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Comparison of Percutaneous Nephrolithotomy with Retrograde Intrarenal Surgery Techniques in treatment of renal lower calyceal stones

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Abstract

Background and objectives: The aim of this study is a random prospective comparison in the outcomes of patients treated with percutaneous nephrolithotomy and retrograde intrarenal surgery in management of renal stones regarding stone free rate, quality of life, complications, fluoroscopy use, analgesic requirements and duration of hospital stay.

Methods: This study was conducted in Hawler / Paky hospital Urology department between January 2019 and June 2019 in a prospective study. A total of 50 patients ages between 18-65 years with renal lower calyceal stone; single or multiple and size between 1-2 cm were randomized into two groups of 25 patients; patients treated with percutaneous nephrolithotomy (n; 25) and patients treated with retrograde intrarenal surgery techniques (n; 25).

Results: : There was no statistical significant difference between the 2 groups in regard to patients' pre-operative stone size, stone skin distance, complete blood count, creatinine values, analgesia requirement and stone-free rates. There were significantly higher values in regard to hospital stay, amount of radiation, percentage of hematocrit decrease due to bleeding and complication status in percutaneous nephrolithotomy compared to retrograde intrarenal surgery. Preoperative stone sizes for patients with percutaneous nephrolithotomy and retrograde intrarenal surgery was 15.7 ± 2.5 mm, 13.6 ± 2.2 mm, respectively, statistically there was no significant difference.

Conclusions: We deduced that both percutaneous nephrolithotomy and retrograde intrarenal surgery minimal invasive surgical techniques can be applied to treat renal lower calyceal stones. Both techniques do not differ in stone-free rate, but in case of complications, fluoroscopy use, bleeding and hospital stay were higher in percutaneous nephrolithotomy.

Key words: Percutaneous nephrolithotomy, Retrograde intrarenal surgery, Small renal calculi.

Introduction

Urinary system stone disease regarded as the third pathology affecting the system after urinary tract infections and prostatic pathologies. It has been affecting mankind since ancient times[1]. In a tomb in El Amrah in Egypt around 4800 BC a male skeleton was found with bladder stone, and bladder stone surgeries were performed by the Indians in 1500 BC has been reported by archaeological studies[1]. However, urinary tract stones studies on the structure and the reason for the formation of the stone has been done since second half of the 19th century, the exact reasons are still not clarified.Urinary system stone disease affects 1–5% of the industrial society[1]. The

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prevalence of stone disease throughout life varies between 1-20%[2]. In Some countries, this rate has been reported to be up to 37% in the last twenty years[3], while the risk of lifetime stone formation in adult white males is 20% and 5-10% in women. Patients with renal stones 25% have a positive family history and many patients have a hereditary diseases causeing stone formation. Familial renal tubular acidosis (RTA) and cystinuria are common genetic diseases, also Xanthinuria, 2,8- Dihydroxyadenine, Dent disease are Rare genetic disorders that affect the kidney and result in urolithiasis[4].Renal stone disease affected by geographical region and environmental risk factors. Higher renal stone prevalence is observed in high mountainous regions, deserts and tropical regions due to hot and dry climatic conditions[4]. Iraq is within endemic region for stone disease. Renal stone disease in our country, especially due to geographical variation is requiring more detailed epidemiological studies to elucidate pathogenic factors for this serious problem. Stone disease in regions with low socioeconomic and education levels has higher incidence.Stone disease is more common in the summer months. A seasonal difference, loss of fluid from the body due to hot weather and sunlight induced increase vitamin D production was blamed. In the literature one of the views on urinary tract stone disease is that increased heavy water consumption in patients accompanied by increased excretion of factors that attribute to stone formation.The treatment options for small renal calculi (<1.5 cm) include extracorporeal shock wave lithotripsy (ESWL), percutaneous nephrolithotomy PCNL, and retrograde intrarenal surgery techniques RIRS. However, the limitation of ESWL includes relatively lower stone clearance rates and the need for repeated sessions, especially in lower polar and harder stones. While RIRS is a standard treatment option for small renal calculi, but the actual cost of each procedure is about six times greater than for ESWL[1.] . Retrograde intrarenal surgery has a better safety profile, but its stone clearance rates are lower than that of PCNL Percutaneous nephrolithotomy has good stone clearance rates but is associated with a significant risk of morbidity. Since most of the morbidities associated with PCNL are related to the size of tract, a reduction in tract size can lower the number of complications associated with it. The aim of this study is comparison in the outcomes of patients treated with percutaneous nephrolithotomy and retrograd e intrarenal surgery in management of renal stones regarding stone free rate, quality of life, complications, fluoroscopy use, analgesic requirements and duration of hospital stay.

