Routine Drain Placement After Partial Nephrectomy is Not Always Necessary

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Purpose: To our knowledge the benefit of routine drainage after partial nephrectomy has never been investigated, although a drain after partial nephrectomy can be associated with morbidity. We report our initial experience with omitting the drain in select cases of superficial renal cortical tumors.

Materials and Methods: From a surgery database we identified 512 consecutive open partial nephrectomies performed by a single surgeon between January 2005 and May 2009 using standardized technique. The study group included 75 evaluable patients (14.6%) who did not have a drain placed. Clinical data, surgical information, histological type and postoperative complications within 90 days of the procedure using the modified Clavien system were included in analysis.

Results: Median patient age was 64 years (IQR 49, 70) and 56.8% of the patients were male. Median tumor size was 2.0 cm (IQR 1.5, 3.0) and more than 70% were malignant. A total of 38 patients (50.7%) underwent renal artery clamping and cold ischemia with a median clamp time of 30 minutes. The overall complication rate was 13.3% (10 patients). In 4 patients (5.3%) complications were related to an absent drain, including grade I urinary leak, grade II perirenal collection, grade III urinoma requiring percutaneous drainage and grade III urinary leak with urosepsis, respectively. No deaths occurred in this cohort.

Conclusions: Omitting drainage after partial nephrectomy in a select group of patients without collecting system entry is feasible and safe. The decision to place a drain after partial nephrectomy for small renal cortical tumors must be made intraoperatively and should be tailored to each case.

Key Words: kidney, kidney neoplasms, nephrectomy, drainage, postoperative complications

Abbreviations and Acronyms

EBL = estimated blood loss

PN = partial nephrectomy

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PARTIAL nephrectomy has become the standard of care for small renal cortical tumors. PN provides excellent local tumor control, equivalent to that of radical nephrectomy for T1 tumors, while at the same time preserving renal function and preventing or delaying chronic kidney disease status.[1–3] The surgical technique is well defined. Essential steps include resecting the tumor, reconstructing the renal parenchyma and collecting system, and ensuring adequate hemostasis and perinephric drainage. A postoperative perinephric drain has become routine and serves to drain urinary leakage during the healing process. Although many groups believe that a drain after a PN is harmless, drain related complications, including infection, retained drain fragments and patient discomfort, can cause postoperative morbidity.[4–6]

The rationale for routine drainage for all PNs may not exist for all patients.

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There is little debate that drain placement is a prudent surgical judgment if the collecting system is entered or there is a question of such an entry. However, in select cases of small, exophytic masses that are excised completely without collecting system entry drainage may not be necessary. Based on our observations postoperative urinary complications rarely develop in such cases. Thus, during the study period we elected not to place a drain in these select situations.

We reviewed our preliminary experience with drain-free PN. Specifically we evaluated the safety and feasibility of omitting the drain after open PN in a select group of patients with small, exophytic, solid renal cortical tumors.

METHODS

Population

After receiving institutional review board approval a review of our prospectively updated renal tumor database revealed that 512 consecutive patients underwent open PN for renal cortical tumors at our hospital between January 2005 and May 2009. Operations were performed by a single experienced surgeon (PR) using standardized technique. During this period 75 evaluable patients (14.6%) in whom no drain was placed comprised the current study group.

Analysis

The surgical technique was previously described.[7] Demographic and perioperative clinical information, pathological data and associated complications were extracted from the database. Nurse notes and any outside correspondence were also assessed for the completeness of complication information. Charts were reviewed in cases with missing information. Collected data included patient age at surgery, gender, American Society of Anesthesiologists score, tumor size, operative time, ischemia type, clamp time, EBL, length of hospital stay and tumor histology.

Postoperative complications that occurred within 90 days of PN were included in analysis. Complication data were reported using the modified Clavien classification system.[8] This system characterizes complications according to the level of intervention required, including grade I—oral medication or bedside care, grade II—intravenous therapy, total parenteral nutrition, enteral nutrition or a thromboembolic event requiring heparin, grade III—intubation, interventional radiology, endoscopy or reoperation, grade IV—major organ resection or chronic disability and grade V—death. Urine leakage after PN was defined as signs and symptoms associated with a perinephric collection of urine when proved to be urine by needle aspiration or postoperative percutaneous drainage. Urosepsis was defined as bacteremia originating from the genitourinary tract procedure or complication, resulting in hemodynamic instability and/or intensive care unit admission.

