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ORIGINAL ARTICLE

A COMPARATIVE STUDY OF PERCUTANEOUS NEPHROSTOMY VERSUS DJ STENTING IN INFECTIVE HYDRONEPHROSIS IN CALCULOUS DISEASE

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ABSTRACT: AIMS AND OBJECTIVE: To compare the outcome of percutaneous nephrostomy versus double J ureteral stenting in the management infective hydronephrosis in calculous disease. **MATERIALS AND METHODS:** From October 2012 to January 2014,40 patients of age 25-65 years with obstructing ureteral or renal pelvic stones with clinical signs of infection were underwent decompression by double J stenting(20 patients) or percutaneous nephrostomy (20 patients) in this study. Patients with single calculus of size less than or equal to 15mm with fever and white blood count (WBC) of 14000/ mm^3 or greater were included in this study. Calculus size greater than 15 mm, patients with bilateral or multiple calculi, pregnancy, ureteral or urethral stricture disease, uncorrected coagulopathy, Patients with solitary kidney were excluded from the study. Outcome parameters included time to achieve normal temperature and WBC of 11000 /mm^3 or less, and resolution of pyuria if present were analyzed in both group of patients. **RESULTS:** Majority of the patients were between 25 to 65 years of age with male to female ratio was2.12:2.87.The most common location of stone was at distal ureter in either group. There was no significant difference between pre procedural WBC count, maximum temperature and stone size in either group. Procedura land fluoroscopy times were significantly shorter for double j stenting (30.95±6.02 and5.3±3.2) compared with percutaneous nephrostomy (35.9± 5.4 and7.2± 4.2). During drainage the appearance of the urine was grossly purulent in 5 patients (12.5%), turbid in 19 (47.5%) and clear in 16 (40%). Overall urine cultures and blood cultures were positive in 50 and 12.5% of patients, respectively. Urine cultures were positive in 60% of the percutaneous nephrostomy compared with 40% of the double j stenting group (p not significant). There was no significant difference in time to clinical improvement (Time to normal WBC and temperature and time for purulent drain to clear) between the 2 groups. **CONCLUSION:** There is no significant difference in the efficacy of relieving obstruction/symptoms in either procedure. We feel the choice of choosing a particular procedure depends on site of stone and degree of proximal obstruction. However prior PCN facilitates easier PCNL.

KEYWORDS: Double J stenting, percutaneous nephrostomy, infective hydro nephrosis.

INTRODUCTION: Hydronephrosis is an aseptic dilatation of the pelvi calyceal system caused by obstruction to the outflow of urine. Presence of hydronephrosis can be physiologic or pathologic. It can be secondary to obstruction of the urinary tract, but it can also be present even without obstruction.

Infected hydronephrosis is simply defined as a bacterial infection in a hydronephrotic kidney. Infected hydronephrosis is UTI proximal to an obstructing stone.

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The term pyonephrosis refers to infected hydronephrosis associated with supportive destruction of the parenchyma of the kidney, in which there is total or nearly total loss of renal function. Where infected hydronephrosis ends and pyonephrosis begins is difficult to determine clinically. Rapid diagnosis and treatment of pyonephrosis are essential to avoid permanent loss of renal function and to prevent sepsis.

The clinical presentation of infected hydronephrosis is variable. Pyuria (>5 white blood cells [WBCs] per high-power field [hpf]) is almost always present but is not diagnostic of proximal infection. The patient is usually very ill, with high fever, chills, flank pain, and tenderness. Occasionally, however, a patient may have only an elevated temperature and a complaint of vague gastrointestinal discomfort. A previous history of urinary tract calculi, infection, or surgery is common. Bacteriuria may not be present if the ureter is completely obstructed.

The ultrasonographic diagnosis of infected hydronephrosis depends on demonstration of internal echoes within the dependent portion of a dilated pyelocalyceal system.

CT is nonspecific but may show thickening of the renal pelvis, stranding of the perirenal fat, and a striated nephrogram.

The urographic findings are those of urinary tract obstruction and depend on the degree and duration of obstruction. Typically, the obstruction is of long standing, and excretory urography shows a poorly functioning or nonfunctioning hydronephrotic kidney. Ultrasound demonstrates hydronephrosis and fluid debris levels within the dilated collecting system.

