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Original article

A prospective comparison of the pathologic and surgical outcomes obtained after elective treatment of renal cell carcinoma by open or robot-assisted partial nephrectomy

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Abstract

Objective: To prospectively compare surgical and pathologic outcomes obtained by elective robot-assisted (RAPN) or open partial nephrectomy (OPN) for small renal cell carcinoma (RCC).

Materials and methods: Between 2008 and 2010, after protocol design and patient consent, we prospectively collected clinical data for 100 patients who concurrently underwent either OPN (58) or RAPN (42) by an individual experienced surgeon. Clinical data included age, BMI, and past medical history. Operative data included operative time, warm ischemia time (WIT), and estimated blood loss (EBL). Postoperative outcomes included hospital stay (LOS), creatinine variation, Clavien complications, pathologic results, and survival. We stratified the complexity of the renal tumor using the R.E.N.A.L Nephrometry score.

Results: Of note, RAPN was superior to OPN in terms of EBL (median 143 mL vs. 415; $P < 0.001$) and LOS (median 3.8 days vs. 6.8; $P < 0.0001$). The median WIT for the RAPN group was 17.5 minutes (vs. 17.1 OPN; $P = 0.3$)) and the mean strict operative time was 134.8 minutes (vs. 128.4 OPN; $P = 0.097$). Regarding immediate, early, and short-term complications, variation of creatinine levels, and pathologic margins, the rates were equivalent for both groups ($P > 0.05$). According to the R.E.N.A.L nephrometry scores, both groups (RAPN/OPN) had similar rates (%) of low (81/72.4) and intermediate (19/20.7) complexity tumors, though there were 4 high complexity tumors in OPN group (vs. 0; $P = 0.03$).

Conclusion: We found that RAPN is superior to the reference standard (OPN) surgical treatment of small RCCs in terms of blood loss and length of hospital stay with equivalent complications, warm ischemia time, and effect on renal function. Larger randomized trials with longer follow-up will give us further information and insight into the oncologic equivalence.

Keywords: Kidney; Nephron-sparing surgery; Renal cell carcinoma; Recurrence; Elective indication; Tumor diameter; Robotics

1. Introduction

Almost 58,000 new cases of renal cell carcinoma (RCC) and renal pelvis tumors are expected to occur each year in the United States and European Union, making RCC both the 8th most common cancer and the 13th leading cause of death in the United States [1]. Management is based upon both tumor factors, including size, location, multifocality, TNM staging, and patient factors. Specific patient factors include age, global renal function, and status of the contralateral kidney [2]. In contrast to the type of tumor seen when Robson described the principles of radical nephrectomy (RN) [3], nowadays with the liberal use of cross sectional imaging, 48%–66% of all renal tumors diagnosed and 38% of tumors excised are so-called 'small renal masses' (SRMs) [4]. Guideline standard treatment for SRM, assuming feasibility, is nephron-sparing surgery (NSS), namely partial nephrectomy (PN). In an era when both the prevalence of chronic kidney disease and SRMs is rising [5], renal preservation is key and NSS has been proven capable of maintaining renal function, whilst achieving comparable onco-

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logic outcomes to the standard set in historical open PN (OPN) series [6,7]. Open NSS was initially proposed for use primarily in 'imperative' cases, clinical situations that would render patients anephric or dialysis-dependant if they were to undergo RN (i.e., solitary kidney, bilateral/hereditary tumor, or renal insufficiency), and only a few reports have reported outcomes after surgery for elective indications [6,7]. In recent years, a minimally-invasive laparoscopic approach (LPN) that offers all of the known advantages of laparoscopy, such as shorter recovery times, less bleeding, and decreased length of hospital stay has been developed [8]. However, pure LPN has not been widely adopted, as it demands skill, learning, and perseverance from the surgeon [9] and it has not superseded OPN as the first line NSS technique for RCC [2]. It is this background against which the rise of robotic surgery has taken place [10]. Since 2004, researchers have suggested that the robot-assisted laparoscopic partial nephrectomy (RAPN) could be an alternative to a pure laparoscopic technique [11–13]. The da Vinci Robot surgical system allows for freedom of motion, three-dimensional (3D) imaging, intuitive operating (e.g., intracorporeal suturing), and superior ergonomics. To date, there are a few studies in the literature, from a single institution, which directly compare the current reference standard of OPN with LPN [12,14] but not with RAPN. Herein, we describe the comparative prospective outcomes of NSS, either by open access or RAPN, obtained at our institution.