Due to the small number of complications in the study data are reported using descriptive methods. No formal statistical analysis was done.

RESULTS

The table lists baseline clinical characteristics, intraoperative data and tumor pathological data. Median patient age was 64 years (IQR 49, 70) and 42 of 75 (56%) were male. Median lesion size was 2.0 cm (IQR 1.5, 3.0) and 53 of 75 (greater than 70%) were malignant histological subtypes. Median operative time was 115 minutes (IQR 100, 129) and the median length of stay was 3 days (IQR 3, 4).

In the 38 patients (50.7%) with renal artery ischemia median clamp time was 30 minutes (IQR 26, 35) and cold ischemia was used in all. Median EBL during the procedure was 250 ml (IQR (125, 500) and the overall complication rate in the series was 13.3% (10 patients). Only 4 patients (5.3%) had complications that were possibly related to the lack of drainage.

The Appendix lists the causes and grades of these complications according to the Clavien modified system.[8] Two of the 4 complications related to the lack of drainage, including a grade I urinary leak and a grade II perirenal collection, successfully resolved during expectant management. The other 2 received appropriate interventions. In 1 patient a large symptomatic urinoma required percutaneous drainage after an episode of acute urinary obstruction, which later resolved completely. The most severe complication developed in a patient who presented with urinary leak and subsequently had urosepsis, requiring longer hospitalization and treatment in the intensive care unit with ultimately successful discharge home on postoperative day 7.

Four of the 6 complications that were not related to an absent drain were classified as grade I or II. The remaining 2 complications, which were not related to an absent drain, were grade 3. One patient needed reoperation due to an incisional hernia. The other patient fell, causing a perirenal hematoma. There were no deaths in the entire series.

Characteristics of 75 patients who did not receive drain after open PN

No. American Society of Anesthesiologists score (%):*	
1	4 (5.4)
2	42 (56.8)
3	27 (36.5)
4	1 (1.3)
No. histology (%):	
Clear cell	28 (37.3)
Papillary	17 (22.7)
Chromophobe	2 (2.7)
Unclassified	6 (8.0)
Benign lesion	20 (26.6)
Other	2 (2.7)

* In 74 patients.

DISCUSSION

Improvements in and the widespread use of diagnostic imaging methods in medicine have led to an increased detection rate for small renal tumors and resultant migration to lower stages and smaller sizes. The development and increased use of PN has proved to be an effective method to provide oncological control equivalent to that of radical nephrectomy with the important added benefits of preserving renal function and preventing or delaying chronic kidney disease. The importance of preserving renal function was recently emphasized since impaired renal function may lead to increased rates of hospitalization, cardiac morbidity and death.[9,10] The current American Urological Association Guideline for Management of the Clinical Stage 1 Renal Mass emphasizes the importance of preserving functional renal parenchyma by performing PN when possible.[11]

Traditionally PN has been done for several absolute indications, including tumor in a solitary kidney, bilateral tumors and tumor in patients with chronic kidney disease. Recently it has become the standard of care for the surgical management of most small renal cortical tumors in the approach termed nephron or kidney sparing.[1–3] At large volume cancer centers such as ours PN is performed in approximately 90% of patients with T1a (smaller than 4 cm) renal cortical tumors.[12] Although variations in technique have been described, especially in regard to ischemia methods and reconstructive techniques, perinephric drain placement near the resection bed is a point in the technique that has never changed regardless of the different open, robotic assisted and laparoscopic approaches.

The main purpose of drainage after PN is monitoring of and early management for urinary leaks and fistulas. Therefore, the major criterion to omit drain placement after PN is absent identifiable collecting system entry. However, it is not always easy to identify minimal openings in peripheral calyces that occur incidentally. For that reason some surgeons inject methylene blue into the renal pelvis so that these openings can be located and repaired.[13] In these cases a drain should always be used to monitor collecting system closure.

We recently reported our experience with urinary fistulas, defined as urinary drainage lasting more than 2 weeks postoperatively.[14] The urinary fistula rate after 1,118 PNs was 4.6% (95% CI 3.5–6.1) and 69% spontaneously resolved during followup. A fistula was associated with tumor size, ischemia time and EBL. These factors are directly (tumor size) or indirectly (ischemia time and EBL) related to the degree of surgical complexity, and invasion of the renal sinus fat and the collecting system, supporting our practice of drain omission during PN for small exophytic tumors. Interestingly the frequency of unrecognized collecting system entry during PN, that is the number of cases of urinary fistula of those without collecting system entry identified during the procedure, was 33 of 563 (5.9%). In patients with intraoperatively identified collecting system entry the urinary fistula rate was lower (3.6% or 19 of 528) but not significantly different. Since most fistulas were conservatively managed by a percutaneous drain, the clinical impact of an absent drain could not be assessed. Moreover, it was not possible to assess the impact of the drain itself as a source or an aggravating factor for some of these fistulas.