The diagnosis of pyonephrosis is suggested if focal areas of decreased echogenicity are seen within the hydronephrotic parenchyma. The various methods of urinary diversions are retrograde double J ureteral stenting, percutaneous nephrostomy and open drainage of kidney.(1) Clear guidelines regarding optimal urinary diversions have not been established. Most authors agreed that decisions should be individualized. Currently, retrograde double-J ureteral stenting and ultrasound guided percutaneous nephrostomy tube insertion are the most widely used techniques for relieving obstruction of the urinary tract. Both are associated with variable technical success, complication rates, and availability and quality of life issues. This study was conducted to compare the outcome of percutaneous nephrostomy versus double J ureteral stenting in the management infective hydronephrosis in calculous disease.

MATERIALS AND METHODS: The study was conducted from October 2012 to January 2014 patients of obstructing ureteral or renal pelvic stones with clinical signs of infection were randomized for decompression by either percutaneous nephrostomy or double J stenting in a tertiary care teaching hospital. After approval from ethical review committee, total number of 40 patients of infective hydronephrosis due to calculi who underwent double J stenting or percutaneous nephrostomy were included in this study. Informed, written consent was taken from each patient before the procedure after explaining all merits and demerits of the procedure.

Inclusion Criteria:

- Patients with single calculus of size less than or equal to 15mm with fever and white blood count (WBC) of 14000/ mm^3 or greater.

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Exclusion Criteria:

- Calculus size greater than 15 mm.
- Bilateral or multiple calculi.
- Pregnancy.
- Prior urinary diversion.
- Ureteral or urethral stricture disease.
- Un corrected coagulopathy.
- Patients with solitary kidney.

Patients were randomized for either percutaneous nephrostomy (20 patients) or double J stenting (20 patients).

Detailed history and physical examination of every patient was done. The investigations done before the procedure including complete blood count, urine complete examination, screening for Hepatitis B &C and serum urea and creatinine. Abdominal ultrasonography, plain x ray KUB was done in every patient to see the degree of hydronephrosis and the side affected and presence of calculi. All patients were maintained on antibiotic prophylaxis.

The outcome parameters studied were:

- Time to normalization of WBC of 11000/ mm^3 or less,
- Normalization of temperature,
- Resolution of pyuria if it was seen at the time of drainage.

Length of stay was excluded as an outcome parameter because factors other medical necessity might effect it. Sample size was determined based on assumption that a difference of one day in time to normalization of WBC and temperature would represent a clinically and economically significant difference between groups. Assuming a standard deviation (SD) of one day, desired power of 80% and P value of 0.05, sample size calculation yielded a necessary sample size of 17 patients per group.

Percutaneous nephrostomy and double J stenting were performed in the operation theatre with patient under local anesthesia, supplemented with intravenous sedation if needed under supervision of a faculty anesthetist. A Foley catheter was placed to drain the bladder. Urine culture was obtained from bladder at initial patient contact, after which broad spectrum antimicrobial agents were initiated. Urine samples were obtained from the kidney during renal drainage. Gross appearance of urine at the time of drainage was noted. Cultures with greater than 1, 00,000 colony forming units/mm^3 were considered positive. Blood cultures were obtained in all cases.

The procedural time was recorded. Fluoroscopy time was noted for each procedure. Complications occurring during the drainage procedure were recorded. Outcome parameters included time to achieve normal temperature and WBC of 11000 /mm^3 or less, and resolution of pyuria if present. Inpatient and outpatient complications relating to the drainage tube were noted. In addition, each patient was asked to complete visual analogue pain questionnaire immediately after drainage to assess tolerance of the procedure. The time until definitive treatment and specific treatment modality were also noted. Statistical analyses were performed using the chi square test, student t test when appropriate.

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RESULTS: A total of 40 patients were randomized to receive percutaneous nephrostomy (20) or double J stenting (20). The 2 groups were comparable in patient, stone and clinical characteristics (table1, 2 and 3). Local anesthesia supplemented with intravenous sedation if necessary was used for both groups. Of the percutaneous nephrostomy group a 12F nephrostomy tube was placed in 85%, 14F in 15%. Of the double j stenting group a 4.5F stent was placed in 90% and 5F stent in 10%.

A Foley catheter for bladder drainage was placed after the procedure in both groups.

Procedural parameters are gross appearance of urine at the time of procedure, duration of procedure, fluoroscopy time, time for urine to be clear from intervention were shown in table 3 and 4. Procedural and fluoroscopy times were significantly shorter for double j stenting compared with percutaneous nephrostomy. No other procedural complications occurred.

During drainage the appearance of the urine was:

- Grossly purulent in 5 patients (12.5%).
- Turbid in 19 (47.5%) and
- Clear in 16 (40%).

