 %) і мінімальними ускладненнями. Післяопераційні ускладнення зустрічались нечасто. **Висновки.** Вважається, що ЧШНЛ є ефективною та безпечною процедурою при видаленні каменів у нирках.

Ключові слова: черезшкірна нефролітомія; нирковий камінь; вторинна лікарня; показник повного видалення каменів