Ann Med Res 2021;28(2):329-35

Annals of Medical Research

DOI: 10.5455/annalsmedres.2020.06.616

Original Article

DJ stent and nephrostomy drainage outcomes for upper urinary tract obstruction and determinative factors for drainage selection

Yavuz Guler

Clinic of Urology, Private Safa Hospital, Istanbul, Turkey

Abstract

Aim: To compare drainage outcomes from double J stent and percutaneous nephrostomy stent for upper urinary tract obstruction and to research factors determining the stent method to be used. Upper urinary tract obstruction may be caused by ureter and kidney stones internally or by local advanced-stage pelvic organ cancers externally and this may lead to sepsis or obstructive uropathy. It is necessary to drain the kidney immediately before definitive treatment of stone patients and prevent increased morbidity and mortality in cancer patients.

Materials and Methods: A total of 213 patients with upper urinary tract obstruction and drainage using double J stent and percutaneous nephrostomy catheter were retrospectively assessed. Demographic, operative-postoperative data and predictive factors for stent selection were assessed.

Results: The groups were different in terms of age and gender demographically, as well as disease duration before the procedure, comorbid diseases, causative factors, hydronephrosis degree and stone size ($p < 0.05$). The groups were different in terms of operational data, operation time, auxiliary time, complications and definitive treatment for stones ($p < 0.05$). Independent predictive factors for stent selection were stone size (Odds ratio:1.3), obstructive duration before the procedure (Odds ratio:1.1), causative factors (Odds ratio:38.1), and hydronephrosis degree (Odds ratio:10.5).

Conclusion: For patients with long duration of obstruction and high degree of hydronephrosis, with obstruction caused by local advanced pelvic cancer and large ureter stones and with sepsis, percutaneous nephrostomy drainage should be chosen instead of double J stent drainage.

Keywords: Bladder ca; Dj stent; nephrostomy; obstructive uropathy; servix ca

INTRODUCTION

Some intraluminal and extraluminal diseases in the ureter cause partial or total blockage of upper urinary tract drainage. Intraluminal obstruction causes are mainly ureter stones, congenital or iatrogenic ureter stenosis and urothelial carcinoma, in order of incidence. Extraluminal causes are mainly masses outside the ureter growing and compressing the ureter. The main cause is local advanced cervical cancer (> stage 3b) and iatrogenic ureter injury in gynecological surgeries in women, while local advanced bladder cancer and prostate cancer are the leading causes in men (1).

When the upper urinary tract is blocked, increased intrapelvic hydrostatic pressure may cause permanent damage to renal parenchyma and finally renal atrophy if drainage is not ensured, depending on the duration of obstruction and whether the obstruction is complete or not (2). As hydronephrosis continues in obstructed patients, pyelonephritis, sepsis and septic shock tableau may be observed in 10-40% of patients (3). Septic shock is a very dramatic tableau resulting in at least 50% patient mortality (4). Buonovito et al. (5) calculated the mortality ORs for septic shock as 58.4 in a large series of 1325 sepsis patients. Currently, the urinary system is known to lead the sources of infection among patients treated in intensive care due to sepsis.

For urinary obstructions causing sepsis, septic shock and renal function disorders requiring emergency amelioration and caused by local advanced stage cancers, firstly it is necessary to ensure renal drainage. To provide renal drainage, DJ stent or ureter stents can be inserted through the retrograde route, and nephrostomy catheters can be inserted through the antegrade route or with open surgery.

Received: 15.06.2020 **Accepted:** 27.07.2020 **Available online:** 19.02.2021
Corresponding Author: Yavuz Guler, Clinic of Urology, Private Safa Hospital, Istanbul, Turkey
E-mail: yavuzguler1976@gmail.com

Generally, in patients with external ureter compression due to tumors, antegrade/nephrostomy catheter is chosen, while DJ stent is mainly chosen for those with obstruction due to ureter stone. However, the topic of which of these drainage methods should be chosen for which disease has still not been fully explained at present. We chose the drainage method for each patient based on our personal experience. In this study, we retrospectively screened patients with both methods used due to obstruction to compare both drainage methods and to find the independent predictive factors for the selection of appropriate drainage method for patients.

