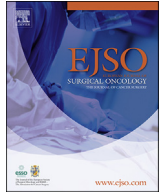




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Patterns of complications following urinary tract reconstruction after multivisceral surgery in colorectal and anal cancer

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ABSTRACT

Background: Multi-visceral resection, including parts of the urinary tract, is sometimes warranted to achieve cancer clear resection margins and optimize survival in patients with locally advanced colorectal and anal cancer. The aim of this study was to assess morbidity after urinary tract reconstruction dictated by colorectal and anal malignancy and to identify potential predictors of urological complications.

Methods: All patients undergoing surgery for colorectal or anal malignancy, including urinary tract resection and synchronous reconstruction, performed at the Karolinska University Hospital during 2004–2015 were included in this retrospective cohort study. Data was collected from medical records with follow-up until at least one year after the index surgery. Complications were graded according to the Clavien–Dindo classification system of surgical complications.

Results: The study included 189 patients; 121 underwent cystectomy and 68 partial ureter resection. The rate of high grade urological complications was 22%. The risk of major urological complications was significantly higher in patients subjected to ureter resection compared to after cystectomy (OR 2.60, 95% CI 1.23–5.49). Also, preoperative radiotherapy and intestinal anastomotic dehiscence significantly increased the risk of high grade urological complications.

Conclusion: To achieve potentially curative resections with uninvolved margins in patients with locally advanced colorectal and anal cancer, multi-visceral resection including urinary tract reconstruction can be performed with reasonable morbidity.

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Introduction

In at least 5–10% of patients with colorectal cancer the tumour invades one or more adjacent organ at the time of diagnosis. According to the 7th ed. UICC/TNM staging system these tumours are defined as T4b [1,2]. The exact prevalence of tumour invasion of the urinary tract is uncertain but bladder involvement has been reported in 17% of patients after multivisceral resection [3]. In an unselected series of resected colorectal cancers, bladder involvement was reported in 3% of specimens [4].

Surgery resulting in specimens with margins uninvolved by tumour (R0 resection) is the most important prognostic factor in determining treatment outcomes in locally advanced and locally

recurrent colorectal cancer [5]. To achieve an R0 resection, partial or complete cystectomy or resection of part of the ureter/s may be necessary, as part of multivisceral *en bloc* surgery. Urinary tract reconstruction after both cystectomy and partial ureter resection has proven more prone to complications when performed in the context of colorectal cancer surgery as compared to surgery for primary urothelial cancer or benign conditions [6,7]. Prior pelvic irradiation, the extent of the surgical resection and major intraoperative blood loss are factors suggested to contribute to the increased urological morbidity. However, evidence in contemporary literature is diverging [6,8]. In addition, comparison of results is difficult due to disparity in how surgical complications are reported [9]. Systematic classifications of surgical complications, for example by the Clavien–Dindo (CD) system, has been sparsely implemented to describe urological morbidity following malignant colorectal and anal cancer surgery [10].

The aim of this retrospective cohort study was to assess morbidity related to urinary tract reconstruction after multivisceral

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resection of colorectal and anal cancer. Furthermore, potential patient and surgical factors predicting urological complications were investigated.

Methods

All patients in whom an *en bloc* resection of a part of the urinary tract was performed for a locally advanced or locally recurrent colorectal or anal cancer at Karolinska University Hospital between 2004 and 2015 were identified using an in-hospital, prospective database of all operative procedures. The inclusion criterion for this study was surgery for a colorectal or anal cancer requiring reconstruction of part of the urinary tract with a synchronous ureteric anastomosis to ureter, bladder or bowel. In-patient and out-patient medical records were scrutinized. Data collected included age, gender, diagnosis, ASA score, neoadjuvant treatment, prior irradiation, date and type of surgery, number and types of intestinal and urinary anastomoses, operative time, estimated blood loss, intensive care unit admissions, reoperations, interventional radiology and endoscopy procedures, length of hospital stay and vital status including date of death.

Incontinent ileal conduits were constructed *ad modum* Bricker with ureteroenteric anastomoses according to either the Bricker or Wallace technique [11,12]. Continent urinary diversion, in the form of ileal neobladders, were constructed according to the Studer technique with or without chimney modifications of the ileoureteral anastomosis [13] and continent cutaneous diversion according to the technique described by Kock [14]. Ureteroneocystostomies were performed as either direct reimplantation, with or without psoas hitch, or with Boari flaps [15,16].

