Original Article
DOI: https://doi.org/10.70749/ijbr.v3i4.1023

INDUS JOURNAL OF BIOSCIENCE RESEARCH
https://induspublishers.com/IJBR
ISSN: 2960-2793/ 2960-2807

Comparison of Percutaneous Cystolithotomy and Vesicolithotomy in Large Vesical Stones

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ARTICLE INFO

Keywords
Hospital Stay, Minimally Invasive Surgery, Operative Time, Open Vesicolithotomy, Percutaneous Cystolithotomy, Vesical Stones

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Declaration
Authors' Contribution: All authors equally contributed to the study and approved the final manuscript.
Conflict of Interest: No conflict of interest.
Funding: No funding received by the authors.

Article History
Received: 20-01-2025 Revised: 12-03-2025
Accepted: 25-03-2025 Published: 23-04-2025

ABSTRACT

Objectives: comparison of percutaneous cystolithotomy and vesicolithotomy in large vesical stones. **Study Settings:** This randomized controlled trial was conducted at the Department of Urology, DHQ Hospital Faisalabad. **Duration of Study:** The study was conducted over a period of six months following ethical approval. **Data Collection:** A total of 60 patients, aged 18–60 years, with large vesical stones (2–4 cm in diameter) were randomly assigned to two groups: Group A (OV) and Group B (PCCL). For PCCL, the urinary bladder was filled using an 8Fr feeding tube, and a suprapubic puncture was performed with an 18-gauge spinal needle. A guide wire was inserted, followed by serial dilatation and the placement of a 28Fr amplatz sheath. A nephroscope was used to locate and remove the stone with a triple-jaw stone grasper. Population data, operative time, and hospital stay were recorded. **Results**: The mean operative time was significantly shorter in the B group (38.20 ± 9.94 minutes) compared to the A group (71.16 ± 13.13 minutes, p = 0.000). Similarly, hospital stay was significantly reduced in the B group (1.47 ± 0.56 days) compared to the A group (2.51 ± 0.67 days, p = 0.000). **Conclusion:** PCCL is an effective and minimally invasive alternative to OV for managing large vesical stones, offering less hospital duration and operative time. These findings support the integration of PCCL into routine clinical practice.

INTRODUCTION

Large vesical stones present a formidable clinical dilemma,[1] necessitating a processed and evidence based strategic approach to stone management.[2] In this context, the surgical modalities of percutaneous cystolithotomy (PCCL) and vesicolithotomy have attracted interest for their potential to address the intricate challenges posed by recurrent stones in the urinary bladder.[3-5] Both procedures exhibit procedural nuances, unique characteristics, and outcomes, thus prompting the need for an thorough comparison to make clear their relative merits in terms of efficacy.

Percutaneous cystolithotomy involves accessing the bladder through a minimally invasive percutaneous route, assisting in removal of stones through a specialized nephroscope. On the other hand, vesicolithotomy entails a direct surgical incision into the bladder, providing direct access for stone extraction.[6] The preference between either these strategies is diverse, involving considerations of stone size, patient comorbidities, and the surgeon's expertise.[7] As medical professionals strive to optimize therapeutic approaches for large vesical stones, a thorough investigation into the efficacy profiles of PCCL and vesicolithotomy is pivotal. The management of recurrent large vesical stones poses a significant clinical challenge, necessitating interventions that not only ensure optimal stone clearance but also prioritize patient safety and efficacy. Among the various surgical approaches, percutaneous cystolithotomy (PCCL) and vesicolithotomy have emerged as feasible choices, each with its unique set of advantages and considerations.[8]

As researchers seek to evaluate the treatment paradigm for patients with large vesical stones, a critical evaluation of these interventions becomes indispensable.[9] Ultimately, the primary objective is to contribute to the refinement of clinical practices, enhancing clinical efficacy and fostering a more personalized and targeted approach to the management of recurrent large vesical stones.[10]

A previous study while dealing with vesical stones evaluated OV and PCCL for vesical stones in pediatrics

population. Their findings illustrate mean hospital stay: 2.6 ± 0.65 days (Group-A) vs. 1.3 ± 0.52 days (Group-B); mean analgesia requirement was recorded as: 30.2 ± 5.38mg (Group-A) vs. 14.8 ± 9.65mg (Group-B), further, mean duration of surgery was 70.5 ± 13.24 minutes in group A and 40.6 ± 8.86minutes in group B respectively. Their findings concluded PCCL as an excellent effective modality more suitable and fewer complications.[8]

The aim of this study is to compare percutaneous cystolithotomy and vesicolithotomy procedures in the treatment of recurrent large vesical stones as the data in local literature in scarce. The technique with better outcome will be recommended in future to reduce postop morbidity.