MATERIALS and METHODS

This study was carried out in accordance with the ethical standards of the committee responsible for human experiments (institutional and national) and the Helsinki Declaration, and with the approval of the ethics committee (M.H.U Istanbul Training and Research Hospital Clinical Research Ethics Committee, Decision no; 2432, Date; 12.06.2020). From January 2008 to December 2018, we compared the drainage methods applied before definitive or cause-related treatment of upper urinary obstructions by a single urology doctor in a single clinic. We included 213 upper urinary tract obstruction patients reached in the records between these dates. The study included patients with renal drainage tube inserted due to obstructive uropathy and/or sepsis. Patients with bilateral, congenital obstruction, with stent exchange due to cancer, with stent inserted after definitive treatment and pediatric patients <16 years of age were not included in the study. Demographic data included age, gender, American Society of Anesthesiology (ASA) risk, body mass index (BMI), blood creatinine, C-reactive protein (CRP), duration of obstruction, comorbid diseases, causative factors, hydronephrosis, stone localization and stone dimension. Operative and postoperative data included operation duration, intensive care unit (ICU) stay, hospital stay, auxiliary stent use, post-stent blood creatinine, complications and definitive treatments.

Pre-drainage assessment

All patients had detailed anamnesis/history taken with physical examination performed. Then, laboratory (HB/HCT, WBC, creatinine, blood urea nitrogen (BUN), CRP, urine and blood cultures) and radiologic investigations (renal ultrasonography (USG), non-contrast abdominal tomography (NCCT)) were performed. USG hydronephrosis grading was done according to the Society of Fetal Urology (SFU).

DJ stent insertion

After anesthesia (spinal, general and rarely local), patients were placed in dorsal lithotomy position on the operating table. After field disinfection with batticon, areas outside the surgical field were covered with sterile drapes. The external urethral meatus was entered with a 20 F cystoscope to reach the bladder. The relevant ureter orifice was identified and a hydrophilic guidewire was sent towards the kidney. Entry of the guidewire into the kidney was confirmed with fluoroscopy. Then, a 5F or 6F polyurethane DJ stent was inserted into the ureter above the guidewire. A polyurethane DJ stent was used in cancer patients.

Nephrostomy catheter insertion

Patients were placed in prone position. A gel cushion was inserted to ensure elevation of the relevant kidney and all mobilization was prevented and distance to skin shortened. With a 3 Hz USG probe (General Electric Voluson 730), the lower pole posterior calyx of the kidney was targeted from the subcostal field. Local anesthesia of skin and subdermis was provided by lidocaine. A 0.5 cm skin incision was made, then an 18 G needle was used to ensure intrarenal field entry from the renal papilla. The needle chuck was removed and urine output was observed. Then, ½ diluted (omnipaque) contrast material was administered through the needle lumen and intrarenal anatomy and the ureter were observed. Then a guidewire was inserted into the kidney. Dilatation to 12 or 14 F was made above the guidewire and a 12 or 14 F pigtail or malecot tube was inserted. The catheter was fixed to the skin with 3/0 nylon sutures. The tip of the tube was linked to a urine bag to ensure closed drainage. Since all these procedures were performed by a single urology doctor in all of the patients included in our study, hours of admission to the hospital and not being able to reach the interventional radiologist 24/7 were not effective factors in the choice of drainage method.

Follow-Up

After all patients were discharged, they were called for check-up at least twice at 1 week and 1 month. At every check-up, USG, x-ray, CUB, blood tests (white blood count (WBC), creatinine), urine analysis and urine culture-antibiogram tests were performed. Definitive treatment for stone patients with drainage catheter was completed within 1 month and the preoperatively-inserted stents were removed. In cancer patients, an exchange protocol was implemented every 6 months for DJ stents and every 3 months for nephrostomy catheters.

