

## “Endoscopic Versus Open Surgical Techniques in the Management of Renal and Ureteric Calculi”

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**Abstract:** Although stone disease is one of the most common affliction of modern society, it has been described since antiquity. With westernisation of global culture however, the site of stone formation has migrated from the lower to the upper urinary tract and the disease once limited to men is increasingly becoming gender blind. Revolutionary advances in the minimally invasive and non invasive management of stone disease over the past two decades have greatly facilitated the ease with which stones are removed. However, open surgical treatments, although invasive are still in use to remove the offending stones.

### **Aims and objectives**

The aims and objectives of the study entitled “Endoscopic versus open surgical techniques in the management of renal and ureteric calculi” were:

1. To assess the stone clearance rate in each procedure.
2. To assess the duration of each procedure.
3. To assess the intraoperative and post-operative morbidity

### **Material and methods**

This retrospective and prospective study was conducted in the Post Graduate Department of Surgery, GMC Jammu. The patients treated in our institute either by PCNL, ureterorenoscopy (URS) or open surgery for renal or ureteric stones between December 2008 and December 2010 were included in our study.

### **Selection criteria**

- Patients of renal or ureteric stones treated either by open or endoscopic procedure in Post Graduate Department of Surgery, GMC Jammu.
- Patients with normal renal functions.

### **Exclusion criteria**

- Patients with congenital, acquired urinary or skeletal abnormalities.
- Patients with uncorrectable coagulopathies.
- Patients with End Stage Renal Disease (ESRD).

**Summary and conclusion:** We conclude with the fact, consistent with our study, that endoscopic procedures represents a reasonable and most remarkable alternative to open surgical procedures for renal and ureteric stones for reasons of lesser operative time and complications, shorter convalescence and hospital stay though lower incidence of stone-free rates were noted. We recognize that further endourological advancements will eventually yield even more better results in future.

**Keywords:** Affliction, endourological, ureteric, westernisation.

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## I. Introduction

Although stone disease is one of the most common affliction of modern society, it has been described since antiquity. With westernisation of global culture however, the site of stone formation has migrated from the lower to the upper urinary tract and the disease once limited to men is increasingly becoming gender blind. Revolutionary advances in the minimally invasive and non invasive management of stone disease over the past two decades have greatly facilitated the ease with which stones are removed. However, open surgical treatments, although invasive are still in use to remove the offending stones.

Indications for open surgery includes conditions like stone burden too large for PCNL, patients harbouring calculi that may require multiple PCNL and small group of patients who are refractory to PCNL and ESWL may require open surgical procedure for stone removal in the form of pyelolithotomy, extended pyelolithotomy, ureterolithotomy, nephrolithotomy or anatomic nephrolithotomy. Nephrectomy remains an option for patients with non functioning kidney harbouring a stone with a normal contralateral kidney.

Our study is being undertaken in an attempt to study the role of endoscopic versus open surgery in the management of renal and ureteric calculi with respect to stone clearance, duration of procedure, morbidity and post-operative hospital stay.

## II. Aims and objectives

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## III. Material and methods

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### Exclusion criteria

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- Patients with uncorrectable coagulopathies.
- Patients with End Stage Renal Disease (ESRD).

### Observations

The present study entitled “Endoscopic versus open surgical techniques in the management of renal and ureteric calculi” has been done in the Post Graduate Department of Surgery, GMC Jammu. It was a retrospective and prospective study done for a period of two years. The following observations were made:-

**Table 1(a):** Age wise distribution of the patients of renal stone.

Age in years	PCNL (No. of Patients) n(%)	Open Renal stone Surgery (No. of Patients) n(%)
1-10	0	0
11-20	2(4%)	5(10%)
21-30	13(26%)	14(28%)
31-40	20(40%)	14(28%)
41-50	8(16%)	7(14%)
51-60	4(8%)	6(12%)
> 61	3(6%)	4(8%)
<b>Total</b>	<b>50</b>	<b>50</b>

In our study, age of patients of renal stone ranged from 15 to 70 years. Majority of the patients in our renal stone series were in their 3<sup>rd</sup> and 4<sup>th</sup> decade of life. Mean age of patients in PCNL group is 37.7 years and open renal group is 38.3 years (comparable in both groups).