Overall urine cultures and blood cultures were positive in 50 and 12.5% of patients, respectively (table 4). Infecting organisms included Escherichia coli in 80%, Proteus mirabilis in 15%, Enterococcus in 2.5% and Klebsiella in 2.5% of the patients. Urine cultures were positive in 60% of the percutaneous nephrostomy compared with 40% of the double j stenting group (p value not significant). There was no significant difference in time to clinical improvement (Time to normal WBC and temperature and time for purulent drain to clear) between the 2 groups.

When the patient was questioned about generalized back pain or bladder pain during or immediately after the procedure (when awake enough to answer appropriately), only back pain was perceived to be greater in the percutaneous nephrostomy compared with the double j stenting (37.2 versus 6.5 on a scale of 0 to 100, where 100 is the worst pain imaginable, $p < 0.05$). There was no significant difference in the duration of pain medication used after the procedure between the 2 groups (2.1 days in the percutaneous nephrostomy versus 1.5 in the double J stenting group ($p = 0.83$). Only 1 percutaneous nephrostomy related complication occurred in the overall group. Nephrostomy tube got dislodged and patient underwent prompt treatment for a lower ureteral stone. In 5 patients the stone passed spontaneously sometime after drainage, precluding the need for the further treatment. Among patients with a persistent stone URSL in 22 and PCNL in 11 was done as definitive treatment. At final follow-up 95% of patients (38 out of 40) were stone-free (2 were lost to follow-up).

DISCUSSION: Infection is most serious complication in any obstructive uropathy due to stone. The most severe manifestation of this syndrome ‘pyonephrosis’ is associated with a high mortality and the risk of the renal loss. Gram-negative sepsis is not an uncommon complication of urosepsis. Pyonephrosis with fear of complications has led to the clinical dogma that obstructing stones with suspected infection should be managed with emergency decompression of the collecting system.

However the mandatory prompt drainage of infected and obstructed pelvicalyceal system is not universally accepted. In 1983 Klein et al reported 16 cases of fever and obstructing ureteral stones managed conservatively with hydration and broad-spectrum antibiotics according to a planned treatment regimen.[2] All patients responded favorably and 11 spontaneously passed stones

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within 48 hours. Nonetheless, this uncontrolled study should be viewed cautiously. The records of these patients were reviewed retrospectively and inclusion criteria were not well defined.

Surgical intervention for pyonephrosis dates back to 1906. Albarran advocated surgical nephrostomy followed by nephrectomy after patient stabilization.[3] With the development of percutaneous drainage procedures, percutaneous nephrostomy replaced surgical nephrostomy prior to nephrectomy.[4,5,6] The advantage of temporary drainage of the kidney is the possibility of renal salvage when renal function is preserved.

In 73 patients with pyonephrosis treated with initial percutaneous nephrostomy, Camunex et al salvaged 83.1% of renal units.[7] Likewise St.Lezin et al salvaged 78.3% of 23 pyonephrotic kidneys drained percutaneously.[8] In fact, percutaneous nephrostomy was shown to decrease mortality associated with gram-negative sepsis due to obstruction of the urinary tract (7.4% mortality) compared to treatment with antibiotics and steroids alone (40%) or surgical decompression.[9]

The development of internal ureteral stents that could be placed cystoscopically provided an alternative to percutaneous renal drainage in cases of ureteral obstruction.[10] Early versions of these stents were difficult to place and associated with frequent proximal or distal migration of the tube.[11]

Improvements in stent design resulted in greater ease of placement and more secure positioning.[12,13,14] However, despite these improvements, the use of ureteral stents for drainage of infected, obstructed kidneys was sporadic and reports in the literature were few [8, 15]. Indeed, in 1 series of 23 patients with pyonephrosis treated with percutaneous nephrostomy a previous retrograde attempt at drainage had failed in 30%.[8]

Proponents of percutaneous drainage of the obstructed, infected collecting system cite several advantages over retrograde ureteral stent placement. They argue that the external tube provides means for monitoring on-going drainage of the kidney. If necessary the nephrostomy tube can be irrigated to relieve temporary obstruction of the tube. In addition, a variety of the tube sizes can be placed (typically 8 to 14F), most of which are larger than those that can be safely placed retrograde. Percutaneous nephrostomy avoids manipulation of the obstructed ureter with its potential for perforation and exacerbation of the infection.[8,16] Finally, advocates of nephrostomy drainage maintain that the procedure can be performed with patient under local anesthesia, obviating the need for an anesthesiologist or risk of general anesthesia in patients with hemodynamic instability.

Advocates of stent placement note greater patient comfort with an internalized stent compared with the more cumbersome external nephrostomy tube and a seemingly lower potential for complication. However, the efficacy of internal drainage in this setting has never been evaluated and a direct comparison of the 2 drainage modalities has not been reported to our knowledge.