Statistical analysis

Statistical analyses were performed using SPSS 22.0 (IBM Co., New York, USA). Continuous data are presented as mean±Sd, while categorical data are given as number and %. Homogenic data were compared with the independent t test, while non-homogenic data were compared with the chi-square test. On univariate analysis, predictive variables causing statistical difference between the groups were analyzed with binary logistic regression analysis. Values below $p < 0.05$ were accepted as statistically significant.

RESULTS

The patient numbers in the DJ stent (Group 1) and nephrostomy catheter (Group 2) groups were 128 and 89, respectively. Demographic and preoperative classification found differences between the groups in terms of mean age, gender, comorbid diseases, disease duration, causative factors and hydronephrosis degree ($p < 0.05$). There was no difference in clinical presentation in terms of sepsis and obstructive uropathy ($p = 0.225$).

The nephrostomy group was mean 1.5 years older than patients in the DJ stent group (p < 0.001). In Group 1, 54% of patients were female, while this rate was 37% in Group 2 (p < 0.001). Nearly 13% of patients in Group 1 used preoperative anticoagulant medications, while this rate was 0% in Group 2 (p < 0.001).

The cause of urinary obstruction in patients with DJ stent inserted was ureter stone for 86%, while it was 40% in the nephrostomy group. Contrary to this, the etiology of obstruction in patients with nephrostomy was cervix, bladder and prostate carcinoma at rates of 27%, 12% and 7%, respectively. There were only 4 cervix cancer (3%) patients in the group with DJ stent inserted (p < 0.001).

Table 1. Demographic Characteristics

	DJ stenting	Nephrostomy	p
No	128	89	0.511
Age, year	45.7±14.9 (19-81)	47.0±14.4 (21-77)	**0.012**
Gender, n(%)			**< 0.001**
Male	81 (63%)	41(46%)	
Female	47 (37%)	48(54%)	
ASA, mean ±sD	1.5±0.6(1-3)	1.5±0.7 (1-3)	0.910
BMI, kg/m2	27.2±4.3(18-35)	26.7±3.4 (21-34	0.976
Kreatin, mg/dL	1.7±0.5 (0.5-3.2)	1.89±0.6 (0.7-3.8)	0.556
CRP,ml/L	104±93 (10-350)	93±83 (15-320)	0,584
Obstruction time,day	18.6±17.8(4-90)	68.6±58.4(15-300)	**< 0.001**
Comorbid disease, n(%)			**< 0.001**
DM	12(11%)	7(8%)	
HT	18(14%)	18(20%)	
Anticoagulant use	17(13%)	-	
Causative factor, n(%)			**< 0.001**
Stone	112 (88%)	36 (40%)	
Stenosis	9 (7 %)	5 (6%)	
Cervix ca	4 (3 %)	24 (27%)	
Bladder ca	-	11 (12 %)	
Prostat ca	-	6 (7 %)	
Tah+Bso	3 (2%)	4 (5%)	
Retroperitoneal fibrosis	-	2 (2%)	
Unknown cause	-	1 (1 %)	
Hidronephrosis, n(%)			**< 0.001**
Grade 1	29 (23%)	-	
Grade 2	76 (59%)	64 (72 %)	
Grade 3	23 (18%)	25 (28 %)	
Pyelonephritis, n(%)	46 (36 %)	39 (44%)	0.244

Age, ASA, BMI; It was given as mean ± sD (IQR). IQR;Inter guartile range, ASA; American Society of Anesthesia, BMI; Body mass index, CRP; C-reactive protein, DM; Diabetes Mellitus, HT; Hypertension, TAH+BSO; Total Abdominal Hysterectomy+Bilateral Salpingo-Ooferectomy

In the DJ stent group, 23% of patients had grade 1 hydronephrosis, while this rate was 0 in the nephrostomy group. Most patients in both groups were identified to have grade 2 hydronephrosis (59% vs. 72% in Group 1 and 2) (p < 0.001). The preoperative disease duration was significantly shorter in the DJ stent group compared to the nephrostomy group (Table 1). Stone dimensions were 13.4±2.3 vs. 17.5±4.7 mm in the DJ stent and nephrostomy groups, respectively (p < 0.001) (Table 2).