Materials and methods

This study was conducted in Hawler/ Paky hospital Urology department between January 2019 and June 2019 as a prospective study for patients with renal lower calyceal stone; single or multiple and size between 1-2 cm. Total of 50 patients ages between 18-65 years were randomized into two groups of 25 patients; patients treated with PCNL (n; 25) and patients treated with RIRS (n; 25).Preoperatively a detailed history done and complete physical examination is done and blood biochemistry, bleeding tests, full urine test and urine culture were taken. Patients with uncorrectable bleeding diathesis, advanced age (> 70 years), cognitive dysfunction, patient with disability, renal system anomaly, patients with history of renal surgery and pregnant or planning pregnancy were excluded from the study. Patients with

preoperative urinary infection received antibiotic therapy till urine culture become sterile then they were operated.Patients' characteristics, operation time, radiation time in operation, intraoperative or postoperative complications, blood test parameters before and after the procedure, blood transfusion (if present), post-operative bleeding related hematocrit value, stone-free condition after the procedure, need for additional intervention, quality of life, hospital stay duration, analgesic requirement before and after the procedure were recorded. Each patient had native Computerized tomography (CT), detailed information about size and location of the stone and renal anatomy. Patients postoperatively on the 1st day, 1st week, 1st month and 3rd month were evaluated with KUB x-ray and / or ultrasonography (USG) for stone status. If necessary, Computerized tomography (CT) performed for the patients. The data were entered into SPSS program for statistical analysis. Kolmogorov smirnov test was applied for variable numerical data and Chi-square test was used for conceptual (nominal) variables. Statistical p-value <0.05 was considered significant.

Results

In this prospectively designed study, randomized comparison of PCNL and RIRS techniques in lower calyx stones, a total of 50 patients were included in the study. In both groups 25 patients were included, the demographic findings and preoperative values of the patients were recorded. Operational and post-operative findings were also recorded and compared. Patient's demographic findings are shown in Table (1).In the PCNL group, a total of 25 patients 15 men and 10 women, group average age was 44 (± 14) years. Of 25 patients in the RIRS group, 13 were male and 12 were female, the average age of the group was 48 (± 13.9) years. Preoperative stone sizes for PCNL and RIRS patients, it was 15.7 ± 2.5 mm, 13.6 ± 2.2 mm, respectively. Preoperative stone sizes between groups statistically was of no significant difference (p = 0.09). In 44% of the patients in the PCNL group and 36% of patients of the RIRS group had a single stone in the kidney lower calyx, the other patients had multiple lower pole stones. Preoperative patient's biochemistry and hematocrit values revealed no statistically significant difference (creatinine p = 0.586, hematocrit p = 0.459), Table (1).

Table (1): Patient's demographic and preoperative characteristics.

Patients' characteristics	PCNL	RIRS	p-value
Patient number	25	25	
Age	44 +/- 14 year	48 +/- 13.9	0.4 (p>0.05)
Gender	Male; 60% (15) Female; 40% (10)	Male; 52% (13) Female; 48% (12)	0.569 (p>0.05)
Pre-op stone size(mm)	15.7 +/- 2.5	13.6 +/- 2.2	0.09 (p>0.05)
Skin-stone distance(mm)	95.6 +/- 24.1	97.4 +/- 15.2	0.294 (p>0.05)
Pre-op creatinine	0.9 +/- 0.3	0.9 +/- 0.4	0.586 (p>0.05)
Pre-op hematocrits	41 +/- 5.6	40 +/- 3.7	0.459 (p>0.05)
Pre-op analgesia	Yes; 44% (11)	Yes; 68% (17)	0.87 (p>0.05)

	No; 56% (14)	No; 32% (8)	
Pre-op pain (VAS)	4+/-0.4	4+/-0.4	0.549 (p>0.05)
Stone burden	Single;44%(11) Multiple;56%(14)	Single; 68%(9) Multiple; 64%(16)	0.564 (p>0.05)

