BANGLADESH JOURNAL OF
UROLOGY
Bangladesh J. Urol. 2022; 25(2): 71-75
www.banglajol.info/index.php/BJU
DOI: https://doi.org/10.3329/bju.v25i2.68580

Original Article

ISSN : 2304 - 8514 (Print)
ISSN : 2304 - 8522 (Online)

Superperc: Minimally-Invasive Percutaneous Nephrolithotomy Initial Experience

N I Bhuiyan[1], Md. Hasibul Islam[2], Md. Masud Rana[3], Md. Abdullah Al Mamun[4], M Ali Arafat[5]

Received: 01 - 01 - 2022
Accepted: 03 - 03 - 2023
Conflicts of interest: None

Abstract

Introduction: *For the management of renal stones, Percutaneous nephrolithotomy (PCNL) has undergone significant changes in the last few years in the quest for improving efficacy and reducing morbidity. Minimally-invasive modalities of PCNL, such as mini-PCNL, ultra-mini PCNL, and micro-PCNL, have evolved with advancements in optics and technology. However, with these newer advancements, the migration of small fragments produced with laser lithotripsy remains a concern, which may result in incomplete stone clearance. A new technique of PCNL is termed "Superperc" that utilizes suction to remove all the fragments and maintain a one-way flow.*

Methods: *This study involved 35 consecutive patients who underwent PCNL with the Superperc technique from March 2020 to December 2020. Surgery was performed using a pediatric ureteroscope used as a nephroscope and a specially designed sheath with a suction attachment. The Superperc uses a 10/12 F tract size, a specially designed Superperc sheath (Shah Sheath) with a suction mechanism, and a pediatric ureteroscope 4.5/6.*

Results: *The age range is 20-65 years, with 23 males and 12 females. Stone size was 1-3 cm, and operative time was 30-90 min. Upper calyceal punctures 7cases , 19 had middle, 6 lower calyceal and 3 had two punctures. DJ stent was placed in 7 patients, whereas 28 patients had a ureteric catheter for 24 hours. Only three patients required a nephrostomy tube. No blood transfusion. Postoperatively one patient had a mild fever, and one had transient hematuria. Complete stone clearance as per nephroscopy &fluoroscopy. The hospital stay was 24-72 h.*

Conclusion: *Superperc is a new technique of minimally-invasive PCNL and can be successfully done with minimal modification in the armamentarium, with the potential advantage of good stone clearance.*

Keywords: Percutaneous Nephrolithotomy, Ultra Mini PCNL, Shock wave lithotripsy, Flexible uretero renoscopy, Retrograde Intra renal surgery.

Introduction:

Worldwide incidence of urolithiasis is increasing. Multiple minimal invasive procedures like shock wave lithotripsy (SWL), flexible ureterorenoscopy (f-URS), and percutaneous nephrolithotomy (PCNL) are used. Management of renal stone is complete stone clearance in one sitting, which is only sometimes achieved despite the advancements in optics, technology, and lasers. In the newer minimally-invasive modalities of PCNL such as mini-PCNL,[4] ultra-mini PCNL (UMP),[5]

1. Associate Professor & Head, Department of Urology, BMCH, Dhaka
2. Assistant Professor, Department of Urology, NEMC, Sylhet
3. Assistant Professor, Department of Urology, BMCH, Dhaka
4. Assistant Professor, Department of Urology, JIMC, Bajitpur, Kishoregonj
5. Consultant, Department of Urology, BMCH, Dhaka

Correspondence : Dr. N I Bhuiyan, Associate Professor & Head, Department of Urology, BMCH, Email : drnib@yahoo.com, drnibbd@gmail.com

and micro-PCNL, the tract size has decreased considerably[6]. Still, concerns remain about small fragments produced with laser lithotripsy migrating to other parts of the pelvicalyceal system. Keeping this in mind, a new technique of PCNL termed "Superperc," utilizing suction to remove all the fragments and maintain low intrapelvic pressure, and keep one-way flow has been introduced. This method utilizes a specially designed sheath with a suction attachment. Except for this sheath, this technique does not require any special equipment and is performed using a pediatric ureteroscope (4.5/6.0 F, Richard Wolf, Germany) as the nephroscope. Here, we describe the technique in detail and assess its feasibility as a new entrant in the present armamentarium for minimally-invasive PCNL.

