SURGICAL TECHNIQUE

Retroperitoneal and transperitoneal laparoscopic cryotherapy for small renal masses


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Abstract

Objective: Cryotherapy is a minimally invasive ablative technique that is considered an alternative to conventional surgery for preserving renal function in small renal tumors and in selected cases. We present our results from laparoscopic renal cryotherapy.

Material and method: We retrospectively analyzed 17 renal tumors diagnosed in 16 patients treated with cryotherapy. The patients’ mean age was 66 years (43–80). The mean tumor size was 1.8 cm (0.7–3.7 cm). Cryotherapy with double-freeze cycle was performed laparoscopically in all cases (10 by transperitoneal approach and 7 by retroperitoneal approach).

Results: Perioperative biopsies were performed on all patients and were positive for malignancy in 10 cases (59%). The mean stay was 2.8 days. The mean operative time was 162 min. Only 1 case reverted to open surgery due to bleeding. One patient required a blood transfusion in the immediate postoperative period. The majority of complications were Clavien-Dindo grades I and II. Some 76.5% of the patients had no complications. After a mean follow-up of 31 months (6–102), 1 patient died from nontumor-related causes, and 12 patients (75%) still show no evidence of local recurrence or progression. One patient had tumor persistence and therefore underwent partial nephrectomy at 6 months. One patient had a metachronous recurrence in the same kidney at 36 months, and another patient had a recurrence at 23 months.

Conclusions: Laparoscopic renal cryotherapy is a safe and feasible technique and is a good alternative to surgery for selected renal tumors.

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Introduction

In recent decades, the diagnosis of small renal masses has increased thanks to the widespread use of imaging techniques. The greatest incidence of these tumors has been found in patients >70 years, who normally have higher comorbidities. It is for this reason that in the management of these patients it is important to seek a balance between cancer control, life expectancy, renal function, and individual risk of undergoing surgery.

Partial nephrectomy remains the treatment of choice for localized renal tumor (T1a) due to its optimal oncological results. Active surveillance has emerged as a possible option in elderly patients and/or with significant comorbidity, with low life expectancy and not candidates for surgery. In recent years, there have been, as an alternative to nephron-sparing surgery, minimally invasive ablative techniques in order to preserve renal function and decrease operative morbidity in patients with high surgical risk. In this sense, we have laparoscopic cryotherapy, which offers good oncological results, optimal preservation of renal function, and the advantage of having a reduction in intra and perioperative complications with respect to conventional surgery. We present the second largest series of laparoscopic renal cryotherapy published in our country.

Materials and methods

All patients undergoing laparoscopic renal cryotherapy were retrospectively analyzed in our center. The selection criteria were patients with kidney tumor <4 cm, of peripheral location diagnosed by abdominal computed tomography (CT) or magnetic resonance (MRI) (stage T1a). Cystic renal masses, tumors in the renal hilum, near the ureter, or with extension of the tumor in the urinary tract were discarded for the performance of this technique. All patients were informed of all treatment options (radical nephrectomy and partial nephrectomy).

The follow-up was performed with the same imaging test performed for diagnosis at 3, 6 and 12 months; subsequently every six months. Postoperative complications were recorded and sorted by Clavien-Dindo classification.

Surgical technique

All operations are performed under general anesthesia in lateral decubitus. The choice of the laparoscopic technique to be performed (transperineal or retroperitoneal) depends on tumor location, reserving the retroperitoneal approach for renal lesions located on the renal dorsal side.

After trocar placement, Gerota fascia is dissected leaving the kidney completely freed from the perirenal fascia, with the aim of locating and facilitating direct view of the tumor. Prior to starting the cryopreservation, biopsies of the lesion are taken with Trucut® (18 G).

Subsequently, insertion of cryoneedles of 1.47 mm (17 G) (Galil Medical SeedNet™, Tel Aviv, Israel) is performed through the tumor (Fig. 1). We used 2 types of needles: IceSeed (small cryoball of 10.5 mm × 19 mm in diameter) and IceRod (long cryoball of 16 mm × 41 mm in diameter). The choice of type and number of needles used depend on the tumor size and the diameter of the cryoball that is desired.
Figure 1  Cryoneedles insertion percutaneously in a retroperitoneal laparoscopic approach.

Figure 2  Cycle of tumor freezing and cryoball formation.

(Fig. 2). It is advisable that the cryoball has a safety margin of 1 cm around the tumor.7

In all cases, 2 cycles of freezing of 10–15 min per cycle are performed, separated by a heating process. High-pressure argon gas is used for freezing and helium gas for thawing. The temperature in the tumor is measured by thermosensors introduced within and at the periphery of the tumor, and they can reach temperatures of −40 °C or lower.

After the second cycle of freezing, after a few minutes of active thawing, the cryoneedles are cautiously removed. Subsequently, local hemostatic control is performed using, if necessary, synthetic hemostatic agents, and finally a drain is placed.