METHODOLOGY

This randomized controlled trial was conducted at the Department of Urology, DHQ Hospital Faisalabad, over six months following the approval of the study synopsis. The sample size was calculated using the Open Epi sample size calculator for two means, with a level of significance of 5% and a power of 80%. Based on anticipated means of 2.6 ± 0.655 for Group A and 1.3 ± 0.525 for Group B, a total of 60 patients (30 per group) were included in this research work study. Patients were selected using a non-probability consecutive sampling technique.

Patients aged 18 to 60 years of both genders with large vesical stones measuring 2 to 4 cm in diameter were included. Patients with comorbid conditions such as hypertension and diabetes mellitus, as well as pregnant individuals, were excluded. After obtaining approval from the Institutional Ethical Review Committee and CPSP, informed consent was obtained from each participant before inclusion. Patients meeting the inclusion criteria were recruited from the urology outpatient department and randomized into two groups through random allocation.

Group A underwent conventional open vesicolithotomy, while Group B underwent percutaneous cystolithotomy. For PCCL, the urinary bladder was filled using an 8Fr feeding tube, and a suprapubic puncture was performed with an 18-gauge spinal needle. A guide wire was inserted, followed by serial dilatation and the placement of a 28Fr amplatz sheath. A nephroscope was used to locate and remove the stone with a triple-jaw stone grasper. After the procedure, Group A patients had a Foley catheter inserted for three days and a Nelaton drain placed for 24 hours, while Group B patients had only a suprapubic cystostomy tube. Analgesia was provided with intravenous ketorolac (10 mg). In Group A, the Foley catheter was removed after three days, and the drain was removed after 48 hours as required. In Group B, the suprapubic cystostomy tube was removed after 24 hours once normal micturition was confirmed. The process of data analysis performed through spss-26. We compared the outcome variables i.e. operative duration and stay at hospital between the two groups by applying significance test.

RESULTS

Table 1 presents the demographic and clinical information for 60 patients with large vesical stones, divided equally between Group A (vesicolithotomy) and Group B (percutaneous cystolithotomy). The table is stratified by age, with two age groups: 18–40 years and >40–60 years. In Group A, 23 patients (76.7%) were in the 18–40 years category and 7 patients (23.3%) were in the >40–60 years range, while Group B had 24 (80.0%) and 6 (20.0%) patients in these respective groups. The overall distribution shows 47 patients (78.3%) aged 18–40 years and 13 patients (21.7%) aged >40–60 years, with a p-value of 0.754, indicating no significant difference between the groups based on age distribution. The table also details gender distribution, where Group A comprised 17 males (56.7%) and 13 females (43.3%), compared to Group B with 22 males (73.3%) and 8 females (26.7%), with an overall distribution of 39 males (65.0%) and 21 females (35.0%), and a p-value of 0.176. Additionally, the mean weight is similar between the groups (74.67 ± 14.73 kg in Group A and 76.97 ± 17.07 kg in Group B; p = 0.579), and the mean stone size is comparable (3.08 ± 0.52 cm for Group A vs. 3.24 ± 0.56 cm for Group B; p = 0.238).

Table 2 compares the procedural outcomes between the two surgical interventions for large vesical stones. The outcomes evaluated include operative time and hospital stay. Group A (vesicolithotomy) exhibited a significantly longer operative time with a mean of 71.16 ± 13.13 minutes, while Group B (percutaneous cystolithotomy) had a mean operative time of 38.20 ± 9.94 minutes, resulting in a mean difference of 32.96 minutes (p = 0.0). Furthermore, the hospital stay was notably longer in Group A, with patients staying an average of 2.51 ± 0.67 days compared to 1.47 ± 0.56 days in Group B, (p = 0.0), showing percutaneous cystolithotomy is associated with significantly reduced operative time and shorter hospital stays compared to vesicolithotomy.