Table 2. Demographic Characteristics

	DJ stenting	Nephrostomy	p
Stone localization (no, %)			0.060
Renal pelvis	26 (20%)	27 (30%)	
Upper ureter	45 (35%)	49 (55%)	
Middle ureter	34 (27%)	9 (10%)	
Lower ureter	23 (18 %)	4 (5%)	
Stone Burden, mm	3.4±2.3 (7-18)	17.5±4.7 (8-27)	**< 0.001**

Stone Burden ; It was given as mean±sD (IQR)

Table 3. Operasyonel ve post-operasyonel classifications

	DJ stenting	Nephrostomy	P
Operation time	20.6±4.4 (17-28)	37.3±4.2 (32-47)	**< 0.001**
ICU unit, n(%)	19 (15 %)	23(25 %)	0.178
Hospital stay	3.1±1.3 (2-6)	4.2±1.4 (3-8)	0.763
Auxiliary stent use, n(%)	7 (% 6)	0	**< 0.001**
Kreatin (mg/dL)	1.3±0.2 (0.9-1.7)	1.2±0.2 (1-1.8)	0.343
Complications, n(%)			**0.022**
Dizüri, irritation of stent	29 (22 %)	N/A	
Hematüria (Microscobic)	14 (11 %)	16 (17 %)	
Encrustation	5 (4%)	N/A	
Stent withdrawing	2 (2 %)	N/A	
Sepsis	6 (5 %)	1 (1%)	
Problems of nephrostomy	N/A	4 (4%)	
Clavien-Dindo Classifications			
Stage 1	38 (30 %)	12 (13%)	
Stage 2	5 (4%)	4 (4%)	
Stage 3	7 (5%)	4 (4%)	
Stage 4a	6 (5 %)	1 (1%)	
Total	56 (44 %)	21 (22%)	
Definitive treatment for stone, n(%)			**< 0.001**
Retrograde	94 (79 %)	7 (17 %)	
Antegrade	25 (21 %)	34 (83 %)	

Operation Time, Hopital Stay and Kreatin, It was given as mean±sD (IQR)

ICU; Intensive Care Unit

The mean operation duration in the group with DJ stent inserted was significantly shorter compared to the other group ($p < 0.001$). The number of patients requiring intensive care and duration of hospital stay after surgery were similar in both groups ($p > 0.05$); however, postoperative complication rates were different ($p = 0.020$). In the DJ stent group, the most common complication was irritative complaints linked to the stent, present in 29 patients (23%). In the nephrostomy group, 16 patients (18%) had minor hemorrhage which was the most common complication. There were differences in terms of auxiliary stent use and definitive treatment for stones. In the DJ stent group, 7 pyelonephritis patients had no regression of hydronephrosis and infection tableau after stent insertion so auxiliary nephrostomy catheter was inserted. In the nephrostomy group, no patient required insertion of auxiliary DJ stent ($p < 0.001$) (Table 3).

Binary logistic regression analysis analyzed the predictive values of variables for stent selection. Causative factors, hydronephrosis, stone size and disease duration were identified to have predictive value. According to logistic regression analysis, DJ stent should be used for upper urinary tract obstruction due to small ureter stones, grade 1 hydronephrosis and short duration of disease. Contrary to this, patients with urinary obstruction due to external local advanced stage cancerous mass compression, grade 2-3 hydronephrosis, long disease duration and large stones should have nephrostomy catheter inserted (Table 4).