2. Materials and methods

2.1. Patient population

After local ethics committee approval (Assistance Publique-Hôpitaux de Paris), protocol design, and patient consent, we prospectively collected clinical data for 100 patients who underwent either OPN (58) or RAPN (42) in our department between 2008 and 2010. We collected the following clinical [age, gender, body mass index (BMI), ASA score (American Society of Anesthesiology), symptoms], operative (surgical technique, operating time, blood loss, length of clamping), postoperative [serum creatinine variation (mg/dl), an estimated glomerular filtration rate (GFR) [5], Clavien complications and length of stay (LOS)], pathologic (Fuhrman grade, 2009 TNM stage [15], tumor size, margin status), and oncologic (recurrence and survival) data. In addition, we systematically used the R.E.N.A.L. nephrometry score [16], a validated system for quantifying renal tumor complexity based on size, location, depth, and exophytic properties (i.e., nephrometry score of 4 to 6 = low complexity; 7 to 9 = moderate complexity; 10 to 12 = high complexity). Preoperative evaluation in all patients included ultrasonography and computerized tomography of the abdomen/thorax. No patient had preoperative or intraoperative suspicion of significant lymphadenopathy. Determination of tumor location within the involved kidney was obtained by a review from surgeons and radiologists of all preoperative imaging studies. NSS was considered 'elective' in the presence of a normal contralateral kidney and the following: a tumor pre- and intra-operatively found to be <4 cm, a tumor discovered to be >4 cm intra-operatively but amenable to safe partial excision, and any tumor in the upper or lower pole, regardless of size, thought technically feasible to be done (based on the surgeon's experience). Multifocality was defined as 2 or more tumors separated by 10 mm or more. We excluded patients with hereditary RCC and patients with 'imperative' indications as described above, to avoid study bias.

2.2. Operative technique

Two experienced surgeons were individually dedicated to each procedure and the patients underwent either OPN (MOB) or RAPN (CV) at the physician's discretion. The surgical principles were identical in both groups, as described previously [7]. Briefly, OPN was performed through a standard sub-11/12th rib 'loin/flank' incision with the patient in the lateral decubitus position and the operative table broken to open up the renal space. The pedicle was systematically controlled with clamps (mechanical clamping) before tumor removal. RAPN was performed via a transperitoneal approach, and we used the 3-arm da Vinci surgical system and a 4-port technique. The patient was positioned in a modified lateral position on a 45° tilted operating table. Briefly, pneumoperitoneum was created para-umbilically using a standard open Hasson technique and a 12-mm port was inserted, to be later used by the bedside assistant. A further 12-mm port was then inserted under vision, approximately 5 cm lateral and superior to the umbilicus (along an imaginary line from xiphisternum to anterior superior iliac spine) to accommodate the robotic laparoscope arm (30° lens). Two 8-mm ports for the robotic instrument arms were inserted approximately 6 cm either side of the camera port, along the mid-clavicular line, to facilitate triangulation. A 5 mm trocar was inserted inferior to the right 8 mm robot arm to aid in retraction. Following inspection of the peritoneal cavity, the bowel was mobilized medially, Gerota's fascia opened, and the ureter identified and traced up to the renal hilum. In both techniques, the renal pedicle was carefully dissected to enable complete individual vessel clamping with either a classic or laparoscopic bulldog clamp. PN of the macroscopic lesion was performed with monopolar scissors aiming for a 5-mm margin of normal parenchyma. After the tumor was removed, the renal surface was evaluated for possible tumor bed infiltration. Routinely, no frozen section was sent. Visibly bleeding vessels and incidental opening of the calyceal collecting system were sutured using a running 3/0 monofilament (Monocryl). The parenchymal defect was closed using a combination of sliding-clip (Hem-o-lok) renorrhaphy and a running 0 polyglactin (Vicryl) suture after