According to the data obtained after the operations performed, the average time for PCNL was 71.7 (± 24.4) minutes and the average time for RIRS was 72.8 (± 24.2) minutes, statistically there was no significant difference in operation times between the groups (p = 0.696). Fluoroscopy average time used during PCNL was 18.9 (± 13.8) sec, and for SIRS was 2.7 (± 2.8) sec, this value is low in RIRS group and statistically was of no significant difference (p <0.05). Hemorrhage and hematocrit value although it was low. When the two groups compared; it was statistically higher in PCNL group (p <0.05). According blood transfusion in follow-up of patients, 2 patients in PCNL group had blood transfusion and non in RIRS groups, statistically no significant difference in terms of blood transfusion. (p = 0.490). While the average length of hospital stay is 4.6 (± 3.5) for PCNL, this value is 1.2 (± 0.59) for RIRS. This difference is significantly higher for PCNL (p <0.05). Double J stent placement in patients is depending on the requirement in the operation, DJ catheter was placed in 20 of 25 patients in RIRS group and compared to PCNL group, DJ catheter was placed in 4 of 25 patients who underwent PCNL. DJ placement was found to be significantly higher in RIRS group (p <0.05), Double J catheter left-in-place for an average 1 month. Stone-free conditions of the patients on the 1st day, 1st week, 1st month and 3rd month after the operation Compared; on the 1st day in PCNL stone-freeness was 64%, while it was 48% in RIRS (p = 0.254), at the 1st week for PCNL and RIRS was 68%, 64% respectively (p = 0.765), at 1st month and 3rd month stone-free status in PCNL was 68% and 72%, while in RIRS this rate was found to be 68%. When these rates are compared statistically, the two groups had no significant difference in stone-free rates. Patients' post-operative follow-up after the first day, the stone-free rate was observed that it increased in 3rd months in both groups. All the data of the patient's operation and subsequent stone-free status summarized showed in Table (2).

Table (2): Patients operation and subsequent stone-free status

	PCNL	**RIRS**	**p-value**
Operation length (min)	71.7 +/- 24.4	72.8+/- 24.2	0.696 (p>0.05)
Radiation length (sec)	18.9+/-13.8	2.7+/-2.8	(p>0.05)
Hospital stay (day)	4.6+/-3.5	1.2+/-0.59	(p>0.05)
Blood transfusion	Yes; 2 (8%) No; 23(92%)	Yes; 0 (0%) No; 25 (100 %)	0.490 (p>0.05)
Hematocrits %	4.8 +/- 3.8	1.6 +/- 2.6	0.000(p>0.05)
Post-op 1st day	16 (64%)	12(48%)	(p>0.05)
Post-op 1st week	17(68%)	16(64%)	(p>0.05)
Post-op 1st month	17(68%)	17(68%)	(p>0.05)
Post-op 3rd month	18(72%)	17(68%)	(p>0.05)
Post-op Double J stent duration	Yes; 4(16%) No; 21 (84%)	Yes; 20 (80%) No; 5(20 %)	0.000(p>0.05)

Discussion

Urinary system stone disease is a condition that persists from ancient times. Important steps were taken over the years with technological advances for surgical treatment of kidney stones[1].The aim of kidney stone treatment is to achieve the highest stone-free success with minimum morbidity. Provided with the advances in endourology, high success has been achieved.Hospitalization times are shortened, surgical complications and other morbidity conditions are also significantly decreased. For these purposes, now percutaneous nephrolithotomy (PNL) and retrograde intrarenal surgery (RIRS) replaced open surgery as minimally invasive[1].Percutaneous nephrolithotomy was first implemented in 1976[2]. This method provides a high stone-free rates for stone therapy, short hospital stay, patients allowing them to return to their daily lives quickly, low treatment costs and its advantages such as low undesirable side effects, today, PNL is a successful surgical treatment of stone disease. Overall success rates of PNL are between 76-91% in the literature[7-8]. The success of PNL often affected by; structure, size and location of the stone, previous surgical history, lithotripter type, and surgeon's experience[9], However, this method, although has high success rates, its complication rate varies between 20.5-29%[7]. This traumatic condition created on the kidney and the tools used to enter the kidney due to complications that develop, afterwards miniaturization was made.Developments in retrograde intrarenal surgical endoscope and lithotripter technologiesWas the result of its thinner diameter, better image quality, increased rotation and maneuverability more common with low-caliber flexible Ureterorenoscope and their introduction started to be used. Surgery of kidney stone with the advancing laser technology RİRS has started to take an important place in the treatment[10]. Almost in all anatomical localization of kidney stones can be easily accessible with RIRS without damaging the renal parenchyma. Therefore, today RIRS stands out at the forefront with low complication rates and minimal morbidity[11].Percutaneous nephrolithotomy is used effectively in the surgical treatment of lower calyx stones. 2001 In the study of Albala et al the stone-free rates of PCNL in calyx stones less than 1cm, 1-2cm and more than 2cm are 100%, 93% and 86%, respectively[8]. In many studies in the literature, for lower calyx high stone-free rate has been reported in PNL[13-14]. Retrograde intrarenal surgery is also a successful method used in the surgical treatment of lower calyx stones. It causes fewer complications than PNL, and as an alternative PNL in the treatment of lower calyx stones less than 2 cm it is a treatment method. In Grasso and Ficazzola study in 1999, lower calyx stones less than 1cm, 1-2cm and more than 2cm reported stone free rate at 82, 71% and 65% respectively[5]. Other literature studies have reported that stone-free rate for RIRS is gradually increasing[15-18].Our study revealed that the radiation time of the PNL, hospital stay duration and decrease in hematocrit percentage due to bleeding are higher in PCNL than RIRS. Looking at the stone-free rates; according to the data we obtained on the 1st day, 1st week, 1st month and 3rd month between the two groups; we did not find any significant difference, so we could not see higher stone-free success of PNL compared to RIRS in our study. However, 20 of 25 patient undergoing RIRS; double J stent induced lower urinary tract symptoms, as well as migration, fall or incrustation, also patient’s re-hospitalization for stent

removal may cause patients to be dissatisfied with RIRS.