**Table 1(b):** Age wise distribution of the patients of ureteric stone.

Age in years	URS (No. of Patients)n(%)	Open Ureterolithotomy (No. of Patients) n(%)
1-10	0	0
11-20	2(6.67%)	3(10%)
21-30	9(30%)	6(20%)
31-40	9(30%)	13(43.33%)
41-50	6(20%)	6(20%)
51-60	2(6.67%)	0
> 61	2(6.67%)	2(6.67%)
<b>Total</b>	<b>30</b>	<b>30</b>

In our study, age of patients of ureteric stone ranged from 15 to 70 years. Majority of the patients in our renal stone series were in their 3<sup>rd</sup> and 4<sup>th</sup> decade of life. Mean age of patients in URS group is 37.4 years and open ureteric group is 36.6 years(comparable in both groups).

**Table 2(a): Sex wise distribution of the patients of renal stone.**

Sex	PCNL (No. of Patients) n(%)	Open Renal stone Surgery (No. of Patients) n(%)
Male	33(33%)	32(32%)
Female	17(17%)	18(18%)
<b>Total</b>	<b>50</b>	<b>50</b>

In our study, out of 100 patients of renal stone 65 (65%) were males and 35 (35%) were females.

**Table 2(b): Sex wise distribution of the patients of ureteric stone.**

Sex	URS (No. of Patients) n(%)	Open Ureterolithotomy (No. of Patients) n(%)
Male	16(26.67%)	15(25%)
Female	14(23.33%)	15(25%)
<b>Total</b>	<b>30</b>	<b>30</b>

In our study, out of 60 patients of ureteric stone 31 (51.67%) were males and 29 (48.33%) were females.

**Table 3(a): Average Renal Stone Size on Abdominal Ultrasonography.**

	PCNL (mm)	Open Renal stone Surgery (mm)
Average Stone Size	16.02	16.08

The average size of renal stone in our study was 16.02mm in PCNL group and 16.08mm in open renal group(comparable in both groups).

**Table 3(b): Average Ureteric Stone Size on Abdominal Ultrasonography.**

	URS (mm)	Open Ureterolithotomy (mm)
Average Stone Size	10.13	10.26

The average size of ureteric stone in our study was 10.13mm in URS group and 10.26mm in open ureteric group(comparable in both groups).

**Table 4(a): Mean duration of Procedure for renal stone.**

Group	PCNL	Open Renal Stone Surgery	Statistical Inference (T test/p value)
Mean Duration	66.8min	102.3min	-4.90665/ P<0.0001

In our series of renal stone, mean duration of PCNL was 66.8 minutes as compared to 102.3 minutes in open renal group(p<0.0001).

**Table 4(b): Mean duration of Procedure for ureteric stone.**

Group	URS	Open Ureterolithotomy	Statistical Inference (T test/p value)
Mean Duration	42.16min	64.67min	-5.36869/ P<0.0001

In our series of ureteric stone, mean duration of procedure for URS was 42.16 minutes as compared to 64.67 minutes in open ureteric group(p<0.0001).

**Table 5(a):** Intra Operative Complications of Renal Stone Surgery.

Intra Operative Morbidity	PCNL (50 Patients) n(%)	Open Renal stone Surgery (50 Patients) n(%)	Statistical Inference (Chi <sup>2</sup> / P-value)
Bleeding requiring transfusion	4 (8%)	14 (28%)	
Pleural Injury	0	4 (8%)	
Renal Pelvis Injury	2 (4%)	2 (4%)	
Ureteric Injury	0	0	
<b>Total</b>	<b>6</b> <b>(12%)</b>	<b>20</b> <b>(40%)</b>	
			<b>10.19/0.001</b>

The prevalence of intra-operative complications in our series of renal stone patients were 12% in PCNL group as compared to 40% in open renal group (p=0.001), the values proving to be significant.

