Robotic versus open partial nephrectomy: a systematic review and meta-analysis

CRD summary
This review concluded that robotic partial nephrectomy (kidney removal) resulted in a significantly lower rate of perioperative complications, less estimated blood loss, shorter hospital stay and longer operative time than open surgery. Given the lack of good quality randomised studies, the authors’ conclusions should not be seen as definitive; their recommendations for further research are likely to be appropriate.

Authors’ objectives
To compare surgical outcomes of robotic partial nephrectomy and open partial nephrectomy for renal cell carcinoma.

Searching
PubMed, Web of Science and Scopus were searched up to October 2013 for studies published in English. Reference lists of included studies were also consulted. Search terms were reported.

Study selection
Studies that compared robotic partial nephrectomy with open partial nephrectomy were eligible for inclusion. Eligible study designs included randomised controlled trials (RCTs), quasi-RCTs, cohort and case-control studies.

In included studies, most patients were recruited from 2005 up to 2010; their mean age ranged from 53.5 to 63.8 years across groups. Most patients were male. Tumour size varied across the studies and was significantly larger for the open partial nephrectomy group: average tumour size ranged from 2.6cm to 5.4cm in the open partial nephrectomy group; and 2.4cm to 3.8cm in the robotic partial nephrectomy group. Most tumours were malignant.

Two reviewers independently assessed studies for inclusion, with disagreements resolved through consensus.

Assessment of study quality
Quality of RCTs was assessed using the Jadad five-point scale and non-randomised studies were assessed using the Newcastle-Ottawa nine-point scale; higher scores indicated higher quality. The level of evidence was rated for each included study according to criteria by the Oxford Centre for Evidence-Based Medicine (six-point scale; lower scores indicated higher quality).

The number of reviewers assessing quality was not reported.

Data extraction
Outcomes data (operative time, ischaemia time, blood loss, transfusion rate, conversion rate and complication rates) were extracted to calculate odds ratios, risk ratio and mean differences. Complication severity was classed as either minor or major following the Clavien Classification.

Two reviewers independently extracted data.

Methods of synthesis
Outcomes data were combined in a meta-analysis to calculate pooled odds ratios and weighted mean differences. A fixed-effect model was used, unless evidence of significant heterogeneity was found, in which case a random-effects model was employed. Heterogeneity was assessed using $X^2$ and $I^2$.

A funnel plot was used to assess publication bias.

Results of the review
Eight studies (3,418 participants, range 50 to 2,022) were included in the review, comprising one non-randomised prospective study, six retrospective observational studies, and one retrospective study with a historical control.

Newcastle-Ottawa quality scores ranged from 5 to 8 out of 9.
Overall perioperative complication rate was significantly lower for patients undergoing robotic partial nephrectomy compared with open surgery (OR 0.53, 95% CI 0.42 to 0.67; six studies). Five studies reported similar results for overall postoperative complications within 30 days (OR 0.58, 95% CI 0.42 to 0.79), including minor (OR 0.66, 95% CI 0.45 to 0.96) and major events (OR 0.41, 95% CI 0.22 to 0.77). There was no evidence of heterogeneity (I²=0 to I²=28%). There was no statistically significant difference between groups in perioperative transfusion rate (four studies) and conversion to radical nephrectomy (three studies).

The odds of renal artery unclamping were lower in patients undergoing robotic surgery (OR 0.60; 95% CI 0.38 to 0.95; I²=0%). There was no statistically significant difference between the two groups in ischaemia time and estimated glomerular filtration rate change.

Robotic procedures had a longer operative time (WMD 40.89, 95% CI 14.39 to 67.40; five studies), but were associated with shorter hospital stay (WMD -2.78, 95% CI -3.36 to -1.92; six studies) and less estimated blood loss (WMD -106.83, 95% CI -176.4 to -37.27; five studies). Heterogeneity was high for these outcomes (I²≥83%). There was no statistically significant difference in positive margin rates between the two groups (five studies).

Cost information
There were no statistically significant differences in costs between the two procedures (three studies).

Authors' conclusions
Robotic partial nephrectomy resulted in a significantly lower rate of perioperative complications, less estimated blood loss, and shorter hospital stay, although the operative time was longer. Transfusions, ischaemia time, estimated glomerular filtration rate change, and early cancer outcomes were similar to the open surgery. Randomised controlled trials were needed to confirm these findings.

CRD commentary
The review question and selection criteria were generally clear. Only studies published in English were sought, so some studies may have been missed. Attempts were made to reduce reviewer error and bias during study selection and data extraction.

All the included studies were non-randomised studies with short-term follow-up, and nearly all were retrospective observational studies. Tumour size was statistically significantly smaller in the robotic surgery group, which the authors acknowledged may indicate selection bias. Methods of analysis appeared appropriate, although units of analysis for results based on continuous outcomes (minutes, days, mL) were not always reported, which made their interpretation more difficult.

The results of the review generally reflected the evidence. However, given the lack of randomised studies and significant baseline differences between the intervention groups, the authors' conclusions should not be seen as definitive; their recommendations for higher quality trials are likely to be appropriate.

Implications of the review for practice and research
Practice: The authors did not make any recommendations for practice.

Research: The authors stated that well-designed global multi-centre randomised trials with extensive follow-up were required to estimate the effects of robotic partial nephrectomy on long-term renal preservation and cancer control compared with open partial nephrectomy.

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Bibliographic details
Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.