Complications were identified *via* a prospective in-hospital register. In addition, a retrospective review of medical records prior to and up to at least one year following the index surgery was undertaken. Data extracted from the register and medical records were entered into a designated database for further analyses.

Complications appearing within 30 days postoperatively or during the in-patient care for the index operation were graded according to the Clavien-Dindo classification system of surgical complications [10]. Complications related specifically to the urological procedure were recorded separately and sub grouped into early and late urological complications. Early urological complications were defined as complications within 30 days postoperatively or during the in-patient care for the index operation and late complications as appearing thereafter, within one year of the index operation. If a urological complication was registered the follow-up was extended beyond one year. Only high grade urological complications (CD IIIa - V) were recorded.

The definition proposed by Brown et al., *i.e.* presence of creatinine rich effluent from abdominal drains or wound sites and/or evidence of contrast extravasation from the conduit or ureteric anastomosis identifiable on imaging, was used to define a urinary leak [17]. For the purpose of this study, a ureteric stricture was defined as a surgical complication when clinically significant postoperative hydronephrosis was detected on imaging after the formation of an anastomosis involving the specific ureter, in absence of other apparent causes of obstruction. A urinary fistula was defined as an abnormal passageway connecting two organs of which one was part of the urinary tract. Failure of the urological reconstructive surgery was defined as: irreversible renal failure requiring dialysis, urinary diversion by permanent catheterization including urinary catheter and nephrostomy tube(s) or surgical conversion of a ureteroneocystostomy to permanent conduit diversion. Permanent urinary catheterization was considered a failure only when the indication was clearly stated as an atonic urinary bladder.

Ethical approval was granted by the regional ethics committee of Stockholm (Regional Ethical Vetting Board, Stockholm, Sweden).

Statistical methods

Study data was analysed with Stata version 14.0 (StataCorp LP, College Station, TX, USA). Groups were compared with non-parametric (Wilcoxon ranksum) or Fischer's exact test as appropriate and p-values <0.05 were considered statistically significant. Univariable logistic regression models were used to assess the effect of type of urological procedure (cystectomy vs partial ureter resection), age, gender, ASA score, origin of cancer, presentation of cancer, irradiation, operative time, intraoperative blood loss and intestinal anastomotic dehiscence on urological complications. Covariates with statistically significant effects in the univariable analysis, significant interaction terms with type of urological procedure or important confounding effect on the association between type of urological procedure and urological complications (more than 10% change in point estimate) were considered for the multivariable logistic regression model. Origin of cancer was not included due to co-linearity with irradiation and a small sample size of anal cancer (n = 8).

Results

In total, 191 patients fulfilled the inclusion criterion during the study period. Two patients were lost to follow up, leaving 189 patients in the study.

Patient characteristics

Pre-operative patient characteristics are presented in Table 1. Forty-nine patients (26%) had locally advanced colon cancer, 15 patients (8%) locally recurrent colon cancer, 75 patients (40%) locally advanced rectal cancer, 42 patients (22%) recurrent rectal cancer, five patients (3%) locally advanced primary anal cancer and three patients (2%) recurrent anal cancer. Among patients with locally advanced rectal cancer and locally recurrent rectal cancer 112 patients (96%) had received prior pelvic irradiation. Among irradiated patients 82 (70%) received radiotherapy as part of a neoadjuvant regimen prior to the index surgery. In the group of patients with locally advanced and locally recurrent colon cancer 19 patients (30%) had received prior pelvic irradiation. Among these, 11 patients (17%) received radiotherapy as part of a neoadjuvant regimen. In addition, five patients with primary colon cancer were treated with cytoreductive surgery and hyperthermic intraperitoneal chemotherapy (HIPEC) due to synchronous

Table 1
Baseline characteristics of patients undergoing urinary tract reconstruction at the time of colorectal and anal cancer surgery, n = 189.

Variable	Number (%)
Age, years, median (range)	64 (19–92)
Gender	
Male	125 (66)
Female	64 (34)
ASA score	
1–2	124 (66)
3–4	65 (34)
Origin of cancer	
Colon	64 (34)
Rectum	117 (62)
Anus	8 (4)
Presentation of cancer	
Primary	129 (68)
Recurrent	60 (32)
Irradiation	
Yes	139 (74)
No	50 (26)

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