Table 3 demonstrates the comparison of both groups according to various effect modifiers, to evaluate their significance on hospital stay and operative time.

Regarding age of the participants, 18–40 years age group in Group A had a mean operative time of 71.61 ± 14.62 minutes, whereas those in Group B had a significantly shorter operative time of 38.41 ± 10.49 minutes (p = 0.000). Similarly, hospital stay was longer in Group A (2.45 ± 0.68 days) compared to Group B (1.53 ± 0.58 days, p = 0.000). In the 41–60 years age group, operative time remained significantly longer in Group A (69.67 ± 6.77 minutes) compared to Group B (37.33 ± 8.11

minutes, p = 0.000). Correspondingly, hospital stay was longer for Group A patients in this age group (2.71 ± 0.67 days) than for Group B (1.23 ± 0.42 days, p = 0.001).

Gender-based stratification shows that male patients undergoing vesicolithotomy had an operative time of 74.22 ± 14.53 minutes, while those undergoing PCCL had a mean of 37.51 ± 9.19 minutes (p = 0.000). Hospital stay for males was significantly shorter in Group B (1.41 ± 0.51 days) than in Group A (2.49 ± 0.72 days, p = 0.000). Among female patients, operative time was 67.16 ± 10.22 minutes in Group A and 40.09 ± 12.29 minutes in Group B (p = 0.000). Hospital stay also showed a significant reduction in Group B (1.63 ± 0.69 days) compared to Group A (2.54 ± 0.63 days, p = 0.006).

Weight-based stratification indicates that patients weighing 50–70 kg in Group A had an operative time of 69.22 ± 14.05 minutes, compared to 39.02 ± 6.97 minutes in Group B (p = 0.000). Hospital stay was also significantly shorter in Group B (1.44 ± 0.55 days) compared to Group A (2.68 ± 0.77 days, p = 0.001). Similarly, in the >70–100 kg category, operative time was 72.13 ± 12.91 minutes for Group A and 37.79 ± 11.29 minutes for Group B (p = 0.000). Hospital stay was again significantly lower for PCCL patients (1.49 ± 0.58 days) than for vesicolithotomy patients (2.43 ± 0.62 days, p = 0.000).

Stratification based on stone size shows that for stones measuring 2.20 to 3.0 cm, the mean operative time in Group A was 72.86 ± 14.89 minutes, significantly longer than 35.85 ± 8.73 minutes in Group B (p = 0.000). Hospital stay followed a similar trend, being longer in Group A (2.60 ± 0.68 days) than in Group B (1.59 ± 0.73 days, p = 0.001). For stones sized >3.0 to 4.0 cm, operative time in Group A was 69.46 ± 11.36 minutes, compared to 39.76 ± 10.63 minutes in Group B (p = 0.000). Hospital stay was also longer in Group A (2.43 ± 0.68 days) versus Group B (1.39 ± 0.42 days, p = 0.000).

Table 1

Demographic and Clinical Information of Cases with Large Vesical Stones (n=60)

Variable		Group A (Count or Mean ± SD) (n=30)	Group B (Count or Mean ± SD) (n=30)	Total (Count or Mean ± SD)	p-value
Age (years)	18-40	23 (76.7%)	24 (80.0%)	47 (78.3%)	0.754
	>40-60	7 (23.3%)	6 (20.0%)	13 (21.7%)	0.754
	Mean age	40.77 ± 12.00	34.90 ± 2.92	-	0.074
Gender	Male	17 (56.7%)	22 (73.3%)	39 (65.0%)	0.176
	Female	13 (43.3%)	8 (26.7%)	21 (35.0%)	0.176
Weight (kg)	Mean+sd	74.67 ± 14.73	76.97 ± 7.07	-	0.579
Stone Size (cm)	Mean+sd	3.08 ± 0.52	3.24 ± 0.56	-	0.238