Conclusions

Both PCNL and RIRS are used effectively as minimally invasive surgical treatment of kidney stone. Both surgical techniques have their own advantages and disadvantages. Stone free rate is considered the most controversial topics between these two methods for successful treatment of lower calyx stones. Retrograde intrarenal surgery techniques are more advantageous in regard to regarding complication, radiation time, bleeding, and hospital stay time compared to PCNL On the other hand, percutaneous nephrolithotomy has no significant difference in stone free rate compared to retrograde intrarenal surgery. However, choosing the suitable choice for the patient depend on the surgical technique, patient's choice, surgeon's experience, technical possibilities, complications.and consequence s of each method.

Conflict of interests

There were no conflicts of interest.

References

1. Alelign T. Petros B. Kidney Stone Disease: An Update on Current Concepts. Hindawi Adv Urol. 2018, Article ID 3068365. Available form: http://downloads.hindawi.com/journals/au/2018/3068365.pdf
2. Türk C, Petřík A, Sarica K et al. EAU Guidelines on Diagnosis and Conservative Management of Urolithiasis. Eur Urol. 2016;69(3):468-74.
3. Fernström I, Johansson B. Percutaneous pyelolithotomy. A new extraction technique. Scand J Urol Nephrol. 1976;10(3):257-9
4. Pearle M, Lotan Y. Urinary lithiasis: etiology, epidemiology, and pathogenesis. Campbell-walsh urology, 2015.
5. Grasso M1, Ficazzola M. Retrograde ureteropyeloscopy for lower pole caliceal calculi. J Urol. 1999;162(6):1904-8
6. Wewers ME, Lowe NK. A critical review of visual analogue scales in the measurement of clinical phenomena. Res Nurs Health. 1990;13(4):227-36
7. de la Rosette J, Assimos D, Desai M, et al. The Clinical Research Office of the Endourological Society Percutaneous Nephrolithotomy. Global Study: indications, complications, and outcomes in 5803 patients. J Endourol. 2011;25(1):11-7.
8. Albala D, Assimos D, Clayman R, et al. Lower pole I: a prospective randomized trial of extracorporeal shock wave lithotripsy and percutaneous nephrostolithotomy for lower pole nephrolithiasis—initial results. J Urol. 2001;166(6): 2072-80.
9. Goldwasser B, Weinerth J, Carson C, Dunnick N. Factors affecting the success rate of percutaneous nephrolithotripsy and the incidence of retained fragments. J Urol. 1986;136(2):358-60.
10. Johnson G, Portela D, Grasso M. Advanced ureteroscopy: wireless and sheathless. J Endourol. 2006; 20(8): 552-5.
11. Papatsoris A, Sarica K. Flexible ureterorenoscopic management of upper tract pathologies. Arch Urol Res. 2012; 40(6): 639-46.
12. Binbay, M., Erbin A., Muslumanoglu A. The Role of Percutaneous Nephrolithotomy and Retrograde Intrarenal Surgery in the Management of Kidney Lower Pole Stones. Turk Urol Sem. 2011; 2: 331-5

13. Lingeman, J., Siegel Y. and Steele B., Management of lower pole nephrolithiasis: a critical analysis. J Urol. 1994; 151(3): 663-7.
14. Resorlu, B., and Kara C. Effect of previous open renal surgery and failed extracorporeal shockwave lithotripsy on the performance and outcomes of percutaneous nephrolithotomy. J Endourology, 2010; 24(1): 13-6.
15. Galvin DJ., Pearle MS., The contemporary management of renal and ureteric calculi. BJU int, 2006; 98(6):1283-8
16. Mariani, A.J., Combined electrohydraulic and holmium: YAG laser ureteroscopic nephrolithotripsy of large (greater than 4 cm) renal calculi. J Urol. 2007; 177(1): 168-73
17. Kourambas, J., Delvecchioa F, Munver R, Premingera P. Nitinol stone retrieval-assisted ureteroscopic management of lower pole renal calculi. Urology. 2000, 56(6): 935-9
18. Bozkurt O, Resorlu B, Yildiz Y, Can C, Unsal A. Retrograde intrarenal surgery versus percutaneous nephrolithotomy in the management of lower-pole renal stones with a diameter of 15 to 20 mm. J Endourology. 2011, 25(7): 1131-5