

# Comparative study of silicone and polyurethane nephrostomy catheters used for long-term urinary drainage in malignancy

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## ABSTRACT

*Despite the modern advancement in endourology, percutaneous nephrostomy play an important role in many urologic conditions, which of the most important is the relief of upper urinary tract in patients with malignancies that interests the ureter or the uretero-vesical junction.*

*The aim of the study is to compare the complications of polyurethane and silicone catheters used for percutaneous nephrostomy in patients with unilateral or bilateral uretero-hydronephrosis secondary to locally advanced abdomino-pelvin malignancies.*

*We have retrospective analyzed 164 patients (p), admitted between January 2013 and December 2016 in Urology Department Sibiu, who benefit from unilateral or bilateral percutaneous nephrostomy for secondary uretero-hydronephrosis with acute renal failure.*

**Keywords:** percutaneous nephrostomy, catheter, polyurethane, silicone, uretero-hydronephrosis

## INTRODUCTION

Despite the modern advancement in endourology percutaneous nephrostomy play an important role in many urologic conditions, which of the most important is the relief of upper urinary tract in patients with malignancies that interests the ureter or the uretero-vesical junction.

Malignant urinary obstruction can be secondary to extrinsic tumor compression, direct tumor invasion or an intrinsic genitourinary (GU) malignancy. One large study reported malignant obstruction as the indication for over 60% of all nephrostomies (1).

Percutaneous nephrostomy is a gentle procedure associated with high technical success and low morbidity. The complications of percutaneous nephrostomy consists in urinary tract infection, catheter dislodgement, catheter ob-

struction by debris, urinary leakage and inflammation of the skin at the site of insertion of the percutaneous catheter (2).

## MATERIAL AND METHODS

In the present study we analyzed in a comparative manner the complications of polyurethane and silicone catheters used for percutaneous nephrostomy in patients with unilateral or bilateral uretero-hydronephrosis secondary to locally advanced abdominopelvic malignancies.

We have retrospective analyzed 164 patients (p), admitted between January 2013 and December 2016 in Urology Department Sibiu, who benefit from unilateral or bilateral percutaneous nephrostomy for secondary uretero-hydronephrosis with acute renal failure. We used for

nephrostomy two types of catheters: 1. A polyurethane Cope loop 12 Fr or 14 Fr catheter; 2. 2 way silicone Foley 12 Fr or 14 Fr catheter. The placement of the catheters was done using a combined ultrasound and fluoroscopic technique. Intraoperative urine cultures were collected using the puncture needle. The catheters were changed every 3 months or earlier if needed using the fluoroscopic guidance. We evaluated the patients at every catheter change over an exact period of time of 1 year. At every evaluation urine culture were collected 1-2 hours before removing the nephrostomy catheters, and after removal all catheters were microscopically analyzed for encrustation and using a hydrophilic guidewire for patency. Patients who could not complete the follow-up at 1 year were excluded from the present study.

The statistical analysis of this paper was done by using chi-square test, the Fischer exact test. A p value <0.05 was considered statistically significant.

## RESULTS

The mean age of patients (p) was 67.8 years (range 39-91 years) and 65.2% (107/164) were women. Bilateral percutaneous nephrostomy was performed in 75.6 % cases (124/164). Polyurethane nephrostomy catheters were used in 54.2% p (89/164). The characteristics are presented in Table 1.

When comparing the need of catheter replacement before pre-established visit, 17.1% p required at least one catheter change, with higher rate in the silicone group (Table 2).

The most common reason of catheter replacement was the obstruction due to debris with a rate of 4.9% (60/1222), followed by catheter dislodgement with a rate of 1.1% (11/1222).

The obstructed catheter rate was higher in the silicone catheter group with a rate of 7.5 % (9.7% for 12 Fr and 4.8% for 14 Fr) compared to polyurethane catheters that had a rate of 2.4% (2.7% for 12 Fr and 2% for 14 Fr) (Table 3).

**TABLE 1**

	All patients	Polyurethane catheter	Silicone catheter	p
Patients	164	89	75	
Mean age (yr) ± SD (range)	67.8 ± 19.4 (39-91)	66.7 ± 17.6 (39-88)	68.1 ± 16.4 (42-91)	ns
Sex				
Women	107 (65.2%)	56 (62.9%)	51 (68 %)	ns
Men	57 (34.8%)	33 (37.1%)	24 (32 %)	ns
Catheter placement				
Unilateral	40 (24.4 %)	22 (24.8 %)	18 (24 %)	ns
Bilateral	124 (75.6 %)	67 (75.2 %)	57 (76 %)	ns
Catheter diameter				
12 Fr	111 (67.6 %)	71 (79.7 %)	40 (53.3 %)	ns
14 Fr	53 (32.4 %)	18 (20.3 %)	35 (46.7 %)	ns
Intraoperative positive culture	18 (10.9 %)	8 (8.9 %)	10 (13.3 %)	ns