Figure 1

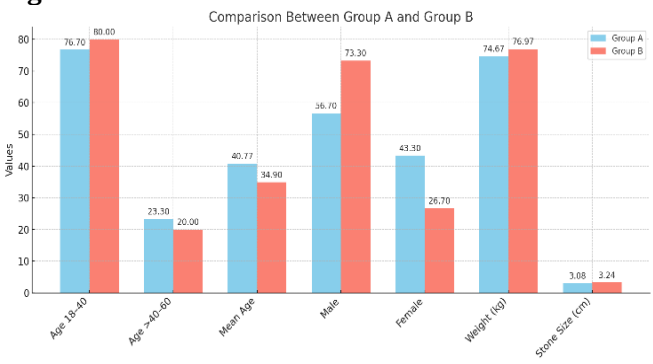

Table 2

Comparison of Percutaneous Cystolithotomy and Vesicolithotomy in Large Vesical Stones (n=60)

Variable	Group A (Mean ± SD) (n=30)	Group B (Mean ± SD) (n=30)	Mean Difference	p-value
Operative Time (minutes)	71.16 ±13.13	38.20 ± 9.94	32.96	0.0
Hospital Stay (days)	2.51 ± 0.67	1.47 ± 0.56	1.04	0.0

Table 3

Comparison of Percutaneous Cystolithotomy and Vesicolithotomy in Large Vesical Stones according to Various Effect Modifiers (n=60)

Effect modifiers		Outcome variable	Study Group	N	Mean	Std. Deviation	P value
Age	18-40	Operative Time (minutes)	Group A	23	71.61	14.62	0.000
			Group B	24	38.41	10.49	
		Hospital Stay (days)	Group A	23	2.45	0.68	0.000
			Group B	24	1.53	0.58	
	41-60	Operative Time (minutes)	Group A	7	69.67	6.77	0.000
			Group B	6	37.33	8.11	
		Hospital Stay (days)	Group A	7	2.71	0.67	0.001
			Group B	6	1.23	0.42	
Gender	Male	Operative Time (minutes)	Group A	17	74.22	14.53	0.000
			Group B	22	37.51	9.19	
		Hospital Stay (days)	Group A	17	2.49	0.72	0.000
			Group B	22	1.41	0.51	
	Female	Operative Time (minutes)	Group A	13	67.16	10.22	0.000
			Group B	8	40.09	12.29	
		Hospital Stay (days)	Group A	13	2.54	0.63	0.006
			Group B	8	1.63	0.69	

Weight (kgs)	50-70	Operative Time (minutes)	Group A	10	69.22	14.05	0.000
			Group B	10	39.02	6.97	
		Hospital Stay (days)	Group A	10	2.68	0.77	0.001
			Group B	10	1.44	0.55	
	>70-100	Operative Time (minutes)	Group A	20	72.13	12.91	0.000
			Group B	20	37.79	11.29	
		Hospital Stay (days)	Group A	20	2.43	0.62	0.000
			Group B	20	1.49	0.58	
Stone size(cm)	2.20 to 3.0	Operative Time (minutes)	Group A	15	72.86	14.89	0.000
			Group B	12	35.85	8.73	
		Hospital Stay (days)	Group A	15	2.60	0.68	0.001
			Group B	12	1.59	0.730	
	>3.0 to 4.0	Operative Time (minutes)	Group A	15	69.46	11.36	0.000
			Group B	18	39.76	10.63	
		Hospital Stay (days)	Group A	15	2.43	0.68	0.000
			Group B	18	1.39	0.42	

DISCUSSION

The present study compared the clinical outcomes of percutaneous cystolithotomy (PCCL) and open vesicolithotomy (OV) in the management of large vesical stones. Our results demonstrated that PCCL is associated with significantly shorter operative time and hospital stay compared to OV, highlighting its advantages as a minimally invasive approach. These findings align with previous literature investigating various minimally invasive techniques for vesical stone management.

Our study included 60 patients, equally divided into Group A (OV) and Group B (PCCL). The majority of patients (78.3%) were in the 18–40 years age group, with no significant difference in age distribution between the two groups (p = 0.754). Males constituted 65.0% of the study population, and the gender distribution was comparable between groups (p = 0.176). The mean weight of patients was also similar (74.67 ± 14.73 kg in Group A vs. 76.97 ± 17.07 kg in Group B; p = 0.579), and the mean stone size did not significantly differ (3.08 ± 0.52 cm in Group A vs. 3.24 ± 0.56 cm in Group B; p = 0.238). These comparable baseline characteristics allow for a robust comparison of surgical outcomes between the two procedures.