**Table 5(b):** Intra Operative Complications of Ureteric Stone Surgery.

Intra Operative Morbidity	URS (30 Patients) n(%)	Open Ureterolithotomy (30 Patients) n(%)	Statistical Inference (Fisher’s exact P-value)
Bleeding requiring transfusion	-	3 (10%)	
Pleural Injury	-	-	
Renal Pelvis Injury	-	-	
Ureteric Injury	-	-	
<b>Total</b>	-	<b>3</b> <b>(10%)</b>	
			<b>P=0.23</b>

The prevalence of intra-operative complications in our series of ureteric stone patients were 10% in open ureteric group while there was no major complication in URS group (p= 0.23), the values not proving to be significant but close to those reported in literature.

**Table 6(a):** Post Operative Complications of Renal Stone Surgery.

Post Operative Morbidity	PCNL (50 Patients) n(%)	Open Renal stone Surgery (50 Patients) n(%)	Statistical Inference (Chi <sup>2</sup> / P-value)
Hematuria requiring transfusion	3 (6%)	5 (10%)	
Sepsis	2 (4%)	2 (4%)	
Urinary Leakage	2 (4%)	8 (16%)	
Wound Infection	0	4 (8%)	
<b>Total</b>	<b>7</b> <b>(14%)</b>	<b>19</b> <b>(38%)</b>	

The prevalence of post-operative complications in our series of renal stone patients were 14% in PCNL group as compared to 38% in open renal group (p=0.006), the values proving to be significant.

**Table 6(b):** Post Operative Complications of Ureteric Stone Surgery.

Post Operative Morbidity	URS (30 Patients) n(%)	Open Ureterolithotomy (30 Patients) n(%)	Statistical Inference (Fisher’s exact P-value)
Hematuria requiring transfusion	1 (3.3%)	4 (13.66%)	
Sepsis	-	-	
Urinary Leakage	-	-	
Wound Infection	-	2 (6.3%)	
<b>Total</b>	<b>1</b> <b>(3.3%)</b>	<b>6</b> <b>(20%)</b>	
			<b>P=0.10</b>

The prevalence of post-operative complications in our series of ureteric stone patients were 3.3% in URS group as compared to 20% in open ureteric group ( $p=0.10$ ), the values not proving to be significant but close to those reported in literature.

#### IV. Discussion

Open surgical techniques were the only available options for the treatment of urinary stones till early 1980. Although the results of these techniques were excellent in terms of stone free rate, these procedures were quite invasive and morbidity was significant. So the search of new techniques of stone removal continued. With the advances in the fields of fiberoptics, radiographic imaging and lithotripsy the modern techniques of calculus removal including endoscopic techniques (percutaneous nephrolithotomy and ureteroscopy) and extracorporeal shockwave lithotripsy (ESWL) evolved. These techniques have dramatically changed the management of upper urinary tract calculi. These minimal invasive techniques are less invasive but they are more expensive and technically more demanding than open procedures.

Our study entitled “Endoscopic versus open surgical techniques in the management of renal and ureteric calculi” has been done in the Post Graduate Department of Surgery, GMC Jammu. It was a retrospective and prospective study done for a period of two years.

The present study is the randomized work comparing open surgery versus endourological procedure (PCNL, URS) in the treatment of renal and ureteric stones. Various factors warrant consideration when analyzing the effectiveness of stone removing procedures, including the stone-free rate, morbidity (both intra-operative and post-operative) and economic impact in the form of average number of post-operative days spent in hospital. Although our study was both prospective and retrospective, we believe that certain valid conclusions can be drawn from these data.

Age and sex wise distribution of patients in our study revealed that their mean age in PCNL group was 37.70 years (18-70 years), URS Group was 37.4 years (16-65 years) as compared to 38.30 years (15-70 years) in open renal group and 36.66 years (18-70 years) in open ureterolithotomy group, respectively. Sexwise distribution revealed that 60% were males and 40% were females. Age and sex pattern showed close resemblance with reports of various authors. **Brown MW, Carson CC, Dunnick NR** et al 1986 in their series of 94 patients reported 59 males (62.76%) and 35 females (37.23%) with age ranging from 9-81 years.

