Minimally invasive partial nephrectomy in the age of the ‘trifecta’

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In a recent meta-analysis reported in *BJUI*, Zhang et al. [1] looked at the peri-operative outcomes of robot-assisted partial nephrectomy (RAPN) vs those of laparoscopic partial nephrectomy (LPN). Their study represents the third meta-analysis carried out over the last year [1–3], which is testament to the growing interest on this topic that is driven by the rapid spread of robot-assisted kidney surgery.

Some limitations of the previous two meta-analyses have been elegantly outlined by Ficarra et al. [4]. By using a slightly different methodology, Zhang et al. reached the same conclusions as previous two meta-analyses: RAPN provides equivalent peri-operative outcomes to those of LPN, with the added advantage of a significantly shorter warm ischaemia time (WIT) for the robotic approach. In a recent analysis of a single-surgeon series of 500 cases from our group [5], however, we found that RAPN outperformed LPN by offering a wider range of indications, better operative outcomes and lower peri-operative morbidity. In our analysis, we used the ‘trifecta’ (defined as a combination of WIT <25 min, negative surgical margins and zero peri-operative complications) as a surrogate measure of surgical quality. Not surprisingly from our point of view, RAPN achieved the trifecta in 27.1% more cases than did LPN.

Besides representing a surrogate measure of surgical quality, the concept of the trifecta represents a standardised tool for comparing outcomes in the partial nephrectomy setting. Depending on the criteria used, the trifecta encompasses the oncological complications and functional outcomes associated with nephron-sparing surgery. The definition of each of these components has varied among different authors, but the core concept remains the same (Table 1 [5–9]).

With regard to negative surgical margins, there is universal agreement among the publications that this is a goal that any surgeon should strive for, as they represent an indirect measure of oncological safety; however, the actual impact of a pathological finding of a positive surgical margin on the treatment history of renal cancer remains controversial.

In the published trifecta analyses, the definition of complications varies from zero complications to no major or no urological complications. For functional outcome WIT has been used as a surrogate for final renal function by most authors. Although relevant, WIT may not be as important as renal parenchymal preservation in predicting final renal function. Hung et al. [6] overcame this limitation by defining

<p>| Table 1 Combined outcomes in partial nephrectomy series: an overview. |</p>
<table>
<thead>
<tr>
<th><strong>Buffi et al. [7]</strong></th>
<th><strong>Porpiglia et al. [8]</strong></th>
<th><strong>Hung et al. [6]</strong></th>
<th><strong>Khalifeh et al. [5]</strong></th>
<th><strong>Minervini et al. [9]</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of cases</strong></td>
<td>99</td>
<td>206</td>
<td>534</td>
<td>500</td>
</tr>
<tr>
<td><strong>Study type</strong></td>
<td>Case series</td>
<td>Case Series</td>
<td>Case series</td>
<td>Comparative case series</td>
</tr>
<tr>
<td><strong>Surgical technique</strong></td>
<td>RAPN</td>
<td>LPN</td>
<td>RAPN/LPN</td>
<td>RAPN vs LPN</td>
</tr>
<tr>
<td><strong>Terminology</strong></td>
<td>MIC</td>
<td>Trifecta</td>
<td>Trifecta</td>
<td>Negative surgical margins, WIT &lt;25 min, no urological complications</td>
</tr>
<tr>
<td><strong>Definition</strong></td>
<td>Negative surgical margins, WIT &lt;20 min, no major complications</td>
<td>Negative surgical margins, renal function loss (&lt;10%), no urological complications</td>
<td>Negative surgical margins, WIT &lt;25 min, no complications</td>
<td>Negative surgical margins, WIT &lt;20 min, no complications</td>
</tr>
<tr>
<td><strong>Tumour characteristics</strong></td>
<td>T1a/T1b</td>
<td>Mostly T1a</td>
<td>Mostly T1a</td>
<td>T1a</td>
</tr>
<tr>
<td><strong>Trifecta rate, %</strong></td>
<td>75.8</td>
<td>63.1</td>
<td>45–68</td>
<td>58.7 vs 31.6</td>
</tr>
</tbody>
</table>

RAPN, robot-assisted partial nephrectomy; LPN, laparoscopic partial nephrectomy; WIT, warm ischaemia time; MIC, margin, ischaemia, complications.
new criteria based on the ratio of actual postoperative estimated GFR to predicted estimated GFR as a measure of renal function after nephron-sparing surgery. Predicted estimated GFR was calculated based on preoperative estimated GFR and a subjective estimate of volume of kidney resected during surgery. This method is unique for considering the volume of renal parenchyma resected but does not account for ischaemic injury. It is dependent on subjective assessment and the assumption that the two kidneys contribute equally toward total GFR.

One reason for the discrepancy between our study and the previously mentioned meta-analyses lies in the timing of assessment of the RAPN technique. The studies included in these meta-analyses were generally small, and only four of the total 11 studies included >100 patients and only three of the 11 studies had >50 RAPN cases. Judging by these numbers, it becomes clear that many of the surgeons carrying out robot-assisted procedures in these series were in the early phase of their experience with the technique. These results were compared with ‘mature’ LPN cases performed by surgeons who were probably beyond their learning curves for the procedure.

The IDEAL (Idea, Development, Exploration, Assessment, Long-term follow-up) [10] recommendations provide us with a useful tool when assessing any new technology. The studies pooled in the meta-analyses represent the ‘development and exploration’ step of RAPN technology. Another factor to consider is that none of the three meta-analyses considered tumour complexity as a factor that could affect peri-operative outcomes or tried to control for these variations between the two treatment arms. This is probably attributable to lack of reporting by the studies included in the meta-analyses. Recent data suggest that, despite increasing tumour complexity, the peri-operative outcomes of RAPN have improved over time [5,6] and we are now at the ‘assessment’ stage (according to the IDEAL model) for the RAPN technique. At the same time, long-term oncological and functional data are maturing and seem to be encouraging.

High-quality (randomised or matched) comparative studies performed at this stage of evaluation, together with standardisation of reporting of outcomes, will provide us with appropriate data suitable for meaningful meta-analysis.

**Conflict of Interest**

J.K. is a consultant for Intuitive Surgical and speaker for Ethicon and Endocare. R.A. is a consultant for Wiley Publishing. The remaining authors have no conflict of interest to declare.

**References**


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**Abbreviations:** RAPN, robot-assisted partial nephrectomy; LPN, laparoscopic partial nephrectomy; WIT, warm ischaemia time.