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Review

Management of complications arising from the treatment of small renal masses

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HIGHLIGHTS

- Complications can vary based on surgical approach and modality.
- Vascular, intra-abdominal organ and urinary system complications are discussed.
- Knowledge of potential complications allows for quick treatment minimizing morbidity.

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ABSTRACT

This article offers a review of the complications, and management of such complications, associated with different modalities used for the treatment of the small renal mass.

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1. Introduction

Renal surgical complications can arise regardless the vigilance of the practitioner. Nevertheless, many complications may be lessened or avoided through thorough pre-operative evaluation and careful selection of treatment modality specific to each patient and tumor. Patient and surgery related factors should be considered when choosing treatment options for the small renal mass (SRM). For example an equally complex 2 cm mass may be treated completely differently in a 55 year old patient compared to an 85 year old patient. Patient and surgical selection should be based on the patient's age, comorbid medical conditions and past surgical history. Each treatment modality imparts unique risks and benefits and each should be considered carefully prior to subjecting the patient to the risks of the chosen treatment.

Generally the complication rates for patients undergoing nephron-sparing surgery (NSS) options are significantly higher than are the rates experienced by patients undergoing radical nephrectomy. When considering NSS options we accept a higher complication rate in exchange for lower incidence of chronic kidney disease.

Thermal ablative (TA) therapies have been implemented as a NSS technique to treat the SRM in large part due to the reduction in complication rate compared to the standard of care, the partial nephrectomy (PN). TA therapies, such as cryoablation and radiofrequency ablation, are performed laparoscopically or percutaneously. Studies report the complication rate of TA therapy to be between 8.8 and 19.8% [1–6] (Table 1). TA techniques such as microwave ablation, high intensity focused ultrasound and irreversible electroporation are utilized less frequently and need further study prior to routine utilization for patients with a SRM.

PN by the open approach is the traditional gold standard for the treatment of a SRM. There was a slow adoption of laparoscopic PN due to the complexity of laparoscopic suturing. However, introduction of robotic surgery diminished the technical burden of laparoscopic suturing rendering robotic PN a more popular option in the treatment of a SRM. PN has a complication rate between 4.1 and 35.7% [7–18] (Table 2) and generally subject's patients to a

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Table 1
Reported complication rates of thermal ablative therapies from both comparative and non-comparative studies.

	Series	Technique	Procedure number	Tumor size (cm)	Major	Minor	Complications (total)
CA	Duffey et al. [4],[a]	Lap, Perc, Open	116	2.76	1.7%	18.1%	19.8%
	Klatte et al. [5],[b]	Laparoscopic	1177	2.4	10.2%	6.8%	17.0%
	Buy et al. [3],[c]	Percutaneous	122	2.6	7.4%	4.1%	11.5%
	Breen et al. [2],[c]	Percutaneous	153	3.32	4.6%	5.9%	10.5%
	Atwell et al. [1],[c]	Percutaneous	311	3.2	7.7%	4.5%	12.2%
RFA	Ramirez et al. [6],[a]	Laparoscopic	79	2.2	3.8%	5.1%	8.8%
	Atwell et al. [1],[c]	Percutaneous	254	2.1	4.7%	5.1%	9.8%

[a] Major complication defined as Clavien grade 3 and above.
[b] Systemic review; Major and minor complications determined by AUA complication grading scheme.
[c] Major complication defined as Clavien grade 2 and above.

Table 2
Reported complication rates of partial nephrectomy from both comparative and non-comparative studies.[b]

	Series	Procedure number	Tumor size (cm)	Major	Minor	Complication (total)
Open	Springer et al. [15]	170	2.9	1.8%	4.1%	5.9%
	Ficarra et al. [8]	200	[a]	4.5%	17.0%	21.5%
	Gill et al. [9]	1028	3.5	–	–	19.2%
	Gill et al. [10]	100	3.3	1.0%	12.0%	13.0%
	Mason-Lacomte et al. [12]	58	3.1	3.4%	10.3%	13.9%
Lap	Zargar et al. [18]	646	2	5.8%	15.1%	20.9%
	Porpiglia et al. [14]	206	3.3	5.8%	10.7%	16.5%
	Springer et al. [15]	170	2.8	0%	4.1%	4.1%
	Wheat et al. [17],[c]	336	2.8	6.6%	29.1%	35.7%
	Gill et al. [9]	771	2.7	–	–	24.9%
Robotic	Zargar et al. [18]	1185	2.3	3.3%	11.5%	14.8%
	Tanagho et al. [16]	886	3.0	3.6%%	12.1%	15.6%
	Mathieu et al. [13]	240	3.0	10.4%	22.5%	32.9%
	Kaouk et al. [11]	400	3.17	3.3%	12.0%	15.3%
	Ficarra et al. [7]	347	2.8	2.9%	8.9%	11.8%

Major complications defined as Clavien grade 3 or above, unless otherwise noted.
[a] 87% of patients in study arm had cT1a tumors.
[b] 85.5% of patients in study arm had cT1a tumors.
[c] Major complication defined as National Cancer Institute Common Toxicity Criteria ver 2.0 grade 3 and above.

higher rate of complication than does TA. The higher risk of complication from PN compared to TA is accepted in healthy patients because of better oncologic control obtained by extirpative surgery.

2. Positioning injuries

The surgical, anesthesia and nursing team works in cooperation to make certain suitable patient positioning has occurred. Positioning injuries are common and probably underreported. Soft tissue, vascular and nervous system injuries can occur if the patient is not positioned correctly.

Lateral decubitus position is most frequently used in the treatment of the SRM. Padding of pressure points, particularly the lower extremities, will prevent soft tissue injury [19]. The most troublesome positioning injury from the patients' point of view is neurapraxia of the brachial plexus. Neurapraxia is a nervous injury that can occur either by stretch, compression or ischemia [20]. The lateral decubitus position can lend itself to neurapraxia due to compression of the brachial plexus on the down side or stretch of the brachial plexus on the up side. The weight of the patient lying on the arm will cause compression of the nerves supplying the arm by the clavicle and first rib and is prevented by the placement of an axillary roll. The nerves of the contralateral brachial plexus are injured by stretching of the arm or if the head is not supported. The contralateral arm should be supported at a 90-degree angle from the thorax with care taken not to over abduct above the head, or pull too far laterally [21].

Neurapraxia can be marked by numbness, pain, tingling burning, weakness or paralysis. Motor and sensory dysfunction is for the most part temporary with function returning after 6–8 weeks. Once recognized, neurapraxia should be treated with physical therapy to speed functional recovery.

3. Renal vascular complications

3.1. Intraoperative bleeding

Intraoperative bleeding from the renal parenchyma is a complication of PN. A multi-institutional analysis reported an intraoperative hemorrhage rate of 1.0% during robotic-assisted PN [16]. A methodical and routine approach to PN can reduce the incidence of intraoperative hemorrhage. Further, contrasted CT will aid in identification of renal hilar structures during surgical dissection. Although vascular clamps are placed, bleeding may still be encountered. An unrecognized, anomalous or early branching renal artery can cause unexpected bleeding during tumor excision. If there is difficulty in isolating the missed artery, a clamp of the entire renal hilum can be employed to ensure renal ischemia. Alternatively, in the case both the renal artery and vein have been clamped but there remains some arterial flow to the kidney, bleeding may arise from obstruction of renal venous outflow. In this case removal of the clamp from the renal vein, leaving the arterial clamp in place, can help bleeding subside.

3.2. Hematoma

Retroperitoneal and perinephric hematomas are the result of

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