Methods:

Prospective observational study involving 35 consecutive patients who underwent PCNL with the Superperc technique from March 2020 to December 2020. The inclusion criteria were unilateral renal stones in adults (age >18) with no bleeding diathesis. Any patient with a urinary tract infection was treated before the procedure with intravenous antibiotics till the urine culture was sterile. Preoperative investigations included blood counts, renal function tests, electrolytes, bleeding parameters, and urine culture. The stone burden was evaluated using a multi-slice helical computed tomography (CT) scan. All patients provided written, informed consent before the procedure. Demography, operative parameters, and outcomes were analyzed in the study. All patients had postoperative plain X-ray before discharge from the hospital and follow-up ultrasound examination/ NCCT at a follow-up visit at 1 month.

The surgical technique of one-way fluid flow and utilizing suction to remove small fragments produced during laser fragmentation is the principle of Superperc. Superperc uses a 10/12 F, specially designed sheath (Shah sheath) with a suction mechanism and a pediatric ureteroscope (4.5/6 Fr, Richard Wolf) as a nephroscope.

The Shah sheath has three components, the cannula, the suction master, and the obturator [Figure 1]. The cannula has an inner diameter of 10 *F* and an outer diameter of 12 F. It is available in different lengths ranging from 8 to 20 cm. The suction master has a large outlet to which the suction cannula is attached [Figure 2]. There is a provision to control the suction in the system. The main port has a silicon valve mechanism to make it water and airtight, through which the telescope enters, without changing the negative pressure inside the suction master. A 10 F obturator cum dilator is used to place the sheath assembly after an initial puncture is obtained.

