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ORIGINAL ARTICLE

Colorectal surgery and enhanced recovery: Impact of a simulation-based care pathway training curriculum☆

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KEYWORDS
Colorectal surgery;
Training;
Care pathway;
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Summary
Background: The aim was to determine whether a simulation-based care pathway approach (CPA) curriculum could improve compliance for enhanced recovery programs (ERP), and residents' participation in laparoscopic colorectal surgery (LCS). Indeed, trainee surgeons have limited access to LCS as primary operator, and ERP have improved patients' outcomes in colorectal surgery (CS).
Methods: All residents of our department were trained in a simulation-based CPA: perioperative training consisted in virtual patients built according to guidelines in both ERP and CS, whilst intraoperative training involved a virtual reality simulator curriculum. Twenty consecutive patients undergoing CS were prospectively included before ($n=10$) and after ($n=10$) the training. All demographic and perioperative data were prospectively collected, including compliance for ERP. Residents' participation as primary operator in LCS was measured.
Results: Five residents (PGY 4—7) were enrolled. None had performed LCS as primary operator. Overall satisfaction and usefulness were both rated 4.5/5, usefulness of pre-, post- and intraoperative training was rated 5/5, 4.5/5 and 4/5, respectively. Residents' participation in LCS significantly improved after the training (0% (0—100) *vs.* 82.5% (10—100); $P=0.006$). Pre- and intraoperative data were comparable between groups. Postoperative morbidity was also comparable. Compliance for ERP improved at Day 2 in post-training patients (3 (30%) *vs.* 8 (80%); $P=0.035$). Length of stay was not modified.

☆ This study was approved by the NRES Committee London — Central under the REC reference: 12/LO/1215.

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Conclusions: A simulated CPA curriculum to training in LCS and ERP was correctly implemented. It seemed to improve compliance for ERP, and promoted residents participation as primary operator without adversely altering patients' outcomes.

Introduction

Surgical skills have long been grounded to technical abilities: training out of the operating room (OR) predominantly consisted of improving intraoperative technical skills using benchtop models and simulators [1,2]. However, both technical and non-technical skills are essential in the training of surgeons. Non-technical skills are needed not only in the OR [3,4], but also in pre- and postoperative care. Indeed, Pucher et al. recently showed that ward round quality had some impact on patients' outcomes in surgery [5].

A care pathway approach implies both technical skills training on a simulator, and training in pre- and postoperative care: the purpose of perioperative training is to improve both decision-making and knowledge. Most perioperative care training interventions that have been published so far are experiential or *via* lectures, but not interactive between the trainees and the patients, *i.e.* that 3D virtual patients (VP), or actors in a simulated ward provide data about their chief complaint, history and exam. In a pilot study, we demonstrated that a simulation-based CPA training (using VP and a virtual reality (VR) intraoperative curriculum) had a positive impact on patient care for acute appendicitis, a common disease requiring basic skills (this work, still unpublished, was presented as a poster presentation at the APDS (Association of Program Directors in Surgery) Spring Meeting in Seattle in April 2015).

A further step in education would be to implement simulation-based CPA for advanced training in laparoscopic abdominal surgery (ATLAS) [6], where intraoperative skills, strategy, and decision-making are paramount. Indeed, advanced technical skills training may reduce learning curves and improve patient safety in the OR. Advanced non-technical skills training should encompass enhanced recovery programs (ERP). Indeed, despite the known benefits of ERP [7,8], uptake remains slow: compliance to colorectal ERP would only be 60—70% [9], and tends to decrease with time, even in reference centers [10].

We previously designed VP in colorectal surgery to train in ERP through pre- and post-operative cases [11], and an intraoperative VR competency-based curriculum for sigmoid colectomy, which demonstrated validity evidence. The objectives of the present study were to implement such a simulation-based CPA curriculum, and to assess its impact on compliance for ERP [12].

Methods

Study population

This was a prospective single-center study, conducted in the department of colorectal surgery of St. Mary's Hospital, Imperial College Healthcare NHS Trust, London, and implementing a simulation-based CPA curriculum in colorectal surgery. The primary objective was to assess such a CPA impact on compliance for ERP in colorectal surgery; the secondary objectives were to assess its impact on residents participation in OR, on patients' outcomes, and on residents' satisfaction. The ERP was well established within the department at the time of the study, as it had been introduced for over 5 years.

The study was approved by the NRES Committee London — Central under the REC reference: 12/LO/1215. After providing informed consent, twenty consecutive patients undergoing colorectal surgery, whether laparoscopic or open, were prospectively included before ($n = 10$) and after ($n = 10$) the training of residents.

The data included the following: demographic data, such as age, gender, body mass index (BMI) and American Society of Anesthesiology score (ASA score); preoperative data, such as indication for surgery, disease location, cancer (and in case of rectal cancer, preoperative radiochemotherapy), type of operation scheduled, preoperative counseling, respiratory preparation, bowel preparation, admission at the day of surgery; intraoperative data, such as type of approach (*i.e.*, laparoscopic or open), type of operation actually performed, stoma creation, drainage, conversion to open surgery, self rating of difficulty (on a 1—5 scale), Objective Structured Assessment of Technical Skills (OSATS) self rating [13], intraoperative complications, operative time, percentage of time during which residents were primary operator; and postoperative data, such as compliance for ERP at Day 1 and Day 2 (including appropriate diet and mobilization, and discontinuation of IV fluids at Day 2), time to liquid and solid diet, type of analgesia, postoperative pain at Day 1 (according to an analogue visual scale (AVS) from 1 to 10), postoperative morbidity (according to Dindo's classification), including gastrointestinal complications, additional surgery and mortality, and length of stay.

Care pathway curriculum

The curriculum was designed in a previous study [11]. In summary, four preoperative VP were designed in the virtual world of Second Life™ (Linden Research Inc, San Francisco, CA, USA). They presented in clinics with various colorectal diseases, including both simple and complex cases. The objectives of pre-operative cases were to elicit the relevant clinical information from the history and examination, establish the pertinent investigation findings, determine the correct diagnosis and initiate an appropriate management plan, similar to how a surgeon should perform in clinics. The cases involved knowledge in colorectal diseases and ERP such as pre-operative counseling, preoperative identification of high-risk patients for ERP failure (in particular, social assessment), medical review, absence of bowel

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