

Research

Intraoperative Ultrasound for Safer Resection Margins During Robotic Assisted Partial Nephrectomy: A Single-Center Experience and Review of the Literature

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Abstract

The purpose of this study was to evaluate the feasibility of intraoperative ultrasound to guide the urologist for safer resection margins during partial nephrectomy. This is an observational prospective study in which all patients operated in our department with a partial nephrectomy for a T1 or T2 kidney tumor between September 2017 and February 2018 were included. Each time, an intraoperative ultrasound was performed by the assistant surgeon to guide the operator to delineate the margins of resection with electric cautery on the renal capsule. Ultrasound data obtained were correlated with histopathological findings. Four men and three women with a median age of 67 years (58-78) had partial nephrectomy. The mean duration of identifying the tumor and electro-cautery delineation of the resection margins was 214s (160-290). The final anatomic-pathological results confirmed negative margins in all patients. This technique of controlling resection margins during partial nephrectomies with the use of intraoperative echography seemed efficient, rapid and easy to perform.

Keywords: Partial; Nephrectomy; Intraoperative Ultrasound; Margins

Introduction

Renal cell cancer represents 2-3% of all cancers [9], with the highest incidence in Western countries. Due to increased detection of tumours by ultrasound (US) and computed tomography (CT), the number of incidentally diagnosed RCCs has increased. These tumours are usually smaller and of lower stage [1]. Since 1970, the treatment of localized kidney cancer was based on an extended

radical nephrectomy, which remained the gold standard until early 1990s [2]. Then, gradually, partial nephrectomy began to take hold. At present, partial nephrectomy is the standard technique allowing having the same oncological results as total nephrectomy while limiting nephrons loss, eventually preserving renal function [2]. This improved renal function compared to total nephrectomy might explain better survival rates observed in several retrospective studies [3]. Thus, the committee of cancer of the French Association of urology recommends a partial nephrectomy for all localized renal tumors classified T1, as well as for tumors classified T2, if the surgery is technically feasible. It is therefore compulsory to remove the entire tumor with a healthy margin of renal parenchymal tissue, although tumor enucleation with negative margins is also allowed. In this study, we propose an intraoperative ultrasound identification to control the margins of resections.

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Patients and Methods

This is an observational prospective study in which all patients operated in our department with a partial nephrectomy for a T1 or T2 (according to 2017 TNM classification system, T1: Tumour < 7 cm or less in greatest dimension, limited to the kidney; T2: Tumour > 7 cm in greatest dimension, limited to the kidney) kidney tumor between September 2017 and February 2018 were included. Before the surgery, all the patients were evaluated physical examination, routine hematologic and biochemical analysis, computed tomography. We included in our study only the patient without renal dysfunction and with localized kidney tumor. All partial nephrectomies were performed by the different senior surgeons of our department.

Operative Technique

All patients were operated on by Da Vinci® robot laparoscopic partial nephrectomy. After dissection of the kidney and pedicle, an

intraoperative ultrasound was performed by the assistant to guide the operator to delineate the resection margins with a scalpel (Figure 1). Under pedicular or selective clamping if possible, partial nephrectomy was performed in a standardized way, while taking care to limit warm ischemic time and to ensure good hemostatic control at the end of the procedure. The piece was extracted with an endo-bag by the 12 mm trocar of the aid (Figure 2). A Jackson Pratt drain was left in contact with the section slice and removed on the second postoperative day. The duration of the ischemia was recorded in the file. Ethical approval and informed consent were obtained from all the patients for this prospective study.

Ultrasound

We used a general electric 5-12 Mhz probe (United States of America), available in our operating room. We evaluate the size of the mass to resect; its depth and visualize the pseudo capsule (Figure 3). The duration of the ultrasound use was recorded in the file for each case.

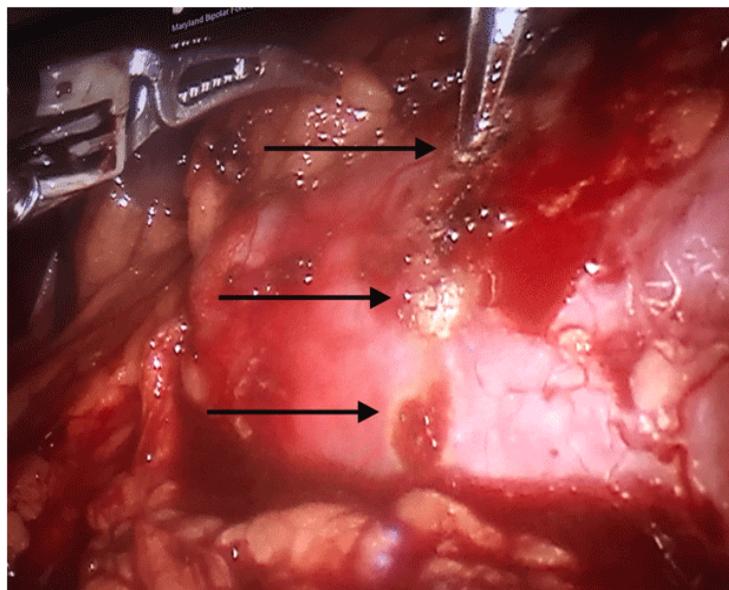


Figure 1. Delineating surgical margins of resection guided by ultrasound (arrow)