Table 4. Binary Logistics Regression Analysis Results of İmportant Predictive Values in Determining the Drainage Path to be Used

	ORs	95% CI Lower/Upper	P
Age	1.005	0.969/ 1.043	0.776
Gender	3.275	0.663/16.180	0.146
Comorbid disease	1.803	0.186/17.426	0.611
Stone burden	1.283	1.051/1.566	0.014
Obstruction time	1.067	1.031/1.105	**< 0.001**
Causative factors	38.073	5.475/274.038	**< 0.001**
Hidronephrosis	10.448	1.649/66.187	**0.013**

ODs: Odds Ratio, CI: Confidence Interval

DISCUSSION

Firstly and urgently upper urinary tract drainage must be ensured in upper urinary system obstruction patients accompanied by pyelonephritis, sepsis, septic shock and obstructive uropathy. The European (EAU) and American Urology Associations (AUA) recommend drainage of the collecting system with emergency JJ stent and/or PCN in patients with obstruction due to ureter stones in urolithiasis panels and sepsis (6). Hong et al. (7) reported that when urinary drainage was delayed in UTI patients with urinary tract obstruction, renal replacement treatment (RRT) requirements, frequency of RRT and the need for intensive care increased further, and the disease became more complicated.

Patients with hydronephrosis and obstructive uropathy with local advanced stage pelvic cancers were reported to have shortened 5-year survival and these patients were prevented from receiving chemotherapy and radiotherapy. Pergialiotis et al. (8) reported that hydronephrosis in cervical cancer had 5-year OS hazard ratio (HR) of 1.34-3.74, while Sinistrero et al. (9) found hydronephrosis lowered 5-year survival in T3b cervical cancer patients (from 41% to 26%), while Zhu (10) reported that preoperative hydronephrosis in bladder cancer patients (especially bilateral hydronephrosis: HR: 5.43, 95% CI [3.14-9.4], $p < 0.001$) caused poor OS and CSS after radical cystectomy. Van Arrdt (11) and Gadducci (12) reported that renal drainage in local advanced cancer patients normalized blood urea nitrogen, allowed these patients to receive chemo and radiotherapy and as a result may lengthen total survival.

DJ stents may be inserted with local anesthesia; however, spinal or general anesthesia may be chosen as most patients cannot tolerate local anesthesia. As a result, DJ stents should be chosen for patients with good general status or normal vital signs. DJ stents have smaller lumen diameters compared to nephrostomy catheters and urinary irritative complaints are frequently observed (13,14). Nephrostomy catheter may be inserted with local anesthesia. The requirement for USG and the low USG experience of urology surgeons is a disadvantage. Other disadvantages include major hemorrhage, injury risk to adjacent organs and low success of intrarenal entry in patients with low grade hydronephrosis (15). Another negative aspect is that the stent is outside the patient's body.

After PCNs, severe, mortal gross hematuria may be observed in patients with hemorrhage diathesis or receiving anticoagulant treatment with platelets below 100,000 (16,17). The American College of Radiologists (ACR) recommended threshold values of 4% separately for hemorrhage and septic shock, while the Society of Cardiovascular and Interventional Radiologists (SCVIR) recommended 1-4% for hemorrhage or vascular injury and 1-9% for septic shock (16). Turo et al. (16) reported they encountered 3% septic shock and 1.5% hemorrhage requiring blood transfusion. Carafillo et al. (18) reported they observed no major complications in grade 2-4 hydronephrosis patients. Kaskarelis et al. (19) observed 0.4% major hemorrhage and reported that the high degree of dilatation of the renal collecting system in patients with PCNs may have contributed to low observation of this complication. Kumar et al. (20), as in our study, reported no major hemorrhage requiring angioembolization or nephrectomy. As in our study, we paid attention that patient who had PCN chosen for drainage had high grade hydronephrosis and this probably prevented observation of major hemorrhage after the procedure.