Although neither drainage modality is associated with a high complication rate percutaneous nephrostomy carries the greater risk of significant morbidity. Lee et al reviewed their experience with emergency percutaneous nephrostomy in 160 patients (169 procedures), including 69 (43%) with an obstructed, infected system.[17] Tube placement was successful in 98% of patients but major complications occurred in 6%, including sepsis in patients not previously septic (3.6%) and hemorrhage requiring transfusion (2.4%). Minor complications occurred in 27.7% of patients and included catheter dislodgement (4.8%), extravasation/perforation (4.3%), pneumonia/atelectasis (1.8%), pleural effusion (1.2%), paralytic ileus (2.4%) and fever lasting longer than 6 hours (12.6%).

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Yoder et al reviewed 70 cases of pyonephrosis treated with initial percutaneous nephrostomy drainage and reported complications in 28%, including septic shock (7%), hemorrhagic shock (1.4%), hypotension (2.9%) and fever and/or chills (14%).[18]

In contrast, in 2 large series comprising 226 attempts at ureteral stent placement (none of which was performed for relief of obstruction associated with infection) was successful in 84% and there were few major complications related to the procedure other than failure.[19,20] Few studies report the incidence of ureteral perforation during ureteral stent placement. Pocock et al reported perforation of the ureter in 8 cases among 138 attempts at stent placement (5.8%) for a variety of obstructive aetiologies. With pre-placement of a ureteral stent before shock wave lithotripsy the incidence of ureteral perforation has been reported to be 2 to 8%.[21,22,23] Stent migration occurs in 0.1 to 7%.[19,20,24] and stent occlusion in 1 to 7%.[20,24] of patients. Irritative symptoms and pain are common with internal ureteral stents; include flank in 17 to 19%, suprapubic pain in 20%, and urinary frequency in 42% and hematuria in 42%.[20,25]

In randomized prospective study by Mokhmalji et al.[26] (Table.8) which comprised 40 patients requiring decompression of hydronephrosis, although only 11 patients in each group had evidence of sepsis at presentation. They reported no failures of access in the percutaneous nephrostomy group, but retro-grade stenting failed in 4 of 20 patients. Reason for failure cited in two cases was enlargement of the prostate, and further two patients, both young men, did not tolerate the procedure under conscious sedation. It is of interest that no stent insertion failed because of an impacted stone or edematous ureter. This study included quality-of-life assessment, and patients in the stent group required more analgesia and had a greater impact on their quality of life. In contrast, 75% of patients with percutaneous nephrostomy required intravenous antibiotics compared with 66% of patients who had a stent inserted. There was no subgroup analysis of the patients with sepsis and obstruction. This study concluded that percutaneous nephrostomy is superior to stent insertion, although it was not clear on what grounds this conclusion was made.

One retrospective case study (Yoshimura et al.[27]) (Table. 8) assessing the out-comes for patients requiring emergency treatment for infected hydronephrosis associated with upper ureteric calculi as opposed to elective treatment was identified. This non-randomized study used features of the systemic inflammatory response as outcome parameters and reported no significant difference between percutaneous nephrostomy and ureteric stenting. The numbers were again small, 24 and 35 patients in each treatment group, and there was no information regarding choice of decompression method other than stone size. Stones were significantly larger in the percutaneous nephrostomy cohort (9.7 mm vs. 2.6 mm). This group did not report any decompression failures for either method.

Sara Ramsey et al.[28] (Table. 8) based on the available published literature till 2010 concluded that there is little evidence to support the superiority of percutaneous nephrostomy over retrograde stenting as primary treatment of infected hydronephrosis, despite traditional teaching to the contrary. The study also concluded that it seems unlikely that an adequately powered multicenter randomized trial will ever be carried out to establish the definitive decompression method.

Despite arguments on both sides, in the present study we found no statistically significant difference in efficacy between percutaneous nephrostomy and double j stenting for the obstructed, infected kidney using time to clinical improvement (Normalization of temperature and WBC, resolution of pyuria if present), as our outcome parameter. Because we are unable to determine whether time to normalization of temperature or WBC was more reflective of clinical improvement, we elected to use the time for both parameters to normalize. Although the power of my statistical tests was below 0.80, the differences between the two groups were so small that the probability of reaching a clinical difference (1 day) with greater patient numbers is low.

In the present study there is no statistical significant difference in time to clinical improvement between the two groups with positive cultures of urine and/or blood, however, the sample size of the two groups (Percutaneous nephrostomy in 12/ 3 and dj stent in 8/2) were too small for accurate comparison.