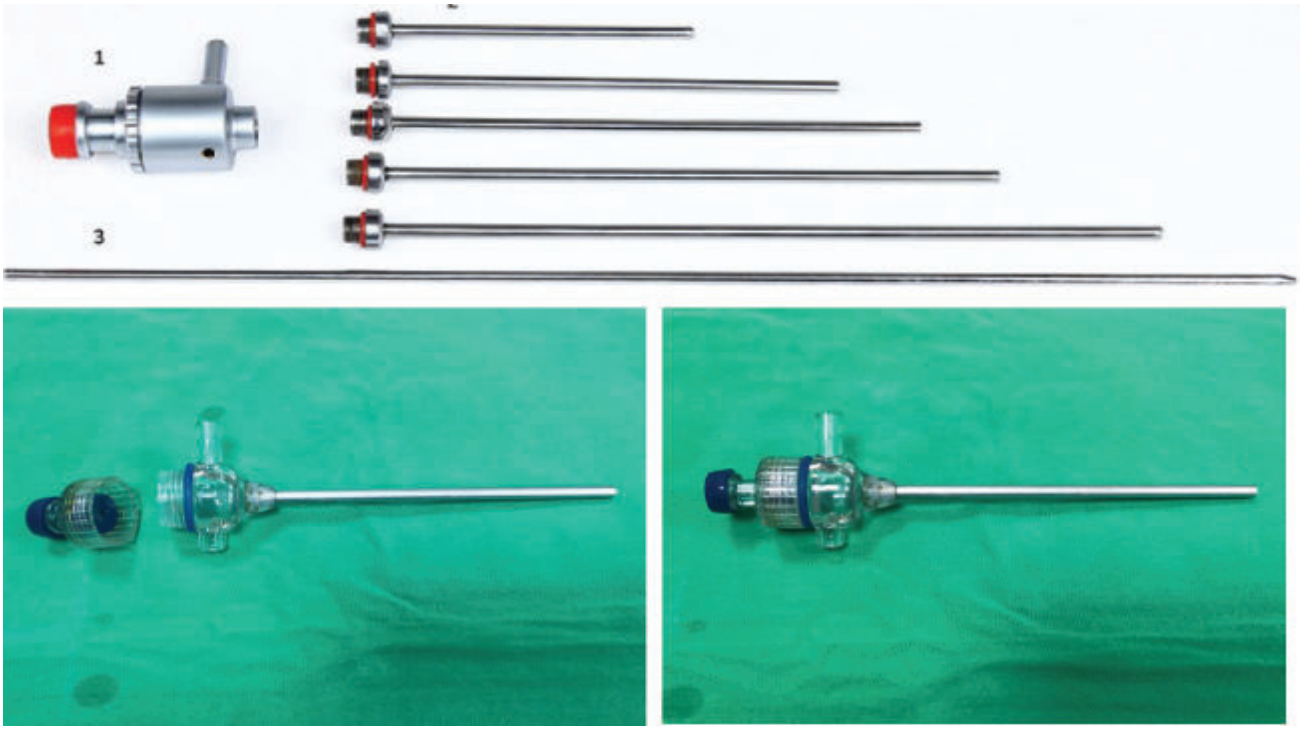

Figure 1: *Shah Sheath with different length cannulas*

Figure 2: *Shah Sheath with suction attached*

The procedure was performed under general anesthesia. Initially, the patient was placed in a lithotomy position, and a 6 Fr ureteric catheter with multiple side holes in the terminal 10 cm was positioned in the pelvicalyceal system under cystoscopic and fluoroscopic guidance. The distal end of the ureteric catheter was connected to a normal saline solution for a continuous inflow of saline. A 14/16 Fr Foley catheter was placed for bladder drainage, and the patient was turned prone.

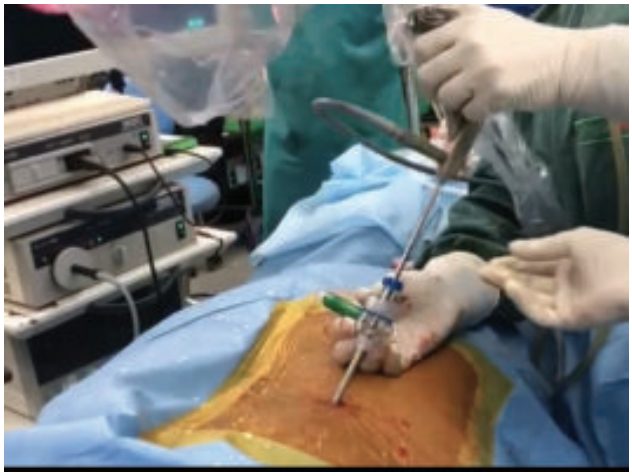

Figure 3: *Whole assembly of Superperc with nephroscope inserted into the sheath*

The initial puncture was obtained using fluoroscopic guidance by a standard bull's eye technique over the desired calyx, and a guidewire was introduced. Tract dilation was done with a single-step screw dilator, and the corresponding Shah Sheath was introduced into the desired calyx. The suction master was then attached to the cannula, and the telescope was introduced [Figure 3]. The stone was fragmented completely with a holmium laser with a 365-micron end-firing laser fiber at power settings ranging between 12 and 50 W (0.8–1.5 Joules, 15–40 Hz). The fragments were aspirated out through the suction master as the flow in the PCS was from the ureteric catheter towards the sheath, thereby pushing all fragments toward the sheath. Once the stone was cleared, the clearance was confirmed with direct nephroscopy and fluoroscopy. A DJ stent was placed, or the ureteric catheter was left overnight for drainage. A nephrostomy tube was not routinely placed.

Results:

The age range is 20-65 years, with 23 males and 12 females. Stone size was 1- 3 cm, and operative time was 30-90 min. Upper calyceal punctures 7 cases , 19 had middle, 6 lower calyceal and 3 had two punctures. DJ stent was placed in 7 patients, whereas 28 patients had a ureteric catheter for 24 hours. Only three patients required a nephrostomy tube. No blood transfusion. Postoperatively one patient had a mild fever, and one had transient hematuria. Complete stone clearance as per nephroscopy & fluoroscopy. The hospital stay was 24-72 h.

Discussion:

Different techniques exist for managing 1-2 cm stones. The best approach for 1-2 cm renal stones is still under debate. The European Association of Urology guidelines recommend different treatment strategies for renal calculi in different sizes and locations.[3] While endourological procedures such as PCNL and retrograde intrarenal surgery (RIRS) are accepted as the first-line treatment modality for stones larger than 2 cm in diameter, SWL is preferred for smaller renal stones. The objectives of high stone clearance, minimal invasiveness, short treatment time, and reduced costs are of great interest in determining the treatment strategy, especially in populations with limited resources.