ns – not statistically significant

**TABLE 2**

	Polyurethane catheter (p)		Silicone catheter (p)		All patients	p
	12 Fr	14 Fr	12 Fr	14 Fr		
V = 4	66 (92.9%)	15 (83.3%)	27 (67.5%)	28 (80%)	136 (82.9%)	ns
V 5-7	4 (5.7%)	3 (16.7%)	9 (22.5%)	5 (14.3%)	21 (12.8%)	ns
V ≥ 8	1 (1.4%)	0	4 (10%)	2 (5.7%)	7 (4.3%)	ns
Total	71	18	40	35	164	ns

ns – not clinically significant, V – visit

**TABLE 3**

	Polyurethane catheter (n)		Silicone catheter (n)		Catheters placed	p
	12 Fr	14 Fr	12 Fr	14 Fr		
Catheters used	441	200	318	267	1222	
Obstructed catheter (%)	12 (2.7%)	4 (2%)	31 (9.7%)	13 (4.8%)	60 (4.9%)	0.031
Catheter dislodgement	1 (0.2%)	0	7 (2.2%)	6 (2.2%)	14 (1.1%)	0.022
Total	17 (2.6%)		57 (9.9%)		74 (6%)	

ns – not clinically significant

TABLE 4

	Polyurethane catheter (n)		Silicone catheter (n)		Catheters placed	p
	12 Fr	14 Fr	12 Fr	14 Fr		
Standard catheters used	441	200	318	267	1222	
Urinary infection	83 (18.8%)	33 (16.5%)	51 (16%)	49 (18.3%)	216 (17.6%)	0.8
Catheter encrustation	126 (28.5%)	59 (29.5%)	98 (30.8%)	74 (27.7%)	357 (29.2%)	0.7
Skin inflammation	48 (10.8%)	18 (9%)	9 (2.8%)	11 (4.1%)	86 (7%)	0.041

The catheter dislodgement in our study group was specific to the silicone catheter group with a rate of 2.2%, with only one case of dislodgement in the polyurethane group (0.2%).

The complications of nephrostomy placement included urinary infection (17.6%), catheter encrustation (29.2%) and local skin inflammation at the site of nephrostomy (7%). (Table 4).

## DISCUSSION

Improvement of renal function after PCN can be of clinical benefit in patients who might be cured or for prolonged palliative care (4).

The ideal nephrostomy tube is yet to be discovered, in meantime the type of nephrostomy to be used the urologist choice depending on the biomaterial used and by personal experience.

We did not experience malposition of nephrostomy because we used a combined ultrasound and fluoroscopic technique to place the nephrostomy tube.

Overall, 18 patients of 164 (10.9%) presented positive urine culture at the moment of nephrostomy.

The silicone nephrostomy tube are more predisposed for replacement (9.9%) than the polyurethane catheter (2.6%), due to debris obstruction and catheter dislodgement.

When talking about the obstructed catheter the result can be explained by the fact that the lumen of a 12 Fr silicone catheter is smaller than a 12 Fr polyurethane catheter, same for the 14 Fr catheter (Fig. 1).



FIGURE 1. Polyurethane catheter (left) and silicone catheter (right) crossing section

Bayne et al. reported that the type of the catheter do not influence the dislodgement rate, but that was a study on short postoperative time catheter placement (3). But this study was done for patient that needed a short time nephrostomy. In our series the rate of dislodgement is higher in the silicone catheters (2.2% vs. 0.2%). We put this result on the fact that we used 2 way silicone catheters with 5 ml intrarenal balloon that was predisposed for deterioration and rupture, that being the reason of dislodgement. The polyurethane catheters were fixed directly to the skin, which seems to be safer than the intrarenal balloon system.

Another complication related to the biomaterial used in the manufacturing of the nephrostomy is the skin inflammation at the site of the insertion of the catheter, which was more present in patients with polyurethane type (10.2%) than in silicone group (3.4%).

Complications of PCN insertion occur in 4-26% of procedures (5-8) and include malposition, dislodgement or occlusion of the tube. Occlusion may result from blood clot formation in the renal pelvis. In our series if we take into account only the dislodgement and catheter occlusion the complication rate is 6%, but if we add the local skin inflammation to the complications the rate will rise to 11%.

## CONCLUSIONS

Percutaneous nephrostomy is a safe, minim invasive, cheap and quick method of urinary diversion in patients with acute renal failure due to ureteral obstruction because of malignant disease of pelvic origin.

Our data suggest that for long term nephrostomy polyurethane catheters represents a better alternative for patients than silicone catheters, with lower rate of dislodgement and occlusion.

Local skin inflammation, catheter encrustation, better modalities of fixation and urinary infection due to catheter placement are important factors to take into account for developing a new generation of nephrostomy catheters.

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