Robot-assisted versus conventional laparoscopic surgery for colorectal disease, focusing on rectal cancer: a meta-analysis

CRD summary
The review concluded that compared with conventional laparoscopic surgery, robot-assisted laparoscopic surgery using the da Vinci Surgical System was associated with reduced blood loss and intraoperative conversion rates in colorectal disease. The uncertain quality of the evidence base and differences across studies limit the reliability of the pooled results so some caution is warranted when interpreting the authors’ conclusions.

Authors' objectives
To evaluate the advantages of robot-assisted laparoscopic surgery using the da Vinci Surgical System over conventional laparoscopic surgery in patients with benign or malignant colorectal diseases.

Searching
EMBASE and PubMed were searched from January 2000 to July 2011. Abstracts had to be published in English. Search terms were reported. Abstracts published at major conference sites were searched. Reference lists of selected articles were searched.

Study selection
Studies of robot-assisted laparoscopic surgery using the da Vinci Surgical System versus conventional laparoscopic surgery in patients with benign or malignant colorectal diseases were eligible for inclusion. Relevant outcomes were perioperative and postoperative outcomes, including operating time, duration of hospitalisation, estimated blood loss, time to bowel function recovery, time to resumption of oral diet, intraoperative conversion and postoperative complications.

The included studies were in patients with rectum or colon cancer. Some studies were conducted in malignant or benign cancer patients only and half of the studies included both types of patients. Mean age of patients ranged from 53 to 71.35 years, where reported. One study included only female patients. Where reported, mean body mass index ranged from 23.3 to 31 kg/m². Studies were conducted in various countries, including USA, Italy, South Korea and Germany.

Four reviewers independently undertook study selection.

Assessment of study quality
The authors did not state that they assessed study quality.

Data extraction
Data were extracted on peri-operative and postoperative outcomes. Mean differences (MD) with 95% confidence intervals (CI) were calculated for continuous outcomes. Risk differences (RD) or odds ratios (OR), together with 95% CIs, were calculated for dichotomous outcomes.

Four reviewers independently extracted these data, which were cross-checked to obtain consensus. Where necessary, study authors were contacted.

Methods of synthesis
Fixed-effect meta-analysis was used to calculate pooled odds ratios, risk differences or mean differences, with 95% CIs. The $X^2$ and $I^2$ statistics were used to assess statistical heterogeneity ($I^2<25\%$ was deemed low, 25% to 50% moderate and $>50\%$ high statistical heterogeneity). A random-effects model was used where there was evidence of high statistical heterogeneity.

Sensitivity analyses were conducted by removing individual studies or replacing risk difference with odds ratio values. Publication bias was assessed using funnel plots. Subgroup analysis was conducted for cancer location and malignancy.
Results of the review
Sixteen studies were included in the review (1,493 patients, range 12 to 211): 14 case control studies and two randomised controlled trials (RCT).

Compared with conventional laparoscopic surgery, robot-assisted laparoscopic surgery was associated with statistically significant reduced blood loss (MD -17.70mL, 95% CI -34.16 to -1.23; I²=54%; 10 studies), hospitalisation duration (MD -0.46 days, 95% CI -0.82 to -0.10; I²=29%; 14 studies) and intraoperative conversion (RD -0.03, 95% CI -0.05 to 0.00; I²=45%; 16 studies). Compared with conventional laparoscopic surgery, robot-assisted laparoscopic surgery was associated with statistically significantly increased operating time (MD 34.92 minutes, 95% CI 18.49 to 51.36; I²=94%; 16 studies). There was no significant difference between the two procedures in terms of time to oral diet (seven studies), bowel function recovery (seven studies), bowel obstruction (13 studies), anastomotic leak (12 studies) and postoperative complications (17 studies). Other results were presented in the review.

Subgroup analysis indicated that robotic surgery may be most effective in rectal cancer patients; full results were presented in the review.

Cost information
There was no statistically significant difference in hospitalisation costs but there was a trend towards higher costs with robotic procedure.

Authors’ conclusions
Compared with conventional laparoscopic surgery, robot-assisted laparoscopic surgery using the da Vinci Surgical System was associated with reduced blood loss and intraoperative conversion rates in colorectal disease patients and was a promising tool, especially for patients with rectal cancer.

CRD commentary
Inclusion criteria for the review were clearly defined. Several relevant data sources were searched. There was potential for language bias as only articles with abstracts published in English were included. Publication bias was assessed but the results were not presented. Attempts were made to reduce reviewer error and bias throughout the review. The lack of a quality assessment made it difficult to assess the reliability of the evidence base but the authors acknowledged that most of the evidence was non-randomised and thus prone to biases and confounding factors.

Data were combined using meta-analysis and statistical heterogeneity was assessed, which was appropriate. Some analyses had extremely high levels of statistical heterogeneity (even with random-effects meta-analysis) which may indicate that the studies were not suitable for pooling. The authors acknowledged that some analyses had only a small number of studies providing data.

The uncertain quality of the evidence base, differences across studies and the small number of studies for some analyses limit the reliability of the pooled results so some caution is warranted when interpreting the authors’ conclusions.

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

Research: The authors stated that the results of prospective clinical trials (such as the ROLARR study) were needed to determine the equivalence or superiority of robotic procedures to conventional procedures.

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