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REVIEW ARTICLE

Robotic versus laparoscopic distal pancreatectomy – The first meta-analysis

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Abstract

Background: Minimally invasive pancreaticoduodenectomy is considered hazardous for the majority of authors and minimally distal pancreatectomy is still a debated topic. The aim of this study was to compare robotic distal pancreatectomy (RDP) versus laparoscopic distal pancreatectomy (LDP) using meta-analysis.

Method: EMBASE, Medline and PubMed were searched systematically to identify full-text articles comparing robotic and laparoscopic distal pancreatectomies. The meta-analysis was performed by using Review Manager 5.3.

Results: Nine studies fulfilled the inclusion criteria and included 637 patients (246 robotic and 391 laparoscopic). RDP had a shorter hospital length of stay by 1 day (P = 0.01). On the other hand, LDP had shorter operative time by 30 min, although this was statistically nonsignificant (P = 0.12). RDP showed a significantly increased readmission rate (P = 0.04). There was no difference in the conversion rate, incidence of postoperative pancreatic fistula, International Study Group of Pancreatic Fistula grade B–C rate, major morbidity, spleen preservation rate and perioperative mortality. All surgical specimens of RDP reported R0 negative margins, whereas 7 specimens in the LDP group had affected margins.

Conclusions: In terms of feasibility, safety and oncological adequacy, there is no essential difference between the two techniques so far. The 30 min longer operative time of the RDP is due to the docking and undocking of the robot. The shorter length of stay by 1 day should be judged in combination with the increased 90-day readmission rate.

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Introduction

In 1994, Automated Endoscopic System of Optical Positioning (AESOP) inaugurated the era of robotic surgery. In 2000, Intuitive Surgical's Da Vinci system was approved by the Food and Drug Administration and began the era of advanced computer-assisted telesurgery.[1] In 2003, Melvin *et al.* performed the first robotic distal pancreatectomy (RDP).[2] Shortly thereafter, Giulianotti *et al.* published his case series proving the feasibility of robotic pancreatectomies.[3] Laparoscopic distal pancreatectomy (LDP) is the most commonly performed pancreatic resection using minimally invasive techniques due to the absence of reconstruction phase, and can be indicated for benign and malignant pancreatic lesions. Some of the technical challenges in pancreatic surgery include the vascular control and precision required for dissection of the pancreas. These are elements that may offset the laparoscopic approach whereas the robotic approach may overcome these limitations. Compared to laparoscopic approach, the potential benefits provided by the robots could be the reproduction of the mobility of the hand and fingers with seven degrees of freedom and therefore the possibility of performing the same action as in open pancreatic surgery. To the best of our knowledge, there are no randomized

controlled trials on this subject. To clarify the value of robotic for distal pancreatectomy, a systematic literature review and meta-analysis was performed of studies comparing RDP and LDP in terms of surgical and short-term outcomes. We aimed to synthesize conclusions that will serve as basis and trigger factors for the further theoretical and practical development of minimally invasive pancreatectomies.

Methods

Study selection

Using the search terms "robotics" or "robotic", "laparoscopy" or "laparoscopic", and "distal" and "pancreatectomy", we performed a systematic review of the literature in Medline, Embase and PubMed (including studies from the last 13 years) up to September 2015. The research was conducted independently by P.G, B.M and C.L; subsequently all the authors compared their results. References from the articles were investigated manually. Any differences were resolved by consensus. This review adhered to the guidelines outlined in the PRISMA statement.[4]

Data review extraction

The following data were extracted: name of authors; study design; number of patients included in the robotic and laparoscopic cohort; age; sex; body mass index (BMI); American Society of Anesthesiologists (ASA) preoperative risk index; indications; operative time; estimated blood loss; number of red blood cell packed units transfused; conversion rate from the robotic and laparoscopic procedure to the open procedure; pancreatic fistula rate; International Study Group of Pancreatic Fistula (ISGPF) grade A, B, C; 90-day minor and major morbidity; 90-day perioperative mortality; length of stay; spleen preservation rate; Ro margin status; number of lymph nodes harvested; tumor size; mean follow-up; 90-day readmission rate; and cost.

Inclusion criteria

We included studies with more than five patients in each arm for comparison of clinical characteristics, outcomes and the cost difference between RDP and LDP. Moreover, from studies that compared robotic, laparoscopic and open distal pancreatectomies, we chose the robotic and the laparoscopic procedures.

Exclusion criteria

Narrative reviews, case series or studies without matched groups, studies with less than five cases, surveys and non-English language articles were excluded.

Outcome definitions

Apart from the study of Kang *et al.*,[5] all the remaining reports and definitions of the pancreatic fistula rate were according to the ISGPF classification.[6] Overall, minor and major complications were categorized according to Clavien–Dindo classification.[7] The operative time of the robotic procedure included the docking time of the robot. Perioperative mortality is defined as death within 90 days.

Quality assessment

The quality of each study was assessed according to risk for bias using the QUIPS (quality in prognosis studies) tool.[8] This is based on the identification of five domains of potential study bias (study participation, prognostic factor measurement, outcome measurement, confounding factor measurement, and analysis) with three to seven items per domain. Each item is given a score according to whether its quality limits potential bias: a score of 2 indicates that it does; a score of 1 indicates that it does so 'partly', and a score of 0 indicates that it does not. Data were extracted independently by the authors (P.G and C.L) and disagreements resolved by discussion.

Statistical analysis

We used Review Manager 5.3 software (Cochrane collaboration, Oxford, England) for all statistical analyses. Considering that patients were selected by different surgical teams and operated in different centers; we chose the random-effects model to assess this heterogeneity. I^2 was used for heterogeneity assessment, and values of more than 50% were considered significant. Dichotomous variables were analyzed and assessed with an odds ratio (OR); a value of less than 1 favored the robotic cohort, while values of $P < 0.05$ and 95% confidence intervals (CIs) without the value of 1 supported the statistical significance of odds ratio (OR). Continuous variables analyzed with the weighted mean difference (WMD). The Mantel-Haenszel method was used to combine the OR for the outcomes of interest; Peto OR was used when necessary. Publication bias and sensitivity analysis were performed.

Results

Literature search result and quality assessment

A total of 182 studies were published in the medical literature until September 2015. After screening of records, 12 duplicates were removed. The researchers investigated the titles and abstracts of the remaining 170 articles; subsequently, 24 studies were selected for full-text investigation. After the full-text investigation process, 9 articles fulfilling the selection criteria were selected (246 robotic and 391 laparoscopic cases) (Table 1[5,9–16] and Fig. 1). Fifteen articles were excluded: 6 studies without a matched group, 4 narrative reviews, 2 surveys, 2 articles with less than 5 patients and 1 non-English language paper.

The median QUIPS score for the included studies was 28 (range: 17–30) of a maximum score of 50 (Supplementary Table S1).

Results of the meta-analysis

Operative time

All studies reported operative times[5,9–16]; whereas three studies did not give a standard deviation (SD).[4,8,11] The mean operative