A study by Mohammed S. Al-Marhoon et al[11] evaluating PCCL and open cystolithotomy in children reported similar demographic distributions, with a male predominance and comparable baseline clinical characteristics. Additionally, Ahmed A. Shahat et al[12] also reported a balanced demographic distribution in their randomized trial comparing transurethral and percutaneous cystolithotripsy. Similarly, Rafique Ahmed Sahito et al[13] found that percutaneous suprapubic cystolitholapaxy was an effective and minimally invasive alternative to open cystolithotomy in pediatric patients, supporting the generalizability of our findings.

The results of our study are evident that the mean operative time for PCCL was significantly shorter (38.20 ± 9.94 minutes) compared to OV (71.16 ± 13.13 minutes; p = 0.000). Our observation is aligned with Ahmed A. Shahat and colleagues[12] reporting PCCL had a shorter operative duration and fewer postoperative complications compared to transurethral cystolithotripsy. Consistently, Mohammed S. Al-Marhoon and others[11] are of the view that PCCL reduced operative time compared to OV in pediatrics. Additionally, İsmail Yağmur and others[14] compared mini-percutaneous cystolithotomy and transurethral cystolithotripsy in preschool-aged children and documented that both strategies are effective, but favoured percutaneous approaches regarding hospital stays and complications.

Hospital stay was also significantly reduced in the PCCL group (1.47 ± 0.56 days) compared to the OV group (2.51 ± 0.67 days; p = 0.000). Similar trends were observed in studies by Chloé Job et al[15] where hospitalization time was significantly shorter in animals undergoing PCCL than in those treated with open cystotomy. Likewise, Muhammad Shahid Bhatti et al[8] reported a reduced hospital stay with percutaneous cystolitholapaxy compared to open vesicolithotomy among pediatric patients. These findings suggest that PCCL may contribute to a quicker postoperative recovery, allowing earlier ambulation and discharge.

Stratified analysis by age, gender, weight, and stone size further confirmed the superiority of PCCL in reducing both operative time and hospital stay across various subgroups. Our results indicated that regardless of patient age or gender, PCCL was associated with shorter surgical times and faster recovery.

Our findings are reinforced by Tariq Ahmad et al[16] who found that minimally invasive cystolithalopexy resulted in reduced complications and a shorter hospital stay than percutaneous cystolithotripsy in pediatric population. Another trial by Ali Yıldız and co-workers[17] conducted a study comparing three different bladder stone treatment modalities and stressed that treatment decisions should be guided by stone size. Importantly, PCCL's effectiveness was not significantly altered by stone size or patient weight, matched with findings from study by Mohammed S. Al-Marhoon et al[11] who observed similar procedural success rates across diverse patients' characteristics.

Although PCCL demonstrated clear advantages in terms of operative time and hospital stay, the choice of surgical approach must be tailored to individual patient characteristics. Larger stones and patients with significant comorbidities may still benefit from an open approach due to its direct access and complete stone clearance. However, for patients without significant risk factors, PCCL presents a promising alternative that minimizes surgical morbidity and accelerates recovery.

A study by Tariq Ahmad et al[16] highlighted that percutaneous techniques, while effective, require technical expertise and access to specialized equipment. Similarly, Rafique Ahmed Sahito et al[13] emphasized that while percutaneous approaches offer significant advantages, open cystolithotomy remains the preferred option in settings where endoscopic resources are limited. Therefore, the availability of surgical resources and surgeon experience must be considered when recommending PCCL over OV.

One of the limitations of this study is the relatively small sample size, which may restrict the generalizability of the findings. Additionally, long-term follow-up was not conducted to assess recurrence rates or late complications. Future studies should explore long-term outcomes, including stone recurrence and patient-reported satisfaction, to provide a more comprehensive evaluation of these surgical techniques. Furthermore, comparative analyses of postoperative pain, urinary retention rates, and infection incidence would provide deeper insights into the safety profile of PCCL versus OV.

CONCLUSION

Our findings demonstrate that PCCL is an effective and less invasive alternative to OV for the management of large vesical stones. It offers shorter operative time and hospital stay, aligning with previous studies supporting the advantages of minimally invasive techniques. Further research is warranted to explore its applicability in broader patient populations and to evaluate long-term outcomes.

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