Emerging Technologies to Improve Techniques and Outcomes of Robotic Partial Nephrectomy

Striving Toward the Pentafecta

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KEYWORDS

• Robotics • Partial nephrectomy • Kidney • Pentafecta • Emerging technology

KEY POINTS

- Robotic partial nephrectomy is no longer an emerging field but has been widely accepted as a safe and appropriate management technique for small renal masses.
- Future directions for robotic partial nephrectomy include identifying patient-specific outcomes to measure improvement. The pentafecta assessing both early and late outcomes may provide this road map for comparison.
- The usage of technologic advances, patient selection, and pathway creation will provide further implementation of this technology and continue to improve surgical results.

Robotic partial nephrectomy (RPN) has been widely adopted for the management of renal masses amenable to extirpative surgery. Its role in providing the advantages of a minimally invasive procedure while still safely sparing nephrons has led to increased adoption.[1] As this technology has been adapted in many high-volume institutions, several techniques and technologies have been implemented to provide improved outcomes; the nomenclature to ensure obtaining these goals is also evolving. **Fig. 1** demonstrates a timeline of advances that have occurred throughout the development of RPN.

The *trifecta* is an established gambling term for describing prediction of the exact order of the first 3 horses finishing a race. This terminology has been adapted to describe outcomes of patients undergoing RPN. As described from the University of Southern California Group, the trifecta in RPN includes negative margins, no urologic complications, and a minimal decrease in renal function postoperatively. They found a trend toward an increased rate of trifecta with their most recent patients; however, the range of patients achieving this outcome was between 44% and 68%.[2] Early reports of trifecta outcomes demonstrate that using the robotic platform seems to improve the likelihood of obtaining these. Khalifeh and colleagues[3] note that RPN is much more likely to produce trifecta outcomes than a strict laparoscopic approach with an increase from 32% to 59% of patients.

Although the achievement of a trifecta may provide early indicators of surgical success, patients inevitably requires further follow-up to assess the success of these elements. Negative cancer

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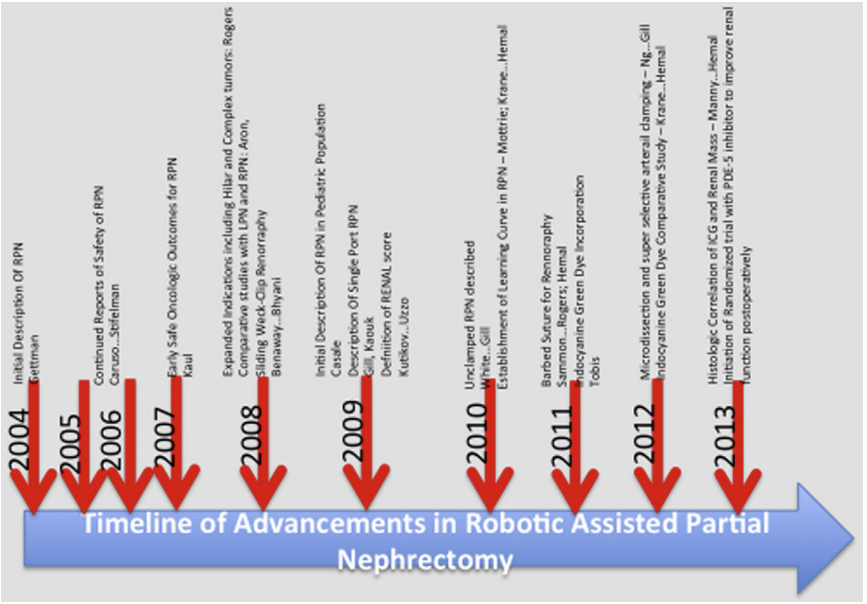

Fig. 1. Overall timeline for RPN. ICG, indocyanine green; LPN, laparoscopic partial nephrectomy; PDE-5, phosphodiesterase type 5.

margins do not necessarily correlate with long-term oncologic control. Although minimizing urologic complications is a goal, patients who experience any complication may not feel as if they have received a trifecta-worthy procedure. The authors, therefore, think the goal of performing RPN should be a pentafecta, which encompasses not only the trifecta but also includes long-term maintenance of preoperative renal function and freedom from cancer recurrence. In addition, avoidance of all complications is required not just pertaining to the urologic subset. In order to achieve a pentafecta outcome, there are several necessary components: a technically sound procedure, an appropriate patient selection, care pathway–guided perioperative management, and long-term continuity of care and follow-up. This review highlights these emerging techniques and their role in improving patient outcomes for RPN, particularly in establishing outcomes leading to a pentafecta.

PATIENT SELECTION AND IMMEDIATE PERIOPERATIVE MANAGEMENT FOR PREVENTION OF COMPLICATIONS

With only 80% of small renal masses identified on computerized tomography being malignant lesions, identifying the appropriate patients to undergo surgical procedures would minimize undue morbidity. Although it was initially reported that there was a poor concordance between renal mass biopsy and final pathology, recent reports have demonstrated improved diagnostic accuracy of the renal biopsy in establishing a pathologic diagnosis. An agreement between biopsy and final pathology was 92% in a recent publication by Halverson and colleagues,[4] and this was associated with 100% positive predictive values for a treatment algorithm based on the biopsy.

In optimizing outcomes, the perioperative patient management also plays a significant role in ensuring safe and reliable care. Several groups have established care pathways, creating standardization in perioperative management and smooth transitions for patients between the hospital and their return home. Abaza and Shah[5] described a pathway including the minimization of narcotics, cessation of drain usage, immediate postoperative ambulation, early induction of a clear-liquid diet, and urethral catheter removal on postoperative day 1 following RPN. Through the use of the pathway, 97% of patients could be discharged from the hospital on postoperative day 1, with only a 2.7% readmission rate. The implementation of the pathway and date of surgery, as noted in the series from Patel and colleagues,[6] was the only predictor of early discharge. In these patients, once again, a low readmission rate was documented.

Complication rates following RPN are in the 15% to 25% range based on the definition of complication used, whether this is a strict deviation from the clinical course or if this is only a complication requiring further management.[7,8] Pentafecta achievement requires a smooth perioperative course by minimizing deviation from the established clinical course