

Percutaneous Nephroureteral Tube: A Useful Tool for Management of Intractable Hematuria

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OBJECTIVE	To describe our experience using percutaneous nephroureteral (PCNU) tube placement for the management of intractable gross hematuria.
METHODS	We identified patients at our institution who underwent PCNU tube placement from August 2011 to October 2017 for management of gross hematuria who had previously failed management with manual irrigation, continuous bladder irrigation, and cystoscopy with clot evacuation. The primary outcome measured was cessation of bleeding obviating the need for further blood transfusion in a 30 day follow-up period.
RESULTS	Six patients were treated with PCNU tube placement for intractable hematuria from either malignant or nonmalignant etiologies. In all patients after PCNU tube placement, hematocrit value remained stable, there were no further transfusions requirements within 30 days, and no immediate or peri-procedural complications were encountered. In no instance did a PCNU become obstructed by blood clots and in all cases the bladder and both kidneys were adequately drained.
CONCLUSION	In patients with hematuria refractory to conventional management techniques, the placement of a PCNU tube allows for cessation of bleeding, successfully diverts urine with no immediate complications and is not subsequent to clot obstruction of the tube. The use of PCNU tube is a viable treatment in the algorithm of intractable hematuria, specifically before resorting to more morbid and potentially irreversible treatments. UROLOGY 00: 1–4, 2019. © 2019 Elsevier Inc.

Gross hematuria is a common presenting symptom in urology. Clot urinary retention secondary to gross hematuria is routinely managed conservatively with mechanical irrigation and continuous bladder irrigation using a 3-way urethral catheter, though occasionally cystoscopy is required for clot evacuation and fulguration of bleeding areas.¹⁻³ In rare cases intractable hematuria is encountered which may necessitate blood transfusions and multiple procedures to remove obstructing clots.⁴

Current management of intractable hematuria includes intravesical formalin instillation, vessel embolization, bilateral nephrostomy tubes, and even cystectomy in rare cases.⁵⁻⁸ These methods, however, are often associated with significant morbidity, including catheter obstruction and compromise of future bladder function. Having an additional step in the algorithm for the management of intractable hematuria prior to undergoing potentially

irreversible therapies is invaluable. Herein, we describe our experience using percutaneous nephroureteral (PCNU) tube placement for the management of intractable gross hematuria. Unlike bilateral nephrostomy tubes which partially divert a patient's urine and require some additional form of bladder drainage, a PCNU tube works by initially allowing an organized clot to form within the bladder (which tamponades further bleeding), and additionally works to drain urine from the contralateral kidney and bladder in a retrograde fashion via capillary action.

METHODS

We conducted a single institutional retrospective review of all patients who underwent placement of PCNU tubes from August 2011–October 2017 for the management of gross hematuria. Only patients whose indication for placement was macroscopic hematuria with failed conservative management with manual irrigation through a 6-eye urethral catheter followed by continuous bladder irrigation and an escalation to cystoscopy with transurethral evacuation of clot in the operating room, were included. All patients were trialed with a PCNU tube prior to considering more invasive treatments such as intravesical formalin instillation, vascular embolization, or cystectomy. All patients received Cook Cope-Nephroureterostomy stents (Cook Medical, Bloomington, IN 47402). The primary outcome measured was the cessation of bleeding obviating the need for further

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blood transfusion in a 30-day follow-up period. The secondary outcome measured was the interval change in serum creatinine after placement of PCNU.

RESULTS

Between August 2011 and October 2017, a total of 6 patients were treated by way of a single PCNU tube for intractable hematuria with urinary retention. All patients had been unresponsive to conservative therapies and subsequent cystoscopy with clot evacuation. Five of the 6 patients were male, and the mean age of the cohort was 72 years. No patient underwent intravesical instillation, hyperbaric oxygen, or vessel embolization prior to PCNU tube placement. In 4 patients, the etiology of bleeding was secondary to malignancy, either from primary bladder cancer, direct invasion of a local malignancy, or malignancy metastatic to the bladder. The other etiologies include postradiation hemorrhagic cystitis and upper tract bleeding of an unclear nature.

PCNU tube placement was on the left side in 4 patients and right side in the other two. Sizes of the PCNU used were 8.5 Fr in 4 patients and 10.2 Fr in 2 patients and lengths of stents ranged from 24 cm to 28 cm. In all patients, urethral catheters were removed after PCNU tube placement to allow for formation of an organized blood clot in the bladder. All patients had required blood transfusion prior to PCNU tube placement for a hematocrit less than 21. In all patients, the hematocrit level remained stable after PCNU tube placement, and no further blood transfusions were required. No patient required intravesical formalin instillation, vessel embolization, or cystectomy after PCNU tube placement. Serum creatinine levels remained stable or decreased in all patients with recorded postprocedure laboratory values following PCNU tube placement (Table 1).

There were no immediate or peri-procedural complications from PCNU tube placement. Several patients did experience bladder spasms in the initial days due to bladder clot formation after removal of the urethral catheters, but all were successfully treated with anticholinergic medication and/or beta-3 agonists. No patient had obstruction of the PCNU tubes by blood clots or required replacement or manipulation of the PCNU tubes due to poor drainage. Two patients, after being stabilized and discharged home, were re-admitted for accidental dislodgment of their PCNU tube requiring replacement. In 2 patients whose intractable hematuria was secondary to terminal, nonoperative cancer, the PCNU tube provided hemostasis and diverted urine without the need for an additional urethral catheter. Both patients expired from their primary terminal disease within 1 month of PCNU tube placement. In an additional patient with a severely contracted bladder after radiation treatment, the PCNU tube was preferred for long-term bladder drainage. In our 3 patients who had PCNU tubes removed, all were able to resume normal voiding per urethra without need for additional instrumentation.

