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Original article

Long-term oncologic outcomes of laparoscopic renal cryoablation as primary treatment for small renal masses

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Abstract

Introduction: Data regarding long-term oncologic outcomes of laparoscopic renal cryoablation (LRC) as first treatment for small renal masses (SRMs) are lacking. We hypothesized that LRC might provide an effective long-term cancer control in patients with a single cT1a SRM without a previous history of renal cell carcinoma (RCC).

Materials and methods: The study design was a retrospective analysis of 174 consecutive patients who received LRC as first treatment for a single computed tomography or magnetic resonance imaging contrast-enhancing cT1a SRM between 2000 and 2013. Patients with a previous history of RCC were excluded. Treatment failure was evaluated 1 day after surgery. Local recurrence, metachronous SRM, systemic progression, disease relapse, cancer-specific mortality, and all-cause mortality were evaluated 10 years after surgery. Kaplan-Meier plots were used to depict outcome-free survival rate.

Results: Median patient age was 66 years. Median tumor size was 20 mm. Median follow-up was 48 months. Among patients with biopsy-proven RCC (63%, $n = 109$), the treatment failure–free rate was 98%. The 10-year recurrence-free survival rate was 95% and the 10-year metachronous SRM–free survival rate was 87%. The 10-year systemic progression–free survival rate was 100% and the 10-year disease relapse–free survival rate was 81%. The cancer-specific mortality–free survival rate was 100%, and the all-cause mortality–free survival rate was 61%.

Conclusions: LRC provides safe long-term cancer control in patients newly diagnosed with a single cT1a SRM. Treatment failure and local recurrence are uncommon. Systemic progression–free survival and cancer-specific–free survival are optimal.

Keywords: Renal cryoablation; Local tumor ablation; Small renal masses; Nephron-sparing surgery; Long-term oncologic outcomes; Kidney cancer

1. Introduction

Partial nephrectomy represents the standard of care for patients diagnosed with a small renal mass (SRM) [1,2]. Ablative procedures aimed at neoplastic cell destruction rather than surgical extirpation are alternative treatments for nonsurgical candidates [1] or patients at high risk of renal function loss [2].

Among different ablative strategies, laparoscopic renal cryoablation (LRC) provides encouraging short-term oncologic outcomes [3–8] and results in lower local cancer progression and lower need for retreatment [9]. However, studies reporting long-term oncologic outcomes after LRC are sparse and based on small but heterogeneous samples, including either patients with a previous history of renal cell carcinoma (RCC) or those with multiple renal masses [10,11]. Specifically, despite previous history of RCC

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emerged as a significant predictor of cancer outcomes [10], no study evaluated the long-term oncologic outcomes of LRC focusing on patients diagnosed with single cT1a SRM without a previous history of RCC only. In consequence, there is a lack of information regarding long-term oncologic outcomes of LRC as primary treatment for SRM.

To address this void, we relied on our institutional database with the intent of assessing the long-term oncologic outcomes of patients treated with LRC as primary treatment for a single cT1a SRM. Our hypothesis stated that LRC might provide an effective long-term cancer control in patients diagnosed with a single cT1a SRM.

2. Materials and methods

2.1. Study design and patient population

The study design was a retrospective analysis of our institutional database, which includes 214 consecutive patients treated with LRC at our institution for at least one computed tomographic or magnetic resonance imaging (MRI) contrast-enhancing renal mass between 2000 and 2013. For the purpose of the study, exclusion criteria were previous history of surgery for RCC [12] ($n = 15$), multiple SRMs or von Hippel-Lindau disease at diagnosis ($n = 14$), stage cT1b ($n = 3$), suspicion of systemic disease at diagnosis ($n = 2$), and incomplete clinical information ($n = 6$). This resulted in a cohort of 174 patients with a first diagnosis of a single cT1a SRM.

2.2. Surgical technique

The retroperitoneal procedure was performed with patient in full flank position, and the transperitoneal procedure was performed with patient in 60° flank position. Operative steps include kidney mobilization, imaging of the kidney using a steerable laparoscopic ultrasound probe (2101 Falcon, 7.5 Hz probe, B&K Medical, Herlev, Denmark), ultrasound evaluation of the tumor, ultrasound-guided biopsy of the tumor (1–3 biopsy cores using a 17-gauge needle biopsy gun), and puncture of the renal lesion with cryoprobes under laparoscopic and real-time intracorporeal ultrasound guidance. In total, 2 thermocouples were placed in the center and 1 in the peripheral margin of the tumor. A double freeze-thaw cycle was performed, extending the ice ball approximately 1 cm beyond the tumor edge. A minimal temperature of −25°C was exceeded at the lesion's periphery. Liquid nitrogen–based Erbe-Cryo 6 (ErBE Elektromedizin, GmbH, Baden-Wuerttemberg, Germany) with laparoscopic, sharp-tip, reusable, 3.2-mm probes was used from 2000 to 2006. Argon/helium Galil cryosystem (SeedNet gold, Galil Medical, Minneapolis, MN) with 17-gauge cryoprobes (Ice-seed and/or Ice-rod) was used starting from 2007, with 1 to 4 probes according to tumor dimension and accessibility. After the second freeze-thawing cycle, cryoprobes were removed from the lesion. Hemostasis was obtained with apposition of hemostatic agents (TabotampT, oxidized cellulose, Johnson & Johnson, New Brunswick, NJ) and compression. In cases of active bleeding from a fracture plane, hemostasis was obtained with a thrombin-gelatin mix (FloSealT, Baxter, Deerfield, IL). Finally, a drain was left in place for 24 hours.

2.3. Follow-up

Follow-up evaluation was scheduled in accordance with established protocols [10] and available standards of practice for other ablation techniques [13,14]. Patients were evaluated on postoperative day 1 with (MRI) to assess appropriate covering of the SRM [15]. Follow-up was determined according to SRM pathology, with MRI in case of biopsy-proven RCC or unknown histology or with ultrasound-sonography in case of biopsy-proven benign SRM. Patients were evaluated at 1, 6, and 12 months during the first year, and yearly thereafter until 10 years after surgery.

2.4. Outcome definitions

Oncologic outcomes were defined in accordance with the American Urological Association SRM guideline panel [16] and in compliance with established definitions for other renal ablative techniques [12,14]. To avoid an underestimation of local recurrence rates, patients who received complex radical nephrectomy for a complication occurred immediately after LRC were censored from long-term local recurrence analysis.

The first end point of the study was to assess the 1-day treatment failure rate, the 5- and 10-year local recurrence–free survival rates, and the 5- and 10-year metachronous SRM–free survival rates. Treatment failure was defined as inadequate covering of the lesion detected at MRI evaluation on postoperative day 1. Local recurrence was defined as simultaneous presence of contrast enhancement and dimensional increase in the cryolesion after MRI-proven treatment success. Metachronous SRM was defined as a new contrast-enhancing lesion located either in the ipsilateral kidney in another site than the cryoablated area or in the contralateral kidney.

The second end point of the study was to assess the 5- and 10-year systemic progression–free survival rates and the 5- and 10-year disease relapse–free survival rates. Systemic progression was estimated only in patient with biopsy-proven RCC and was defined as the presence of RCC anywhere but in the ipsilateral or contralateral kidney. Disease relapse–free survival was defined as simultaneous absence of treatment failure, local recurrence, metachronous SRM, and systemic progression.

The third end point of the study was to assess the 5- and 10-year cancer-specific mortality (CSM)–free survival rates and the 5- and 10-year all-cause mortality [ACM]–free