In DJ stent patients, irritative symptoms like frequency, urgency and dysuria and pain while urinating and hematuria are frequently observed (40-80%) (21,23). Additionally, anxiety, sleep problems, low quality of

life, sexual dysfunction and libido loss are identified (13,23). Some JJ stent patients are reported to attend the emergency service due to pain and remove the stent, rather than experience irritative symptoms. In our study, similar to the literature, the rate of irritative symptoms was 23% in the DJ stent group.

In our PCN group, 4 patients (4.5%) experienced stent problems. Stent obstruction and dislodgement problems were experienced at rates of 4.5% by Ahmed (21) and Turo (16), 5% by Syed Mubarak Ali (22) and 13% by Karim (24). M Ahmed (15) identified more stent obstruction than the average in the literature after the PCN procedure (37.5%). We think this may be due to the quality of the catheter and diameter used due to the study being completed in a less developed country.

Ureter obstructions occurring linked to local advanced stage organ cancers in the pelvic region occur against a chronic background and hydronephrosis is mostly diagnosed late. This progresses to obstructive uropathy in the kidney during this time interval. At the same time, tumor infiltration of the ureter wall and inflammation, edema and fibrosis may cause full closure of the ureter lumen. Without a lumen, it is not possible to send a retrograde intraluminal catheter toward the proximal. Sometimes, mass in the bladder trigon may cause closure of the ureter orifice on cystoscopy. As a result, we inserted a nephrostomy catheter for renal drainage in most patients with upper urinary tract obstruction due to cancer (unless patients had a persistent choice). Similarly in the literature, it is recommended that the nephrostomy drainage method be chosen for ureter obstruction due to external compression linked to chronic processes (8).

In stone patients, differently, for nearly all patients we initially attempted to insert a DJ stent; however, if the guidewire could not pass proximal of the stone, we inserted PCN in the same session. Zachariah (25) recommended choosing PCN in patients with large stones and worse infection tableau. Pandey (26) reported that multiple and large stones were significant predictive factors for failure of JJ stent in patients with obstructive urolithiasis and sepsis with multinomial regression analysis. Similar to the literature, in our study we saw the obstructive duration and mean stone size was significantly greater in patients with PCN inserted for obstructive urolithiasis compared to the DJ stent group ($p < 0.001$). We think this situation is due to irritation and inflammation occurring in the ureter lumen due to long duration of obstruction linked to large stones. Long duration of stone inflammation in the ureter finally causes polyposis and fibrosis leading to stone impaction.

For urologists with moderate levels of ultrasound experience, it is important that hydronephrosis be grade 2 or above for reliable entry into the intrarenal system with USG (24). The American College of Radiology (ACR)-SIR-SPR predicts 95% and 80% successful entry for dilated and nondilated systems, respectively (27). Kumar (20) reported 97.7% success in patients with transverse renal pelvis diameter >1 cm, with only 67% success for grade 1 hydronephrosis patients. Zachariah (25) reported that the PCN procedure was unsuccessful in a patient with 14 mm proximal ureter stone causing renal fornix rupture and urinoma due to insufficient intrarenal dilatation. In our study, we chose this entry for patients with high degree of dilatation, so similar to the literature we achieved 100% PCN entry success in a single attempt.

For patients with dense necrotic debris and fuzzy pyelonephritis, a stent may not always provide sufficient drainage and if the septic features of patients do not resolve, a second drainage method may be required as auxiliary method for the same kidney (28). PCN stents have wider internal lumen so blockage is more difficult, apart from technical reasons. As a result, auxiliary drainage methods are required more in patients with DJ stent inserted. Rosevear (29) reported 15% of internal ureteral stent patients, inserted due to external ureteral obstruction, required insertion of PCN stent in advancing time. Kanou (30) reported that 12% of patients with external ureteral obstruction due to malignancy could not sustain internal ureteric stent. Mertens (2) in a 44-patient series reported that 7 out of 32 patients with initial DJ stent inserted (20%) did not have sufficient renal drainage provided so they were forced to insert auxiliary PCN stent. In our study, 6% of patients in the DJ group had postoperative fever lasting more than 2 days and pyelonephritis within the kidney did not disappear, so we had to insert a nephrostomy catheter as an auxiliary drainage method.