Figure 2. The surgical specimen

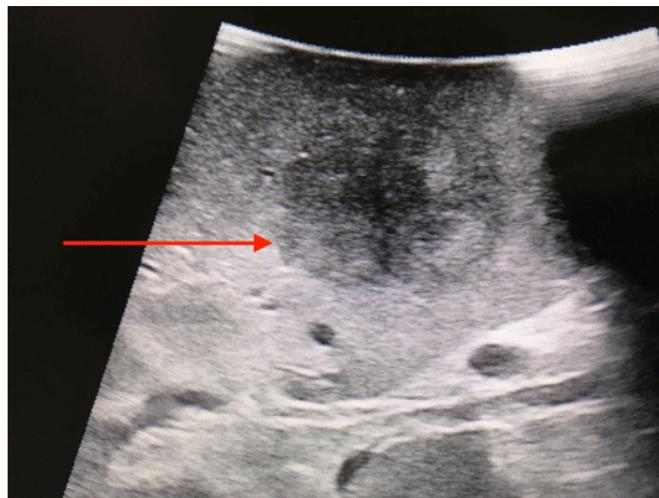


Figure 3. The tumor with its pseudo capsule (arrow) are visualized

Definitive Anatomopathological Results

The histopathological report was standardized according to the recommendations of the Cancer Committee of the French Association of Urology notably concerning the histological type, the tumor size, the Fuhrman grade, the surgical margins and the Tumour Node Metastasis (TNM) classification system classification.

Results

Four men and three women were included in the study. The characteristics of the patients have been summarized in a table.

The median age of patients is 67 years (58-78). Four partial

nephrectomies were performed on the right versus three on the left. Nephrometry is a novel scoring system that quantifies the salient anatomy of renal masses in order to provide a useful clinical tool for: guiding management decisions and more meaningful comparisons of reports in the urological literature (Nephrometry score of 4 to 6 = low complexity; Nephrometry score of 7 to 9 = moderate complexity; Nephrometry score of 10 to 12 = high complexity)

The nephrometry score R.E.N.A.L. (NS) ranges from 4 to 8 with an average of 6.4. The mean duration of the spotting and electrosurgical marking of resection margins was 214s (160-290). Three patients underwent selective clamping. The average duration of clamping was 15.6 (10-25) minutes. The final histopathological findings confirmed the presence of negative margins in all cases.

Age	Sex	Side	R.E.N.A.L. nephrometry score	Surgery time in minutes	Selective renalartery	Warm ischemic time in minutes	Sampling size in cm	Tumor size (major axis)	TNM	Fuhrman grade
71	W	Right	6	120	No	12	3,5 x 1,7 x 1,2	2,1	pT1a	3
72	W	Left	4	175	Yes	19	2,5 x 2 x 1,2	2,2	pT1a	3
78	M	Right	7	165	No	10	4,5 x 3,5 x 3	3,6	pT1b	2
58	M	Right	6	195	No	12	2 x 1,5 x 1,2	1,6	pT1a	2
66	M	Right	7	90	Yes	17	2 x 1,5 x 1,2	1,7	pT1a	2
52	M	Left	8	110	Yes	25	7,2 x 6,5 x 6	5,8	pT2a	3
73	W	Left	7	135	No	14	9 x 7 x 4	8,1	pT2a	2

Discussion

The Cancer Committee of the French Urology Association recommends partial nephrectomy for the treatment of localized kidney cancer whenever feasible [4]. A complete resection with negative surgical margins becomes the challenge. Unlike surgeries for other cancers such as lumpectomy in breast cancer, there is a major challenge when performing a partial nephrectomy: the limited time of renal clamping [4]. In fact, it was the reason behind abandoning extemporaneous histological analysis of surgical margins as the inevitable delay in getting the results unequivocally cause nephrons loss. To overcome this problem, another technique has been proposed: the macroscopic extemporaneous examination by the naked eye. According to Hagemann and Lewis [5]. Gross intraoperative consultations of tumor section have obtained a sensitivity of 75%. For Tim sit et al. [6] these values are improved if the margins are evaluated macroscopically directly by the surgeon himself and thus will obtain a sensitivity of 100% and a specificity of 96%. Unfortunately, there is no randomized comparative study of the different techniques for assessing surgical margins.

The use of ultrasound intra operatively can help identifying the depth of tumor extension in the renal parenchyma and allows complete excision of the tumor with safe margins with the help of delineating the renal capsule using electrocautery.

Despite the limited number of patients included in our study, it would seem from our results, that the practice of intraoperative ultrasound by an urologist is easy and efficient as satisfactory results were obtained. There was no actual need for a radiologist intra-operatively as the surgeon assistant requires only basic notions of ultrasound to be able to perform the task and to locate the tumor.

In addition, the average duration of localizing the mass and delineating resection margins with electrocautery was only 214s.

The intraoperative ultrasound technique has demonstrated advantages notably thanks to the presence of the pseudo tumor capsule, as well as the relatively short amount of time to localize and delineate the tumor thus allowing eventually rapid hemostasis and reduced clamping time.

Nevertheless, in literature, the role of positive margins is discussed in partial nephrectomy. The positive surgical margin increases the risk of local recurrence but appears to have a limited oncological impact in the medium term, while remaining subject to close supervision that allows for catch-up treatment in case of recurrence [6]. It therefore seemed logical and legitimate to propose a complete excision of the tumor and to avoid as far as possible any positive margins.

The control of resection margins during partial nephrectomies with intraoperative ultrasound seems of utmost importance.

Conclusion

The message we want to convey through this article is that this technique of using ultrasound in operatory is feasible, simple and easily reproducible. It allows the control of resection margins of partial nephrectomies by a urologist, without significant increase in warm ischemia time. This technique, however, still needs to be evaluated by larger-scale prospective studies.

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