Robot-assisted radical prostatectomy compared with open and laparoscopic approaches: a systematic review and meta-analysis

Moran PS, O'Neill M, Teljeur C, Flattery M, Murphy LA, Smyth G, Ryan M

CRD summary
The authors concluded that the evidence was limited and should be interpreted cautiously. Compared with open surgery, robot-assisted surgery showed significant improvements in positive surgical margin rates for pT2 tumours, and in sexual function at 12 months. With a small caveat regarding the potential for missed relevant studies, the authors’ conclusions reflect the evidence and seem reliable.

Authors' objectives
To compare the effectiveness of robot-assisted prostatectomy with that of open prostatectomy and of conventional laparoscopic prostatectomy.

Searching
MEDLINE, EMBASE, CINAHL and The Cochrane Library were searched, for publications in English or French, from January 2000 to March 2011. The search terms were those of a published search strategy. The Journal of Robotic Surgery was searched.

Study selection
Randomised controlled trials, controlled clinical trials, and observational studies, comparing robot-assisted radical prostatectomy versus open surgery or conventional laparoscopic surgery, were eligible for inclusion. Eligible outcomes were the positive surgical margins for pT2 and pT3 tumours, sexual function and urinary continence at 12 months after surgery, estimated blood loss (mL), operative time (minutes), length of hospital stay (days), transfusion rate, and complications rate.

Most of the included studies were conducted in the USA; the others were conducted in various countries, but not the UK. Most studies were trials that directly compared the intervention with open prostatectomy. The remainder compared the intervention with laparoscopic prostatectomy, or both alternative approaches. The mean baseline age, body mass index, and preoperative levels of prostate-specific antigens, were similar for intervention and control groups. Where reported, the number of surgeons performing the intervention ranged from one to six.

Two reviewers independently selected studies for inclusion; any disagreements were resolved through discussion.

Assessment of study quality
Study quality was assessed according to their design and performance, which included criteria for patient selection, analytic methods, and outcome reporting. The authors did not state how many reviewers assessed quality.

Data extraction
Data on the outcomes were extracted to calculate relative risks and 95% confidence intervals, for dichotomous data, and weighted mean differences and 95% confidence intervals, for continuous data. Means and standard deviations were estimated, where studies reported medians and ranges.

Two reviewers independently extracted the data; all data were cross-checked and any discrepancies resolved through discussion.

Methods of synthesis
Effect estimates and 95% confidence intervals, from individual studies, were pooled using random-effects meta-analysis. Statistical heterogeneity was assessed using \( I^2 \), and 95% prediction intervals were calculated. Meta-regression was performed, using a binary classification, to explore whether differences in surgeon's experience might explain differences in outcomes. Publication bias was assessed using a funnel plot.
Results of the review
Fifty-one studies were included in the review (23,338 patients; range 40 to 1,904 patients). One was a randomised controlled trial (112 patients), 27 were retrospective observational studies (9,641 patients), and 23 were prospective observational studies (13,585 patients). Three studies (including the trial) were rated as high quality, 14 were good quality, 25 were fair to good quality, and nine were poor to fair quality.

Compared with open surgery, robot-assisted surgery was associated with a statistically significant decrease in length of hospital stay, statistically significant lower rates of blood loss, complications, transfusions, and positive surgical margins (for pT2 tumours only), and increased sexual and urinary function (results given in paper). The operative time for robot-assisted surgery was statistically significantly longer than for open surgery. Statistical heterogeneity in most of these meta-analyses was high ($I^2$ ranged from 17% to 99%).

Compared with conventional laparoscopic surgery, robot-assisted surgery slightly increased urinary function at 12 months (RR 1.09, 95% CI 1.02 to 1.17; three studies; $I^2$=0); this difference was of borderline statistical significance. No statistically significant differences were observed between the two groups for the other outcomes assessed. Statistical heterogeneity in most of these meta-analyses was substantial ($I^2$>50%).

The results from the a priori and post hoc sensitivity and subgroup analyses were reported. Unexplained, significant publication bias was found for the estimated blood loss outcome. Prediction intervals (95%) suggested that robot-assisted surgery offered a highly probable benefit, over open surgery, for estimated blood loss and transfusion requirement. No probable beneficial effects were suggested, compared with conventional laparoscopic surgery.

Authors’ conclusions
The evidence was limited and should be interpreted cautiously. Compared with open surgery, robot-assisted surgery showed significant improvements in positive surgical margin rates for pT2 tumours, and in sexual function at 12 months. The differences between robot-assisted and conventional laparoscopic surgery were minimal.

CRD commentary
The review question and inclusion criteria were clearly defined. Relevant databases were searched. The language restrictions and lack of a search for grey literature and unpublished studies, mean that some relevant studies may have been missed. Significant, unexplained publication bias was found for the estimated blood loss outcome, but it was ruled out for all other outcomes.

Efforts were made to minimise reviewer error and bias during study selection and data extraction, but this was unclear for quality assessment. The overall quality of the evidence was considered to be low. Study details were presented, revealing some clinical and methodological heterogeneity between them. The methods of synthesis seem to have been appropriate and statistical heterogeneity was explored.

With a small caveat regarding the potential for missed relevant studies, the authors’ conclusions reflect the evidence and seem reliable.

Implications of the review for practice and research
The authors did not state any implications for practice and research.

Funding
Not stated.

Bibliographic details

PubMedID
23311943
DOI
10.1111/juju.12070

Indexing Status
Subject indexing assigned by NLM

MeSH
Confidence Intervals; Erectile Dysfunction /etiology /physiopathology; Humans; Laparoscopy /adverse effects /methods; Male; Neoplasm, Residual; Prostatectomy /adverse effects /methods; Prostatic Neoplasms /surgery; Recovery of Function; Robotics; Urinary Incontinence /etiology /physiopathology

AccessionNumber
12013016072

Date bibliographic record published
03/04/2013

Date abstract record published
16/05/2013

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.