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ORIGINAL ARTICLE

Comparison of variation of renal functions after ESWL and Pyelolithotomy for Kidney Stone

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ABSTRACT

Introduction: The effect of ESWL and pyelolithotomy shows that parameters as serum creatinine, renal plasma flow, GFR, and estimated GFR are disturbed for different duration. Moreover, the time required for assessment can be significant because the acute functional deterioration of kidney may resolve and it is hard to measure the chronic injury.

Objectives: To frequency of patients of renal stone that fall in the ESWL range and pyelolithotomy range and also to compare the percentage change in GFR in patients undergoing ESWL versus pyelolithotomy.

Materials & Methods: A total of 126 patients with diagnosed as having renal stone on USG KUB, 15 to 65 years of age were included. Patients having nephrolithotomy, post procedural ureteric obstruction and UTI were excluded. Patients falling in ESWL range and pyelolithotomy range were recorded. Patients were called for follow up 3 months after surgery. GFR was measured and percentage change was calculated.

Results: In this study, ESWL was done in 39 (30.95%) patients and pyelolithotomy in 87 (69.05%) patients. Mean baseline GFR in ESWL group was 32.49 ± 5.98 and in pyelolithotomy group was 31.17 ± 4.621. Mean GFR after 3 months in ESWL group was 45.13 ± 7.54 and in pyelolithotomy group was 44.25 ± 5.96. Mean percentage change in GFR in ESWL group was 36.82 ± 21.27 and in pyelolithotomy group was 44.05 ± 22.40 with p-value of 0.087.

Conclusion: This study concluded that frequency of patients of renal stone that fall in the pyelolithotomy range is higher as compared to ESWL range and also the percentage change in GFR in patients undergoing pyelolithotomy is higher as compared to ESWL.

Keywords: renal stone, pyelolithotomy, glomerular filtration rate.

INTRODUCTION

Urinary Calculi are the third most common affliction of the urinary tract, exceeded only by Urinary tract infections and pathologic conditions of the prostate.[1] Nephrolithiasis is a common problem with 10% prevalence in males and 5% in females.[2] The overall prevalence of kidney stone was constant to 5% in the US from 1998 to 2003, but the male to female ratio decreased from 1.7:1 to 1.3:1.[3] Among the stone forming belt of Afro-Asian, the prevalence of calculi in Pakistan ranges from 4-20%.[4] Kidney stones are a recurrent disorder, with lifetime recurrence as high as 50%.[5]

The hallmark of stone that obstruct the ureter or renal pelvis is renal colic, lumber pain arising from flanks and radiates to the loin or groin along with microscopic hematuria, nausea and vomiting. Another important finding is costovertebral angle tenderness.[6] Renal colic occurs due to acute obstruction and distention of the upper urinary tract.

The most common types of stones comprises of calcium stones mainly calcium oxalate or calcium phosphate.[7] Uric acid, magnesium ammonium phosphate (struvite), and other diverse constituents e.g. cysteine, form other types of stones. Different theories have been proposed because of unknown etiology of urinary stone formations. Supersaturation crystallization theory is one of the most acknowledged theories. [8] this theory states that when the solubility of a product is achieved the increased solutes concentration in urine lead to formation of solid phase nuclei. This nucleation can occur by ombination of same molecules or different forms of molecules. In heterogeneous nucleation the crystal formation is initiated while in homogeneous nucleation the high thermodynamic energy is required and takes place in pure solutions.[9]

Most of the patients pass the indicative kidney stones spontaneously. Patients in which stones do not pass undergo through different processes to remove the stones. Amon these processes the most common process is ESWL (extracorporeal shock wave lithotripsy) introduced in 1980, is non-operative disintegration and destruction of calculus in urinary system. ESWL can be used in most of the patients having 2cm renal calculi. Open surgical stone removal is performed in some patients with extremely complex stag horn stones, in which other invasive procedures failed and have other abnormalities in addition to kidney stones may require this process.

The effect of ESWL and pyelolithotomy shows that parameters as renal plasma flow, are serum creatinine, GFR, and estimated GFR disturbed for different duration. Moreover, the time required for assessment can be significant because the acute functional deterioration of kidney may resolve and it is hard to measure the chronic injury. While another group of authors have stated that renal function improves after pyelolithomy and deteriorate after ESWL. A reduction of 25% in renal plasma flow and glomerular filtration rate was noted after treatment with ESWL while after treatment with pyelolithotomy there was an increase of 58 and 68% in renal plasma flow and glomerular filtration rate respectively.[11] In a study procedures were performed for the purpose of stone fragmentation. Of these 986 procedures, 29.8% (294) were ESWL, 39.3% (387) were URS, 30.2% (298) were PNL, and 0.7% (7) were open surgery.[12]

Rationale of this study was to resolve this controversy and to compare the effect of renal surgery and ESWL on deterioration and improvement of renal function. The effect of these two modalities would be compared in relation to the stone size as the number of sessions of ESWL will depend on stone size and may affect the results. By this study we would be able to predict the effect on GFR postoperatively in these two modalities and thus select the best therapy for these patients.