DISCUSSION

Gross hematuria is a common urologic problem often managed by conservative approaches alone. Hematuria refractory to these conservative measures is uncommon, but can be challenging to manage. Previous studies have shown that bilateral percutaneous nephrostomy (PCN) placement is an effective management strategy for intractable hematuria.^{9,10} However, this method increases

Table 1. Patient characteristics

Patient	Age	Gender	Etiology of Hematuria	Duration of PCNU (months)	Serum Cr pre-PCNU	Serum Cr post-PCNU	Complications	30-Day Follow-Up
1	55	M	Urothelial carcinoma of the bladder	4	0.6	0.6	None	Hematuria resolved, PCNU tube removed
2	92	M	Idiopathic right upper urinary tract bleeding	1	3.6	2.2	PCNU tube dislodged	PCNU tube not replaced, hematuria resolved
3	86	M	Hemorrhagic cystitis after external radiation therapy	28	0.9	0.9	None	Patient chose to continue PCNU with regular 3 month exchanges
4	63	M	Renal cell cancer metastatic to the bladder	3	1.2	1.2	PCNU tube dislodged	PCNU tube replaced, hematuria resolved, PCNU tube removed
5	67	F	Endometrial cancer metastatic to the bladder	1	3.1	1.2	None	Patient expired in hospice care
6	75	M	Urothelial carcinoma of the bladder	1	1.1	n/a	None	Patient expired in hospice care

the risk of patient morbidity by requiring both renal units be manipulated and further does not drain urine from the bladder. To our knowledge, our study is the first series to describe the use of unilateral PCNU tube placement for management of intractable hematuria in patients with both malignant and nonmalignant etiologies of hematuria.

In our experience, PCNU tube placement is a safe and effective method for managing intractable hematuria in the acute setting when more conservative treatment approaches have failed. Further, PCNU tube is a valuable palliative treatment option in end-of-life care. A single PCNU tube can effectively divert urine from both kidneys, requires only one procedure site and subsequently only one drain to manage. Compared to urethral catheters, which are susceptible to clot obstruction in the setting of ongoing severe hematuria, PCNU tube allows for adequate urine drainage without obvious obstructive complications though no postprocedure imaging was obtained. As such, contralateral hydronephrosis may have persisted, however these concerns are tempered by the fact that no patient in our cohort developed contralateral flank pain, infection, or increasing serum creatinine after PCNU placement. No patient in our series required tube exchange for obstruction or poor urinary drainage. We believe the mechanism behind a lack of obstruction is likely related to a smaller tube diameter, allowing for urinary drainage in a retrograde fashion, as similarly described for vascular catheters.^{11,12} Specifically, the 8.5 Fr and 10.2 Fr PCNU tubes used in this study drain via capillary action thereby propelling fluid out the bladder with continuous flow within the lumen of the PCNU tube which simultaneously prevents luminal obstruction by larger blood clots (Fig. 1).¹³

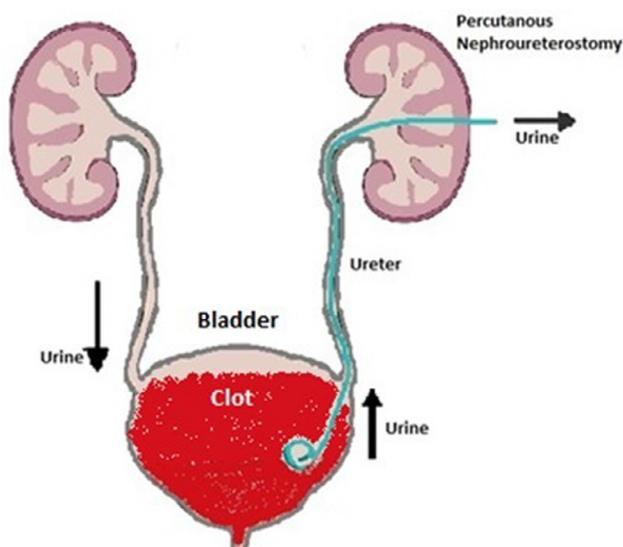


Figure 1. Percutaneous nephroureterostomy (PCNU) tube allows for adequate urine drainage from both kidneys in patients with intractable hematuria while allowing bladder bleeding to tamponade. (Color version available online).

Placement of a PCNU tube for intractable hematuria can obviate the need for more invasive and possibly irreversible surgical procedures. No patient in our series had immediate or periprocedural complications related to the placement of a PCNU tube, though 2 out of 6 patients required readmission for tube dislodgement. A few patients did experience bladder spasms, this was easily managed with anticholinergic medication and/or beta-3 agonists. In our experience, patients were able to resume spontaneous voiding after PCNU removal without need for additional irrigation or instrumentation. The quick resolution of bladder clot after PCNU removal may be due to presence of urokinase which facilitates the breakdown of clot after tamponade of bleeding has occurred. It should also be noted that management of intractable hematuria with a single PCNU tube is only intended for venous bleeding and would not be expected to work in cases of arterial bleeding, which is unlikely to tamponade. Furthermore, PCNU tube placement may not be feasible in the setting of advanced bladder cancer which infiltrates the trigone or obstructs the ureteral orifices.

CONCLUSION

In patients with hematuria refractory to conventional management techniques, placement of a single PCNU tube allows for tamponade of bleeding and successfully diverts urine with no immediate complications or subsequent obstruction of the PCNU tube. The use of PCNU tube is a viable treatment in the algorithm of intractable hematuria, specifically before resorting to more morbid and potentially irreversible treatments.

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