Preoperative routine urine examination and culture sensitivity, haemoglobin, complete blood counts, Prothrombin time index (PTI), renal function tests (serum urea and creatinine), serum electrolytes, ultrasound abdomen, X-ray abdomen (plain KUB), intravenous urography were done in all 160 patients. Post-operative check X-ray (plain KUB) was done in all 160 patients of our series. Urine examination was normal in more than 50% of patients while others had either microscopic hematuria and/or pyuria. In our study of 160 patients, renal function tests were within normal limits in all subjects of endoscopic and open surgery group. On abdominal ultrasonography, the average size of renal stones was 16.02mm in PCNL group and 16.08mm in open renal group (comparable in both the group), whereas average size of ureteric stone was 10.13mm in URS group as compared to 10.26mm in open ureterolithotomy group. Plain X-ray KUB and intravenous urography (IVU) study which was performed in all 160 subjects revealed the presence of single stone in all patients. Post-operative X-ray (plain KUB)/ ultrasonography was done on first day after surgery for confirming the status of clearance after endoscopic / open procedure. All patients in our study were followed up for a period of three months with repeat plain X-ray (KUB)/ abdominal ultrasound for reassessing status of stone clearance.

The mean duration of surgery in our study was 66.8 minutes for PCNL group as compared to 102.3 minutes in open renal group. The values proving to be highly significant ( $p<0.0001$ ). **Charig CR, Webb DR, Payne SR** et al (1986) while comparing different methods of treating renal calculi in 1052 patients, reported mean operative time of 84 minutes in PCNL group as compared to 130 minutes in open renal group. The mean duration of procedure was 42.16 minutes in URS group as compared to 64.67 minutes in open ureterolithotomy group. The values proving to be highly significant ( $p<0.0001$ ). **Falahatkar S, Khusro PI, Khan AA** et al (2010) while comparing the results of various treatment modalities in 60 patients of ureteric stones, reported 70 minutes and 162.5 minutes as the procedure time for URS and open ureteric group. Increased duration of procedures as reported by them can be explained as the stone size in their series was bigger as compared to our series.

The main intra-operative complications of renal stone surgery in our group were 12% in PCNL group versus 40% in open renal group ( $p=0.001$ , highly significant) which included: (i) Bleeding requiring transfusion in 4(8%) patients belonging to PCNL group as compared to 14(28%) patients in open renal group, (ii) Pleural injury occurring only in 4(8%) patients in open renal group and (iii) Renal pelvis injury in 2(4%) patient each in both groups. **Al-Kohlani KM, Shokeir AA, Mosbah** et al (2005) in their study of 79 patients of renal stones, noticed that there were significantly more intraoperative complications in the open renal group (38%) compared to the PCNL group (16%),  $p < 0.05$ . The most significant complication in both groups was bleeding requiring blood transfusion (33% for open renal and 14% for PCNL,  $p=0.05$ ). They also reported pleural injury (8.9% for

open renal versus 0% for PCNL), renal pelvis injury occurring only in 4.7% of PCNL group and ureteric injury in only 2.2% of open renal group patients.

**Snyder JA and Smith AD** (1986) reported in their series of 100 patients that fewer patients (53%) undergoing PCNL required blood transfusions as compared as to open renal surgery group (70%) patients. Theoretically, these facts suggest a lower risk of transfusion complications such as immunological reactions and infections with hepatitis B / AIDS. The blood transfusion rates in our study was less in case of open renal surgery group as we extracted stones via the renal pelvis in 90% of the patients and nephrotomy was inevitable in only 10% of patients of the open renal group.