Follow-up

The follow-up was performed with the same diagnostic imaging technique (CT or MRI) at 3, 6 and 12 months and then every 6 months. To be considered a good radiological result, the cryotreated area must have a total absence of contrast enhancement. Therefore, the cases that showed an increase of lesion size, which did not have a progressive and gradual decrease of it or showed presence of vascularization,6,9 were considered treatment failures and salvage therapy was offered.

Results

Between May 2005 and June 2014, 16 patients (17 tumors), with a mean age of 66 years (43–80), underwent laparoscopic renal cryotherapy in our center. The patient characteristics are summarized in Table 1.

The diagnosis of all renal masses was performed preoperatively with abdominal CT or MRI, the average size being 1.8 cm (0.7–3.7 cm). The tumor characteristics are described in Table 2.

Of the treated tumors, in 9 patients the tumor was located in the left kidney, 6 in the right kidney, and one patient had a bilateral synchronous tumor. One of these 16 patients was also diagnosed with bilateral synchronous renal tumor, but cryotherapy was dismissed in one kidney because of tumor invasion of the renal hilum. For this reason, first radical nephrectomy was performed (PC: chromophobe tumor), and then in a second time, cryotherapy in the contralateral kidney. Along with this, 3 patients were single kidney (25%) at the time of performing

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**Table 1**  Patient characteristics.

| Patients | 16 |
| Age (years) | 66 (43–80) |
| Sex | |
| Men | 13 (76%) |
| Women | 3 (24%) |
| ASA | |
| II | 13 (81.25%) |
| III | 3 (18.75%) |
| Single kidney | 4 (25%) |

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**Table 2**  Tumor characteristics.

| Tumors (n) | 17 |
| Tumor size (mm) | 18 (7–37) |
| Location | |
| Right | 6 (37.5%) |
| Left | 9 (56.25%) |
| Bilateral | 1 (6.25%) |
| Location | |
| Posterior | 7 (41%) |
| Anterior | 10 (59%) |
| Upper pole | 5 (29.4%) |
| Middle | 10 (59%) |
| Lower pole | 2 (11.6%) |
| T1a stage | 17 (100%) |
Table 3 Surgical and follow-up data.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laparoscopy (n)</td>
<td>17</td>
</tr>
<tr>
<td>Transperitoneal</td>
<td>10 (59%)</td>
</tr>
<tr>
<td>Retroperitoneal</td>
<td>7 (41%)</td>
</tr>
<tr>
<td>Surgical time (min)</td>
<td>162 (110–265)</td>
</tr>
<tr>
<td>Mean stay (days)</td>
<td>2.88 (2–6)</td>
</tr>
<tr>
<td>Biopsy result</td>
<td>17</td>
</tr>
<tr>
<td>Clear cell</td>
<td>7</td>
</tr>
<tr>
<td>Papillary</td>
<td>3</td>
</tr>
<tr>
<td>Oncocytoma</td>
<td>2 (11.7%)</td>
</tr>
<tr>
<td>Inconclusive</td>
<td>5 (29.3%)</td>
</tr>
<tr>
<td>Reconversion to open surgery</td>
<td>1 (5.8%)</td>
</tr>
<tr>
<td>Postoperative complications</td>
<td>4 (23.52%)</td>
</tr>
<tr>
<td>Clavien I</td>
<td>2 (11.76%)</td>
</tr>
<tr>
<td>Clavien II</td>
<td>2 (11.76%)</td>
</tr>
<tr>
<td>Mean follow-up time (months)</td>
<td>31 (6–102)</td>
</tr>
<tr>
<td>Tumor persistence</td>
<td>1 (5.8%)</td>
</tr>
<tr>
<td>Local relapse</td>
<td>2 (11.7%)</td>
</tr>
<tr>
<td>No evidence of recurrence</td>
<td>13 (76.47%)</td>
</tr>
<tr>
<td>Exitus</td>
<td>1 (5.8%)</td>
</tr>
<tr>
<td>Tumor cause</td>
<td>0</td>
</tr>
<tr>
<td>Non-tumor cause</td>
<td>1</td>
</tr>
</tbody>
</table>

Cryotherapy (2 of them also due to prior nephrectomy for renal tumor).

Renal cryotherapy was performed laparoscopically in all cases, 10 by transperitoneal approach (58.8%) and 7 retroperitoneal (41.2%). The overall operative time, including trocar placement and 2 cycles of freezing, was 162 min (110–265). Only one patient was reconverted to open surgery by lumbotomy due to intraoperative bleeding that could not be controlled with conservative measures. No other patient suffered complications during the procedure.

In all patients, perioperative biopsy of the tumor area was performed prior to freezing, resulting in renal tumor in 10 cases (59%) and oncocytoma in 2 patients (11.7%), pathological anatomy being inconclusive of tumor in 5 cases (29.3%).

The mean hospital stay was 2.8 days.2–6 23.5% had Clavien-Dindo I-II complications in the immediate postoperative period. Only one patient required postoperative blood transfusion. One patient had skin burns from the cryoneedles, in another case, hematoma was shown at the level of the hypogastrum, accompanied with ipsilateral back pain next to the intervention which improved with conservative treatment, and another presented a febrile syndrome of the upper respiratory tract. The rest (76.5%) had no complications. The operating and follow-up data are collected in Table 3.