MATERIALS AND METHODS

This case series study was conducted at the Department of Urology & Renal Transplantation, Bahawal Victoria Hospital/Quaid-e-Azam Medical College, Bahawalpur and Department of Urology, Shahida Islam Medical College, Lodhran, from June 2018 to May 2019. Permission was taken from institutional ethical review committee. Total number of 126 patients diagnosed as having renal stone on USG KUB and intravenous urography of age 15-65 years were selected. Patients with non-functioning kidney, nephrolithotomy, post Procedural Ureteric Obstruction and UTI were excluded.

On history, clinical examination and laboratory investigations, following parameters were recorded. Age, gender, stone size, site, side, preoperative GFR, number of ESWL sessions, postoperative fever, and ureteric patency on IVU. Patients falling in ESWL range and pyelolithotomy range were recorded (ESWL was performed for stone size of 2 or < 2 cm while pyelolithotomy was performed for stones > 2cm size). Model of the machine for ESWL is Storz Medical Modulith (SLX). Number of sessions for a patient was four or less than four. Number of shocks for a session was kept in range of 500 to 1000.Range of frequency was 1-1.5 Hz. Patients undergoing pyelolithotomy were operated under general anesthesia through retroperitoneal approach. Ureter was identified and free from adjacent tissue up to the renal pelvis. Incision was given in the renal pelvis over the stone and stone was removed. After that Renal pelvis and abdomen were closed in layers. Patients were called for follow up 3 months after surgery. GFR was measured and percentage change was calculated.

Data was collected and analyzed on SPSS 21 version. Quantitative variables like age were mean+/- standard deviation. Frequency and percentage were used for gender. Chi square test was used for comparison of both groups and p-value ≤0.05 was taken as significant.

RESULTS

Age range in this study was from 15 to 40 years with mean age of 35.59 ± 11.82 years. Majority of the patients 88 (69.84%) were between 15 to 40 years of age.

Out of the 126 patients, 70 (55.56%) were male and 56 (44.44%) were females with male to female ratio of 1.3:1.

In this study, ESWL was done in 39 (30.95%) patients and pyelolithotomy in 87 (69.05%) patients as shown in Figure I. Mean baseline GFR in ESWL group was 32.49 ± 5.98 and in pyelolithotomy group was 31.17 ± 4.621. Mean GFR after 3 months in ESWL group was 45.13 ± 7.54 and in pyelolithotomy group was 44.25 ± 5.96. Mean percentage change in GFR in ESWL group was 36.82 ± 21.27 and in pyelolithotomy group was 44.05 ± 22.40 with p-value of 0.087 (Table I).

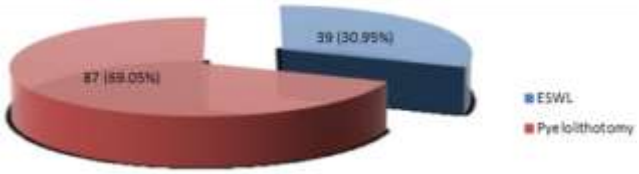

Figure I: Distribution of patients with respect to type of operation (n=126).

Table I: Percentage change in GFR in patients undergoing ESWL versus pyelolithotomy

GFR (ml/min/1.73 m(2))	ESWL (n=39)		Pyelolithotomy (n=87)		P-value
	Mean	SD	Mean	SD	
Baseline	32.49	5.98	31.17	4.62	0.228
After 3 months	45.13	7.54	44.25	5.96	0.524
Percentage change	36.82	21.27	44.05	22.40	0.087

DISCUSSION

Invasive therapies has been minimized due to development in the endoscopic management of nephrolithiasis as the new forms of endoscopies and stone fragmentation energies have been introduced. Despites of these developments, open surgical removal of stones is still an option as it is 2nd or 3rd line treatment in some cases. About 1 to 5.4% of cases are still treated by open surgical procedure in many urological centers around the world due to expertise of surgeons and availability of equipment. Though, the incidence of the open surgical procedure is 14% in developing countries.[13,14] I have conducted this study to find the frequency of patients of renal stone that fall in the ESWL range and pyelolithotomy range and also to compare the percentage change in GFR in patients undergoing ESWL versus pyelolithotomy.