The reported incidence of urinary complications, including leak, urinoma and fistula, in large contemporary PN series is 2% to 18.5% depending on the definitions used and most leaks usually resolve spontaneously without further endoscopic or surgical intervention.[14–18] Drain manipulation usually consists of progressive daily removal of the drain if a Penrose drain, or opening of the suction system to relieve negative pressure for closed suction systems since negative pressure is believed to perpetuate leakage and even delay healing. The only study that compared open to closed drainage systems also described on this issue, showing that closed systems were more likely to prolong urinary drainage (8.9% vs 5.4%).[6] In the current series of PN with no drain the most common complications were urinary, occurring in 4 patients. These cases represented all complications that were related to not using a drain (5.3%), including 2 managed conservatively, 1 requiring percutaneous drainage for an urinoma that formed after an episode of acute urinary obstruction and 1 requiring supportive therapy due to urosepsis.

A drain provides benefits when an early postoperative complication occurs. However, to our knowledge the benefit of routine drainage after PN has never been specifically investigated. Indications for drain use and type have always been matters of surgeon preference and traditional dogma, such as the commonly heard, "When in doubt, drain," instead of being driven by data.

It is difficult to isolate the specific benefit associated with the drain when drainage has consistently been a standard practice. However, analysis of the potential complications associated with it may provide some insight into the risk-benefit decision analysis. Potential drain complications are infection, pain and retention of drain fragments during removal.[14]

Infection is a well established risk since the drain may facilitate bacterial migration to the perinephric space. An animal study showed that bacteria inoculated in the skin surface migrated through the drain tract to the intraperitoneal cavity as soon as 6 hours after placement of a Penrose drain with an increasing rate of positive intraperitoneal cavity cultures associated with longer postoperative time, including 20% in 24 hours and 56% in 72.[4] The clinical part of this study, which evaluated patients who underwent splenic bed drainage after clean traumatic splenectomy, confirmed that the drain could represent a source of surgical site contamination. Similar findings were reported in an experimental study of 15 dogs, which revealed intraperitoneal contamination in the animals with a drain. Also, during the clinical phase of this study 17 of 50 patients had positive Staphylococcus cultures from material obtained at the interior end of the drain, including 12 with minimal drainage, suggesting bacterial migration through the drain.[5]

Because of such data and the data provided by prospective general surgery studies of open passive drainage, mostly using Penrose drains, closed drain systems have been recommended after PN to decrease the infection rate.[13] Revisiting this issue, in a retrospective series investigators specifically looked at the difference in complication rates potentially related to a drain in the early postoperative period after PN.[6] The infection rate was 2-fold higher in cases with a Penrose drain than in those with a closed suction drain (5.4% vs 2.4%), although this difference was not statistically significant. Since all patients had 1 type of drain or the other, the infection rate in the absence of drainage was not assessed. In our study of drain-free open PN the infection rate was 1.3% (1 of 75 patients) since only a single infectious complication developed in a patient with urosepsis after a delayed urinary leak. However, it is unclear whether the outcome would have been different if a drain had been placed perioperatively.

The association of a drain placed in the perinephric space with hemorrhagic complications can also be a source of problems. The prolonged presence of a passive drain in patients with a retained hematoma may be hazardous, converting the sterile hematoma to an infected hematoma and then to an abscess. Also, with a closed suction drain the constant negative pressure could cause delayed hemorrhage from the surgical bed. A comparative study of Penrose and closed suction drains showed that 2.4% of patients in the closed drain group experienced delayed hemorrhage vs none in the Penrose group, although this difference was not statistically significant.[6]

Some urologists commonly postpone hospital discharge for patients with a high drain output due to the belief that drain removal might lead to perirenal collections and cause infection or pain. However, the drain may cause pain, limiting patient ability to ambulate and lie down freely. In our series the median hospital stay was 3 days, suggesting normal or uncomplicated healing.