With a mean follow-up of 31 months (6–102) of the 17 tumors, only one patient (5.8%) had tumor persistence after the procedure, so he underwent partial nephrectomy at 6 months. Two patients (11.17%) had subsequent recurrence. One of them showed radiological recurrence at 23 months, again undergoing another renal cryotherapy, not demonstrating a new recurrence after 4 years of follow-up. The other patient had a metachronous recurrence in the same kidney at 36 months, but on the opposite renal pole where renal cryotherapy was performed, so we opted for performing radical nephrectomy as definitive treatment. The remaining patients have had no evidence of recurrence, progression, or metastatic spread. To date, there have been no deaths related to the tumor. Only an elderly patient died from non-tumor cause.

Discussion

Cryoaulation is an ablative technique, minimally invasive, which begins to show good long-term oncological results and is presented as an alternative to surgery in small tumors and in specific cases.3 The main indications for this technique would be peripheral renal tumors, sized <4 cm (T1a), in selected patients (elderly and/or with comorbidity or high surgical risk, single kidney, renal failure, multiple and/or bilateral renal tumors, tumors of transplanted kidney) and patients reluctant to surgical removal.11–13 Patients with genetic predisposition to develop multiple tumors, such as the syndromes of Von Hippel-Lindau, Birt-Hogg-Dubé, hereditary papillary renal carcinoma, and complex tuberous sclerosis could also be included among the indications of cryotherapy.5

Cryotherapy can be performed either laparoscopically or percutaneously. Laparoscopy allows for certain advantages, such as the displacement of neighboring organs that can be damaged, kidney mobilization for a better approach of the tumor, in situ observation of the cryoball, and repair or application of hemostatic agents for bleeding.14 In contrast, the percutaneous pathway is only possible for rear tumors, is less aggressive than the laparoscopic one, and obtains shorter operating times and hospital stays. The latest studies published show that the complications and renal function are similar in the 2 groups.15 The disadvantage that it shows with regard to the laparoscopic approach is that to date there are no long-term oncological results.

There are several studies, including 2 meta-analyses, comparing perioperative and oncological outcomes of laparoscopic cryotherapy to partial nephrectomy.4,6,16 In one of them, Tang et al.16 found that patients who belonged to the cryotherapy group were older and had a higher rate of single kidney. The 2 metaanalyses carried out agreed that cryotherapy was associated with a smaller amount of intraoperative bleeding and a reduction in both operating time and overall complications compared with partial surgery, but instead, it had higher rates of local recurrence and metastatic progression.16,17

The complications of laparoscopic cryotherapy are rare and usually derived from the surgical procedure or patient comorbidities. Our complication rates are comparable to those of published studies.19 Most series report complication rates of between 10% and 20%.18 Only one third of the complications are attributable to the procedure. In a prospective multicenter study, Laguna et al.19 found that most complications were Clavien grade I-II, whereas grade III-IV occurred in approximately 4%. Likewise, they estimated that the tumor size, presence of previous heart disease, and female gender were the only independent predictors of the presence of complications or unwanted events.19

With regard to follow-up, it has been observed that routine control biopsies are not necessary, since the current imaging techniques can define local recurrence.14
is usually a progressive decrease in the size of the cryo-
lesion that reaches a size reduction of up to 75% at 3
years. The complete disappearance of the lesion was
observed in 38% of cases. Therefore, as explained previ-
ously, non-progressive decline, the persistence of contrast
enhancement, or increase of the size of the lesion will be
considered tumor recurrence or persistence. In their review,
Cordeiro et al. emphasize that tumor persistence rates
typically range between 0% and 17% and usually appear
within the first year, and they can be considered treatment
failure, while recurrence rates vary between 0% and 14% and
are usually rare after 3 or 5 years of follow-up. Although our
series is small, the analyzed results support these data. Kim et al. observed that the predictors of recurrence are the
degree of tumor endophytic growth, tumor size greater than
or equal to 3 cm, and a body mass index greater than or equal
to 30 kg/m².

Currently, we have long-term cancer and laparoscopic
cryoablation data with very good results. Johnson et al. present one of the widest series (92 patients) and with highest average follow-up (97.9 months), with an overall survival of 77.6% in those patients where the pre-
treatment biopsy showed malignancy, with a cancer-specific survival of 98.5%, and a progression-free survival of 91%. Kim et al. described that the predictors of overall mortality in these patients were the Charlson comorbidity index adjusted for age and preoperative glomerular filtration.

Conclusion

In our limited experience, laparoscopic cryotherapy with
double-freeze cycle and use of ultrathin cryoprobes to treat
small renal masses has proven to be a safe technique with
few complications. The results encourage to consider it
an alternative treatment to be considered among the minimally
invasive techniques in selected cases.

Conflict of interest

The authors declare that they have no conflict of interest.

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Appendix A. Supplementary data

Supplementary data associated with this article can be
found, in the online version, at http://dx.doi.org/10.1016/
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