In the present study time for Double j stenting was significantly shorter to perform than percutaneous nephrostomy (by 5 minutes). In addition, 1.9 less minutes of fluoroscopy time were required for double j stenting compared to percutaneous nephrostomy.

No procedural complications occurred in either group. Patient tolerance of the procedure was also similar except that, patients complained of greater back discomfort during percutaneous nephrostomy and irritative voiding symptoms in patients of double J stent group.

There is no significant difference in the time for definitive treatment in both the groups.

Given our findings, the choice of drainage procedure for obstruction and infection can be individualized according to patient and institutional characteristics. Patients likely require a percutaneous nephrostolithotomy for definitive stone management may be best served with percutaneous nephrostomy. Likewise, patients with solitary ureteral stones who are good candidates for shock wave lithotripsy or ureteroscopy would benefit from ureteral stent placement.

CONCLUSION: There is no significant difference in the efficacy of relieving obstruction/symptoms in either procedure. We feel the choice of choosing a particular procedure depends on site of stone and degree of proximal obstruction. However prior PCN facilitates easier PCNL.

Stone location	PCN group (%)	DJS group (%)
PUJ	15	10
Upper ureter	30	35
Mid ureter	10	15
Distal ureter	45	40

Table 1: Showing stone location. PCN= Percutaneous nephrostomy, DJS=Double J stent

Degree of hydronephrosis	PCN group (%)	DJS group (%)
0-I	20	10
II-III	65	70
IV	15	20

Table2: Degree of hydronephrosis. PCN= Percutaneous nephrostomy, DJS=Double J stent

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	Total (40 pts.) Mean ±SD	Percutaneous Nephrostomy (20 pts.) Mean ± SD	Double J stenting (20 pts.) Mean ± SD	P value (students 2 tailed test)
Age (yrs)	46.27±9.36	46.5±9.42	46.05±9.54	Not significant
Male to Female ratio	17:23	8:12	9:11	Not significant
WBC count (mm^3)	16070±1571.25	16210±1850.15	15930±1266.20	Not significant
Max.Temperature(F°)	100.62±1.29	100.6±1.31	100.65±1.30	Not significant
Stone size(mm)	11.1±2.38	11.3±2.43	10.9±2.38	Not significant

Table 3 : Baseline patient and stone characteristics

At the time of admission	Overall (40 pts.)	Percutaneous Nephrostomy (20 pts.)	Double J stenting (20 pts.)	P value (chi-square test)
No. of positive urine cultures	20(50%)	12(60%)	8(40%)	Not significant
No. of positive Blood cultures	5(12.5%)	3(15%)	2(10%)	Not significant

Table 4: Urine and Blood cultures

	Overall (40 pts.)	Percutaneous Nephrostomy (20 pts.)	Double J stenting (20 pts.)	P value (students 2 tailed test)
Mean ± SD length of case (min)	33.42±6.18	35±5.41	30.95±6.02	<0.05 significant
Mean ± SD fluoroscopy time (min)	6.6±42	7.2±4.2	5.3±3.2	<0.05 significant

Table 5 : Treatment parameters

	Overall (40 pts.)	Percutaneous Nephrostomy (20 pts.)	Double J stenting (20 pts.)	P value (students 2 tailed test)
Mean ± SD days to normal temperature	1.57±0.67	1.4±0.50	1.75±0.78	Not significant
Mean ± SD days to normal WBC	1.75±0.70	1.65±0.48	1.85±0.87	Not significant
Mean ± SD days for purulent drain to clear	1.6±0.9(N=5)	1(N=3)	2.5± 0.7(N=2)	Not significant

Table 6 : Clinical outcomes

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Procedure	Total (no. of pts.)	PCN group (no. of pts.)	DJS group (no. of pts.)
Spontaneous expulsion	5	2	3
URSL	22	11	11
PCNL	11	7	4

Table 7 : Definitive procedure done

Study	No. of cases (PCN/stent)	Pyuria	Primary outcome measures (Secondary outcome measures)
Mokhmalji et al.[26]	40 (20/20)	Not given	Relief of symptoms (Duration of diversion, intravenous antibiotics); quality of life (None)
Yoshimura et al.[27]	53 (59 events) (24/35)	Not given	Risk factors for emergency drainage (None)
Sara Ramsey et al.[28]	---	---	Evidence-Based Drainage of Infected Hydronephrosis
Present study	40(20/20)	5	Time to normalization of WBC and time to normalization of temperature, resolution of pyuria if present

Table 8 : Randomized and Comparative Studies of Decompression Methods

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