Age range in my study was from 15 to 40 years with mean age of 35.59 ± 11.82 years. Majority of the patients 88 (69.84%) were between 15 to 40 years of age. Out of the 126 patients, 70 (55.56%) were male and 56 (44.44%) were females with male to female ratio of 1.3:1. In this study, ESWL was done in 39 (30.95%) patients and pyelolithotomy in 87 (69.05%) patients. Mean baseline GFR in ESWL group was 32.49 ± 5.98 and in pyelolithotomy group was 31.17 ± 4.621. Mean GFR after 3 months in ESWL group was 45.13 ± 7.54 and in pyelolithotomy group was 44.25 ± 5.96. Mean percentage change in GFR in ESWL group was 36.82 ± 21.27 and in pyelolithotomy group was 44.05 ± 22.40 with p-value of 0.087. A reduction of 25% in renal plasma flow and glomerular filtration rate was noted after treatment with ESWL while after treatment with pyelolithotomy there was an increase of 58 and 68% in renal plasma flow and glomerular filtration rate respectively.[11] In a study procedures were performed for the purpose of stone removal or fragmentation. Of these 986 procedures, 294 (29.8%) were extracorporeal shock wave lithotripsy, 387 (39.3%) were ureterorenoscopy, 298 (30.2%) were percutaneous nephrolithotomy, and 7 (0.7%) were open surgery.[12]

In humans, the cause of renal renal and perirenal hematomas is reported to be SWL. Almost 25% of hematomas found in the patients were reported to be subclinical according to CT scan and MRI reports, while 0.6 to 1.3% is symptomatic renal and perirenal hematomas.[15] Along with SWL age factor is another risk for formation of hematomas.[15] In a study, Krishnamurthi and Streem reported 21 hematoma cases induced by SWL in 19 patients in the time period of 19.6 months. There were no reports of increase in serum creatinine, worsening of hypertension in a patient or onset of new hypertension.[16] Although, cases of post-SWL hematomas were reported that lead to kidney failure,[17] blood transfusion,[18] and increased hospital stay. Such cases occur rarely but show the ability of SWL for renal destrucrion.

Different imaging techniques were used by the researchers to study the effects of SWL on kidney. Magnetic resonance imaging (MRI), intravenous pyelography (IVP), and quantitative radionuclide renography were used for structural and functional study of the kidney by Kaude and colleagues. The cases with kidney enlargement and ureter obstruction by fragments of stones were 18% and 37%, respectively according to excretory urograms. Almost 22% of patients with treatment of kidney were reported with total parenchymal obstruction and 25% of patients with partial parenchymal obstruction according to images by quantitative radionuclide renography. One or more abnormalities were reports in the 63% of patients who received treatment for kidneys including hemorrhage into a renal cyst, subcapsular hematoma, loss of perirenal fluid and corticomedullary differentiation, and/or miscellaneous abnormalities, according to images of MRI. On the basis of above-mentioned tests, abnormalities occurred in 74% of the patients after treatment. This was further confirmed by Dumont and his colleagues as they demonstrated that in 59% of the patients the dimercaptosuccinic acid (DMSA) uptake by SWL-treated was reduced within 48 hours. [19]

A 30% reduction in the treated kidney functions reported by Thomas and his colleagues as determined by the131I hippuran scanning, in 13 patients was when introduced to post-surgical classic ANL in 13.6 months. It was also noted that 13% contralateral kidney functions was increased and 8% of reduction in the total effective renal plasma flow during this time period.[20] Stubbs and associates calculated creatinine clearance and serum creatinine levels in patients with solitary kidneys exposed to classic ANL.

The serum creatinine level before surgery was 1.6 mg/dL and it remained the same even postoperatively where average follow up was up to 6 years. A slight increase in creatinine clearance was seen from 52cc/min to 55cc/min. in a past study by Demler et al. it was stated that creatinine levels in serum peaked on 2nd and 3rd day postoperatively followed by steady normalization[22]. Similarly Gough et al. demonstrated the effects of

classical ANL in 9 children in terms of renal function postoperatively. Out of the 9 children 7 had significant reduction in renal function (6 to 16%) as seen via DMSA scintigraphy performed 4 months after procedure[23].

CONCLUSION

This study conclude that the frequency of patients of renal stone that fall in the pyelolithotomy range is higher as compared to ESWL range and also the percentage change in GFR in patients undergoing pyelolithotomy is higher as compared to ESWL.

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