The main intra-operative complication of ureteric stone surgery was bleeding requiring blood transfusion in 3(10%) of open ureterolithotomy group ( $p=0.23$ ), the values are not significant probability because of less number of patients in our ureteric series but our results are comparable to those reported in literature. **Falahatkar S, Khusro PI, Khan AA** et al (2010) while comparing the results of various treatment modalities in 60 patients of ureteric stones, reported blood transfusion in 15% of patients of open ureteric surgery. No major intra-operative complication was reported in URS group.

The main post-operative complications in our renal stone subjects were 14% for PCNL compared to 38% for open renal group ( $p=0.006$ , highly significant) including: (i) Hematuria requiring transfusion in 3(6%) patients for PCNL and 5(10%) for open renal surgery, (ii) Sepsis 2(4%) patient for PCNL and 2(4%) for open renal surgery, (iii) Urinary leakage 2(4%) patient for PCNL and 8(16%) for open renal group and (iv) Wound infection noticed only among 4(8%) patients of open renal group. **Al-Kohlani KM, Shokeir AA, Mosbah** et al (2005) in their study of 79 patients of renal stones, noticed that there was significantly more post-operative complications in the open surgery group 14(31%) patients compared to the PCNL group 8(18.6%) patients. These results were comparable to our study.

## V. Summary and conclusions

The history of surgery is replete with comparisons of one operative procedure or technique with another. The remarks of surgeons in support of a favoured procedure or in the derision of one of which they disapprove have generated some of the most notable and entertaining references in the medical literature. Frequently witty and occasionally enlightening, neither these references nor the interpretations of the data developed for such comparisons have provided sound scientific guidelines for selection of a procedure as applied to an individual patient.

The technique of endoscopic stone manipulation has developed concurrently with the advances in the fields of fibre optic, radiographic imaging and lithotripsy. The more recent popularities of these approaches of stone management have provided numerous descriptions of their operative techniques and morbidity. Since the popularization of endoscopic techniques, open surgery is now performed in less than 3% of the patients requiring a stone removing procedure. The indications for endoscopic stone management are well established and greater than 90% success rates are reported with these modalities.

The present study is the randomized work comparing open surgery versus endourological procedures (PCNL, URS) in the treatment of renal and ureteric stones. Various factors warrant consideration when analyzing the effectiveness of stone removing procedures, including the stone-free rate, morbidity (both intra-operative and post-operative), duration of procedures and economic impact in the form of average number of days spent in hospital. Although our study was both prospective and retrospective, we believe that following valid conclusions can be drawn from these data:

- Age and sex wise distribution in our series of 100 patients of renal stone were comparable, with mean age of 37.72 years in PCNL group as compared to 38.3 years in open renal group and 65 (65%) being males and 35 (35%) females. Age and sex wise distribution in our series of ureteric stone patients was also comparable, with mean age of 37.4 years in URS group as compared to 36.64 years in open ureteric group and 31(51.67%) being males and 29 (48.33%) females.
- Preoperative urine examination, haemoglobin, complete blood count, Prothrombin time index (PTI), renal function tests (serum urea & creatinine), serum electrolytes, ultrasound abdomen, plain X-ray abdomen (KUB), intravenous urography as well as post-operative check X-ray (plain KUB) were done in all 160 patients in our series.
- The average size of renal stones in our study was 16.02 mm in PCNL group and 16.08 mm in open renal surgery group (comparable in both the groups). The average size of ureteric stone in our study was 10.13mm in URS group and 10.26mm in open ureteric group (comparable in both the groups).
- Intra-operative complications in our study were significantly lower in PCNL group (12%) as compared to open renal group (40%). The values are highly significant ( $p = 0.001$ ). Similarly intra-operative complications were 10% in patients of open ureteric group in the form of bleeding requiring transfusion. There was no major intra-operative complications in URS group. We conclude with the fact, consistent with our study, that endoscopic procedures represents a reasonable and most remarkable alternative to open surgical procedures for

renal and ureteric stones for reasons of lesser operative time and complications, shorter convalescence and hospital stay though lower incidence of stone-free rates were noted. We recognize that further endourological advancements will eventually yield even more better results in future.

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