Another complication is retained fragments during drain extraction, sometimes requiring surgical exploration to remove the missing fragment. Although retained fragments are not common, the necessity for re-intervention represents a major complication in these patients. More sparse objective data exist on these other potential issues associated with drain placement after PN but the ability to safely avoid them in select cases by omitting drain placement seems advantageous.

This study is not free from limitations, which are mostly related to the retrospective nature of the analysis and its inherent selection bias. Our findings should be interpreted with prudence since this is a hypothesis generating study. Differences in the definitions used to characterize urinary fistulas may affect the reported rate of such urinary complications, making comparisons among institutions difficult. For this reason it is important to adhere to standardized classifications, such as that used in the current study. Although all operations were performed by the same experienced surgeon using standardized consistent technique, the study also lacks a contemporary control group. Comparison with an earlier series from the same surgeon, in which all patients routinely received a drain for the same kind of lesion, was not feasible due to the difficulty of matching baseline characteristics, diagnoses and procedures from different eras. Still, to our knowledge our report represents a unique case series of a select group of patients in whom drain placement was omitted and from whom useful insights can be made to further refine PN surgical technique. We continue to drain cases with deeper lesions that require collecting system entry for resection.

CONCLUSIONS

A drain can lead to potential perioperative morbidity associated with infection, urinary complications, prolonged hospitalization and retained fragments. Omitting drainage after PN in patients without collecting system entry is feasible and safe with a low complication rate, in keeping with larger contemporary PN series. The decision to place a drain after PN for small renal cortical tumors must be made intraoperatively and should be tailored to each case instead of using routine drainage for all PNs.

APPENDIX

Complications

Grade (description)	Related to Absent Drain
I:	
Neuritic chronic pain	No
Atelectasis	No
Urine leak	Yes
II:	
Flank pain-perirenal collection	Yes
Fluid overload	No
Pleural effusion	No
III:	
Perirenal hematoma after patient fall (embolization)	No
Urinoma due to acute urinary obstruction (percutaneous drainage)	Yes
Incisional hernia (reoperation)	No
Urine leak and urosepsis (intensive care unit admission)	Yes

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EDITORIAL COMMENT

These authors challenge an aging axiom of routine perinephric drain placement after uncomplicated retroperitoneal PN. Drain placement was omitted in a carefully selected cohort of patients with peripheral small renal masses if no gross collecting system injury was sustained during excision of the mass (15% of the total PN cohort). Four patients (5%) in whom no drain was placed experienced a complication, which was attributed by the authors to the lack of postoperative retroperitoneal drainage. Importantly grade III complications occurred in 2 patients. While neither designed nor powered to appropriately address the need for routine perinephric drain placement, this study yields several important observations. An overwhelming majority of carefully selected patients with small exophytic renal mass without collecting system injury do not require perinephric drainage after PN. However, at least 5% of collecting system injuries were presumably missed even in this carefully selected group of patients treated at a high volume, tertiary referral center by an experienced surgical team. Can this experience be replicated in a community setting? Could fewer potentially life threatening complications have been avoided simply by leaving a perinephric drain? Are we truly increasing patient morbidity by routine drain placement? Only appropriately designed studies will ultimately answer this question. Until then the decision to leave a drain will be based on the clinical judgment of the surgeon.

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REPLY BY AUTHORS

The main purpose of a perinephric drain after partial nephrectomy is to prevent a urinoma if collecting system elements were entered and repaired. On occasion, despite initial complete healing and removal of the perinephric drain, a delayed leak can still lead to a urinoma from passage of postoperative debris or stones down the ureter or bladder outlet obstruction. Rarely after extensive partial nephrectomy and reconstruction, renal cortical elements may produce urine and not have complementary collecting system elements for drainage. They also lead to perinephric urinoma that usually resolves with time and is not improved by stenting.

However, for many partial nephrectomies, complete resection of an exophytic tumor does not require entry into the renal sinus or collecting system.

We have reconsidered the notion that all partial nephrectomy cases need to have a perinephric drain and instead placed a drain only when the collecting system was obviously entered. The absence of the drain in these carefully selected patients alleviated its associated discomfort, and decreased the potential for drain related nosocomial infections and retained drain fragments. Yet 4 patients (5.3%) had a urinary complication that we attributed to the absence of a drain and 2 patients required secondary treatment including placement of a drain and management of urosepsis. After careful inspection of the surgical bed and without collecting system entry, omission of a perinephric drain is feasible and safe but vigilant postoperative care is required until healing is complete.