After drainage, definitive treatment is required for patients without advanced stage malignant diseases. As this was not the topic of our study, we did not analyze in depth. However, especially in stone patients, definitive stone treatment for most PCN patients used the same/antegrade route, while DJ stent patients mainly chose the retrograde route. Similarly, Zachariah (25) reported that patients with PCN drainage for obstructive urinary tract sepsis chose the percutaneous route for definitive treatment after sepsis resolved (38% vs. 6%, $p < 0.001$), while JJ stent patients mainly chose ureterorenoscopic surgery (65% vs. 40%, $p = 0.004$).

The most significant limitation of this study is that it is retrospective. The lack of patients with congenital ureteral obstruction like UV and UPJ stenosis and bilateral ureter obstruction patients, and the lack of post-catheter survival of cancer patients are the main deficiencies. Additionally, we also did not attempt CT-assisted entry in grade 1 hydronephrosis patients where USG entry was not attempted. There is a need for prospective multicenter studies for these limitations. In spite of these limitations, we think this study will provide direction to readers about which drainage method is the more feasible choice for which patients.

CONCLUSION

In conclusion, for patients with long duration of obstruction, with high grade hydronephrosis, with local advanced

stage pelvic region cancers causing obstruction or with obstructive uropathy due to large ureter stone and sepsis, we should use PCN catheterization as the primary plan, not internal stents.

Competing interests: The authors declare that they have no competing interest.

Financial Disclosure: There are no financial supports.

Ethical approval: SBU Istanbul Training And Research Hospital for this job clinical research approved by the ethics committee (approval number; 2432, date; 12.06.2020).

