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Association between robot-assisted surgery and resection quality in patients with colorectal cancer

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ABSTRACT

Background: Resection quality after robot-assisted surgery for colorectal cancer have not previously been investigated in a nationwide study. The aim of the study was to examine the resection quality in robot-assisted versus laparoscopic surgery for colorectal cancer. Furthermore, 30-day mortality, postoperative complications, and conversion to open surgery were investigated.

Methods: Patients undergoing either laparoscopic or robot-assisted surgery for colorectal cancer between 1 January 2010 and 31 December 2015 were included. The primary outcome was whether R0 resection was achieved. Secondary outcomes were 30-day mortality, postoperative complications, and conversions to laparotomy.

Results: A total of 8615 and 3934 patients had a diagnosis of colon cancer and rectal cancer respectively. Of the patients with colon cancer, 511 patients underwent robot-assisted surgery and of the patients with rectal cancer, 706 patients underwent robot-assisted surgery.

In the multivariate analysis, patients with colon cancer had an odds ratio (OR) = 0.63 (95%CI 0.45–0.88) for receiving R0 resection in the robot-assisted group compared to laparoscopy. For patients with rectal cancer, the OR was 1.20 (95%CI 0.89–1.61). No difference in 30-day mortality or postoperative complications were observed. The OR of conversion to laparotomy was lower in the robot-assisted group compared to the laparoscopic group in both patients with colon – and rectal cancer.

Conclusions: The study showed significant lower odds of receiving R0 resection in patients with colon cancer undergoing robot-assisted surgery. In patients with rectal cancer the robot-assisted surgery non-significantly increased the odds of receiving R0 resection.

1. Introduction

In 2002 the first successful robot-assisted colorectal procedure was performed [1]. Several studies have since then documented the feasibility and safety of robot-assisted colon and rectal surgery [2–4]. Previous studies aimed to investigate differences between robotic and laparoscopic approach in colorectal surgery, have primarily focused on peri- and postoperative outcomes such as blood loss, conversion to laparotomy, costs, duration of surgery and length of stay [5–7].

Studies have suggested that robot-assisted surgery may confer an additional advantage to conventional laparoscopy with respect to oncological quality. These studies has primarily been small single-institution studies and personal series [8–10]. Recently, the ROLARR study [11] examined quality of the resection assessed by circumferential resection margin positivity and plane of surgery in patients undergoing surgery for rectal cancer. The study found no difference between the outcomes and whether the surgery was conventional laparoscopy or robot-assisted. However, the primary outcome of the study was risk of conversion to laparotomy, and therefore the sample size might have been too small to assess differences in resection quality.

Up until now, no nationwide studies investigating whether there is an oncological advantage of robot-assisted surgery for colonic or rectal cancer have been conducted. Thus, we do not have nationwide oncological short-term outcomes, after implementation of robot-assisted colonic and rectal cancer surgery.

The aim of this study was to examine the resection quality in

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relation to surgical approach: robot-assisted or conventional laparoscopy. In addition, 30-day mortality, postoperative complications, and conversion rate to laparotomy were investigated.

2. Methods

The study was a nationwide register-based observational study. Patients undergoing either laparoscopic or robot-assisted elective curative surgery for colorectal cancer in the entire Danish population between 1 January 2010 and 31 December 2015 were included in the study. Study participants were identified through the Danish Colorectal Cancer Group (DCCG) national clinical database which contains information regarding patients diagnosed with CRC in Denmark and has data completeness of 98.6% [12]. Information regarding gender, age at diagnosis, Charlson comorbidity index (0, 1–2, >2), body mass index (BMI) ($\leq$25 kg/m^2, 26–30 kg/m^2, $\geq$31 kg/m^2), type of cancer (colon or rectum), tumor classification (TNM), surgical complications (postoperative bleeding, wound dehiscence, abdominal abscess, anastomotic leakage, complications related to stoma), date of surgery, conversion to laparotomy and information regarding neoadjuvant treatment and quality of the resection (R0 resection yes/no) were obtained. R0 resection is defined as at least 1 mm negative resection margin, assessed microscopically, from primary tumor or tumor deposits. Anastomotic leakage was defined as a leakage requiring surgical, endoscopic or radiological intervention.

All Danish residents have a unique personal identification number, which makes linkage between registers possible [13]. Information on mortality for all patients was obtained by linkage with the Danish Civil Registration System, which, for practical purposes, is complete and includes follow-up on all persons [14]. All hospital contacts including outpatient visits are registered in the Danish National Patient Register (NPR) [15]. Information regarding hospital admission such as date of admission and discharge and procedure codes (International Classification of Diseases (ICD) 10 codes) was obtained from the NPR.