Regarding stone clear, PCNL is better than SWL and is unaffected by anatomical factors. Albala *et al*. compared outcomes of PNL and SWL in lower calyx

stones. The stone-free rate was reported to be 90% and 59%, respectively.[7] Similarly, in another randomized study by Lingeman *et al*. comparing SWL and PNL for renal calculi ≤3 cm, success rates of PNL for lower calyx stones were significantly higher than with SWL.[8]

With new generation flexible ureteroscopes, RIRS has recently emerged as a preferred management option for low-volume renal stones. The success of f-URS significantly decreases in unfavorable anatomical factors such as a long, lower calyx infundibulum and acute infundibulopelvic angle (<30°).[9] The success of f-URS is reported to be higher than for SWL but lower than for PCNL.[10,11] Regardless of the high stone-free rate, PNL has a statistically higher complication rate than RIRS and SWL for medium-sized renal stones (13.19%, 5.26%, and 3.16%, respectively; $P < 0.05$).[11]

A study comparing UMP with f-URS found no significant differences in operating times (UMP vs. f-URS: 121/102 min), hospital length of stay (2.3/2.0 days), SFR (84/87%), and complications (7/7%). However, the costs for disposable materials and endoscopes were less with UMP than with furs.[12]

Mini PCNL (MIP),[4] UMP[5], and micro PCNL[6] have come up with the advent of newer technology in optics and lasers. These have achieved reasonable success rates with lower complication rates than conventional PCNL owing to the size of the tract. Mini-PCNL performed through 20 Fr tract was introduced by Jackman *et al*.[13] and Helal *et al*.[14] especially for pediatric cases. In Mini-PCNL, the stone fragments are washed out by the turbulence of irrigation fluid, the so-called "eddy-current" effect, and the intra-pelvic pressure is expected to remain low due to the open-ended Amplatz sheath. However, Superperc offers the same benefits by assisting in the removal of stone fragments by suction during and after laser lithotripsy. In this study with Superperc, we achieved a stone-free rate of 96.15% and a complication rate of 5.7% only.

Stone-free rate of 86.6% was achieved in the study by Desai and Solanki on UMP[5] on 62 patients, which was comparable to our stone-free rate of 96.1%. The mean Hb drop in the UMP study was 1.4 g, more than the 0.3 g reported in our study. The mean hospital stay was comparable in both studies (1.2 days vs. 31.5 h). Our technique of Superperc is closest to the UMP technique in terms of puncture, dilatation, tract size, and fragmentation. However, the mode of removal of stone fragments in the form of suction in Superperc differs from the dependence on eddy currents in UMP. The suction technique gives a more efficient and complete stone clearance.

The micro perc technique developed by Desai *et al*.[6] utilizes an all-seeing needle for initial puncture and stone fragmentation with laser. The tract size is 4.8 Fr, and there is no tract dilatation. The advantages offered are a negligible chance of blood loss. However, limitations include the possibility of a rise in intra-pelvic pressure as there is no outflow tract except for a ureteric catheter and the likelihood of stone fragments settling down in the PCS. In a study reporting outcomes of micro perc for lower calyceal stones of mean size 17.8 mm,[15] the stone-free rate achieved was 85.7%, whereas the complication rate was 9.5%. The limitations observed in the study were the inability to remove fragments, the risk of increased intrarenal pressure, low optic resolution, and a fine-needle shaft that hinders excessive torque.

The new technique, "Superperc," is considered a superior version of PCNL as it consists of a relatively closed system with an added suction mechanism. The suction mechanism is outside the telescope, thereby allowing the use of the working channel continuously for laser fragmentation. The advantage of the multi-hole ureteric catheter with continuous inflow is that there is no reduced flow and no compromise in visibility whenever the working channel is occupied. In a conventional PCNL, the irrigation fluid goes in via the working channel, which can get compromised while using a grasper or laser fiber, whereas there is no such limitation in "Superperc."

This study has some limitations -the study includes a relatively small sample size and a single case series without any comparison group. We need to compare Superperc with other minimally invasive techniques such as micro perc and UMP on the one hand and with flexible ureteroscopy on the other hand in prospective randomized studies to draw a proper conclusion regarding the right place of this new technique in the vast armamentarium available now for the treatment of small and medium-sized renal stones.

Conclusion:

Minimally-Invasive PCNL Superperc is a new technique that can be successfully performed with minimal modification in the armamentarium, with the potential advantage of good stone clearance. The initial results are promising, but it requires further comparison in a prospective controlled manner to understand its proper place.