REFERENCES

1. Radecka E, Magnusson M, Magnusson A. Survival time and period of catheterization in patients treated with percutaneous nephrostomy for urinary obstruction due to malignancy. Accta Radiol 2006;47:328-31.
2. Mertens S, Zeegers AGM, Wertheimer PA, Hendriksz TR, Van Bommel EFH. Efficacy and complications of urinary drainage procedures in idiopathic retroperitoneal fibrosis complicated by extrinsic ureteral obstruction. Int J Urol 2014;21:283-8.
3. Tambo M, Okegawa T, Shishido T, et al. Predictors of septic shock in obstructive acute pyelonephritis.World J Urol 2014;32:803-11.
4. Tambo M, Taguchi S, Nakamura Y, et al. Presepsin and procalcitonin as predictors of sepsis based on the new Sepsis-3 definitions in obstructive acute pyelonephritis. BMC Urol 2020;20:23.
5. Buonaiuto VA, Marquez I, De Toro I, et al. Clinical and epidemiological features and prognosis of complicated pyelonephritis: a prospective observational single hospital-based study. BMC İnfectious Diseases 2014;14:639.
6. Preminger GM, Tiselius HG, Assimos DG, et al. Guideline for the management of ureteral calculi. Eur Urol 2007;52:1610-31.
7. Hong JY, Suh SW, Shin J. Clinical significance of urinary obstruction in critically ill patients with urinary tract infections. Medicine 2020;99:1.
8. Pergialiotis V, Bellos I, Thomakos N, et al. Survival outcomes of patients with cervical cancer and accompanying hydronephrosis: a systematic review of the literatüre. Oncology Reviews 2019;13:387.
9. Sinistrero G, Sismondi P, Zola P. Results of treatment uterine cervix cancer by radiotherapy. Radiother Oncol 1988;13:257-65.
10. Zhu Z, Zhao J, Li Y, et al. Prognostic value of preoperative hydronephrosis in patients with bladder cancer undergoing radical cystectomy: A meta-analysis. Plos One 2019;14.
11. Gadduci A, Madgirali A, Facchini V, et al. Percutaneous nephrostomy in patients with advanced or recurrent cervical cancer. Obstet Gyneco 1994;21:71-3.
12. Van Aardt MC, Van Aardt J, Mouton A. Impact of percutaneous nephrostomy in South african women with advanced cervical cancer and obstructive uropathy. South Afr J Gynaecol Oncol 2017;9:6-10.
13. Leibovici D, Cooper A, Lindner A, et al. Ureteral Stents: Morbidity and İmpact on Quality of Life. IMAJ 2005;7:491-4.
14. Betchart P, Zumstein V, Piller A, et al. Prevention and treatment of symptoms associated with indwelling ureteral stents: A systematic review. Int J Urol 2017;24:250-9.
15. M Ahmed, AT Lawal, A Bello, et al. Ultrasound guided percutaneous nephrostomy: experience at Ahmadu Bello University Teaching Hospital, Zaria. Niger J Clin Pract 2017;20:1622-5.
16. Turo R, Horsu S, Broome J, et al. Complications of percutaneous nephrostomy in a district general hospital. Turk J Urol 2018;44:478-83.
17. Fowler JE, Mearse EM, Goldin AR. Percutaneous nephrostomy: technigues, indications, and results. Urology 1975;6:428-34.
18. Carrafiello G, Lagana D, Mangini M, et al. Complications of percutaneous nephrostomy in the treatment of malignant ureteral obstructions: single-centre review. Radiol Med 2006;111:562-71.
19. Kaskarelis IS, Papadaki MG, Malliaraki NE, et al. Piperopolous PN. Complications of percutaneous nephrostomy, percutaneous insertion of ureteral endoprosthesis, and replasment procedures. Cardiovasc Intervent Radiol 2001;24:224-8.
20. Kumar S, Dutt UK, Singh S, Dorairajan LN, et al. Prospective audit of complications after ultrasonography- guided percutaneous nephrostomy for upper urinary tract obstructıon using modified Clavien classification system. Urol Ann 2020;12:31-6.
21. Ahmad İ, Pansota MS, Tariq M, et al. Comparison between double J (DJ) ureteral stenting and percutaneous nephrostomy (PCN) in obstructive uropathy. Pak J Med Sci 2013;29:725-9.
22. Ali MS, Mehmood K, Faiq SM, et al. Frequency of complications in image guided percutaneous nephrostomy. J Pak Med Assoc 2013:63;816.
23. Joshi HB, Stainthorpe A, Keeley FX, et al. İndwelling ureteral stents: evaluation of quality of life to aid outcome analysis. J Endourol 2001;15:151-4.
24. Karim R, Sengupta S, Samanta S, et al. Percutaneous nephrostomy by direct puncture technigue: An observational study. İndian J nephrol 2010;20:84-8.
25. Zachariah GG, Olugbemisola OG, Gerber L, et al. Emergent ureteric stent vs percutaneous nephrostomy for obstructive urolithiasis with sepsis: patterns of use and outcomes from a 15-year experience. BJU international 2013;112:122-8.
26. Pandey S, Sharma D, Sankhwar S, et al. Are there any predictive risk factors for failure of ureteric stent in patients with obstructive urolithiasis with sepsis? Investig Clin Urol 2018;59:371-5.
27. Dagli M, Ramchandani P. Percutaneous nephrostomy: Technical aspects and indications. Semin İntervent Radiol 2011;28:424-37.
28. Lynch JO, Cox A, Rawal B, et al. Bilateral obstruction of bilaterally duplicated collecting systems reguiring upper and lower moiety drainage. Ann R Coll Surg Engl 2016;98:55-8.

29. Rosevaer HM, Kim SP, Wenzler DL, et al. Retograde ureteral stents for extrinsic ureteral obstruction: nine years' experience at University of Michigan. Urology 2007;70:846-50.

30. Kanou T, Fujiyama C, Nishimura K, et al. Management of extrinsic malignant ureteral obstruction with urinary diversion. Int J Urol 2007;14:689-92.