The type of surgical procedure (laparoscopic, laparotomy, endoscopic etc.) was registered in DCCG, but until 2014 robot-assisted surgery was registered as laparoscopy. Therefore, to identify patients undergoing robot-assisted surgery in the study period, the procedure code KZXX00 was used and obtained from NPR. Patients were classified as undergoing robot-assisted surgery if registered in either DCCG or NPR.

3. Statistical analysis

Baseline characteristics were analyzed using the chi-squared test for categorical variables. The primary outcome was resection quality assessed by whether R0 resection was performed or not. Secondary outcomes were 30-day mortality, occurrence of postoperative surgical complications and conversion to laparotomy.

Logistic regression was used to estimate resection quality, risk of surgical complications and conversion to laparotomy, whereas 30-day mortality was assessed by Cox regression. For all the mentioned outcomes multivariate analyses were performed. The variables included were selected based on clinical relevance and were as follows: gender, age at diagnosis, Charlson comorbidity index, BMI, TNM classification and year of surgery. For the analysis regarding colon, tumor site (right-sided vs. left-sided) were included in the multivariate analysis. In the analysis of rectal cancer, whether the

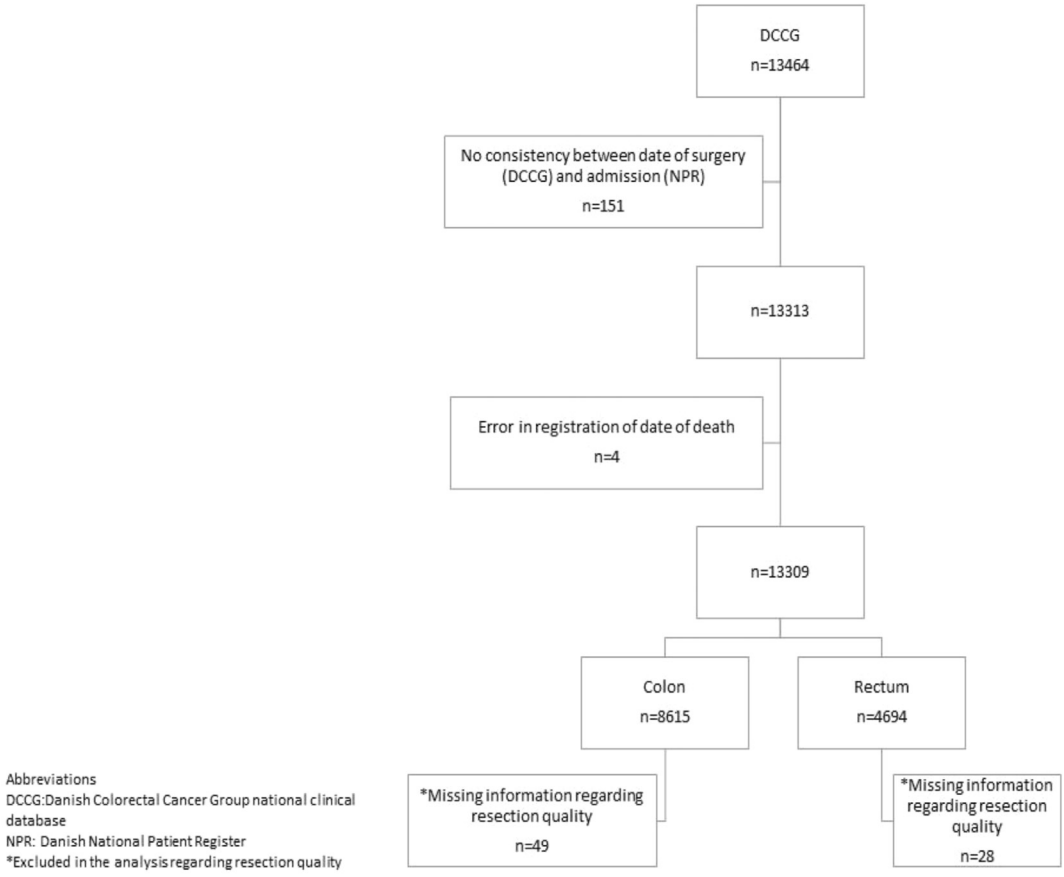

Fig. 1. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) flowchart.