References

1. Romero V, Akpinar H, Assimos DG. Kidney stones: A global picture of prevalence, incidence, and associated risk factors. *Rev Urol.* 2010;12:e86–96. [PMC free article] [PubMed] [Google Scholar]
2. Clark JY, Thompson IM, Rosenberg SA. The economic impact of urolithiasis in the United States. *J Urol.* 1995;154:2020–4. [PubMed] [Google Scholar]
3. Türk C, Knoll T, Petrik A, Sarica K, Skolarikos A, Straub M, et al. *Guidelines on Urolithiasis.* Uroweb; 2013. [Last cited on 2016 Jan 10; Last accessed on 2016 Jan 10]. Available from: http://www.uroweb.org/gls/pdf/21_Urolithiasis_LR.pdf. [Google Scholar]
4. Abdelhafez MF, Bedke J, Amend B, ElGanainy E, Aboulella H, Elakkad M, et al. Minimally invasive percutaneous nephrolitholapaxy (PCNL) is an effective and safe procedure for large renal stones. *BJU Int.* 2012;110(11 Pt C):E1022–6. [PubMed] [Google Scholar]
5. Desai J, Solanki R. Ultra-mini percutaneous nephrolithotomy (UMP): One more armamentarium. *BJU Int.* 2013;112:1046–9. [PubMed] [Google Scholar]
6. Desai MR, Sharma R, Mishra S, Sabnis RB, Stief C, Bader M. Single-step percutaneous nephrolithotomy (microperc): The initial clinical report. *J Urol.* 2011;186:140–5. [PubMed] [Google Scholar]
7. Albala DM, Assimos DG, Clayman RV, Denstedt JD, Grasso M, Gutierrez-Aceves J, et al. The lower pole I: A prospective randomized trial of extracorporeal shock wave lithotripsy and percutaneous nephrolithotomy for lower pole nephrolithiasis-initial results. *J Urol.* 2001;166:2072–80. [PubMed] [Google Scholar]
8. Lingeman JE, Siegel YI, Steele B, Nyhuis AW, Woods JR. Management of lower pole nephrolithiasis: A critical analysis. *J Urol.* 1994;151:663–7. [PubMed] [Google Scholar]
9. Elbahnasy AM, Shalhav AL, Hoenig DM, Elashry OM, Smith DS, McDougall EM, et al. Lower caliceal stone clearance after shock wave lithotripsy or ureteroscopy: The impact of lower pole radiographic anatomy. *J Urol.* 1998;159:676–82. [PubMed] [Google Scholar]
10. Pearle MS, Lingeman JE, Leveillee R, Kuo R, Preminger GM, Nadler RB, et al. Prospective, randomized trial comparing shock wave lithotripsy and ureteroscopy for lower pole caliceal calculi 1 cm or less. *J Urol.* 2005;173:2005–9. [PubMed] [Google Scholar]
11. Ozturk U, Sener NC, Goktug HN, Nalbant I, Gucuk A, Imamoglu MA. Comparison of percutaneous nephrolithotomy, shock wave lithotripsy, and retrograde intrarenal surgery for lower pole renal calculi 10-20 mm. *Urol Int.* 2013;91:345–9. [PubMed] [Google Scholar]
12. Schoenthaler M, Wilhelm K, Hein S, Adams F, Schlager D, Wetterauer U, et al. Ultra-mini PCNL versus flexible ureteroscopy: A matched analysis of treatment costs (endoscopes and disposables) in patients with renal stones 10-20 mm. *World J Urol.* 2015;33:1601–5. [PubMed] [Google Scholar]
13. Jackman SV, Hedican SP, Peters CA, Docimo SG. Percutaneous nephrolithotomy in infants and preschool age children: Experience with a new technique. *Urology.* 1998;52:697–701. [PubMed] [Google Scholar]
14. Helal M, Black T, Lockhart J, Figueroa TE. The Hickman peel-away sheath: Alternative for pediatric percutaneous nephrolithotomy. *J Endourol.* 1997;11:171–2. [PubMed] [Google Scholar]
15. Tepeler A, Armagan A, Sancaktutar AA, Silay MS, Penbegul N, Akman T, et al. The role of micro perch in the treatment of symptomatic lower pole renal calculi. *J Endourol.* 2013;27:13–8. [PubMed] [Google Scholar]