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Original Article

The impact of urological resection and reconstruction on patients undergoing cytoreductive surgery (CRS) and hyperthermic intraperitoneal chemotherapy (HIPEC)

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KEYWORDS
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Abstract *Objective:* Cytoreductive surgery (CRS) and hyperthermic intraperitoneal chemotherapy (HIPEC) are increasingly being used to treat peritoneal malignancies. Urological resections and reconstruction (URR) are occasionally performed during the surgery. We aim to evaluate the impact of these procedures on peri-operative outcomes of CRS and HIPEC patients.
Method: A retrospective review of a prospectively maintained database of all patients who underwent CRS-HIPEC from April 2001 to February 2016 was performed. Outcomes between patients who had surgery involving, and not involving URR were compared. Primary outcomes were the rate of major complications and the duration of stay in the intensive care unit (ICU) and hospital. Secondary outcomes were that of overall survival (OS) and prognostic factors that would indicate a need for URR.
Results: A total of 214 CRS-HIPEC were performed, 21 of which involved a URR. Baseline clinical characteristics did not vary between the groups (URR *vs.* No URR). Urological resections comprised of 52% bladder resections, 24% ureteric resections, and 24% involving both bladder and ureteric resections. All bladder defects were closed primarily while ureteric reconstructions

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consisted of two end-to-end anastomoses, one ureto-uretostomy, five direct implantations into the bladder and three boari flaps. URR were more frequently required in patients with colorectal peritoneal disease ($p = 0.029$), but was not associated with previous pelvic surgery (76% *vs.* 54% $p = 0.065$). Patients with URR did not suffer more serious complications, (14% *vs.* 24%, $p = 0.42$). ICU (2.2 days *vs.* 1.4 days, $p = 0.51$) and hospital stays (18 days *vs.* 25 days, $p = 0.094$) were not significantly affected. Undergoing a URR did not affect OS ($p = 0.99$), but was associated with increased operation time (570 min *vs.* 490 min, $p = 0.046$).

Conclusion: While concomitant URR were associated with an increase in operation time, there were no significant differences in postoperative complications or OS. Patients with colorectal peritoneal metastases are more likely to require a URR compared to other primary tumours, and needs to be considered during pre-operative planning.

1. Introduction

Cytoreductive surgery (CRS) and hyperthermic intraperitoneal chemotherapy (HIPEC) are used to treat selected patients with peritoneal carcinomatosis from colorectal, ovarian, appendiceal, gastric, mesothelioma and primary peritoneal neoplasms [1—4]. Urological resections and reconstruction (URR) are occasionally required during the CRS, due to disease involvement especially in patients with heavy pelvic disease volume, or secondary to inadvertent injury. Urological involvement during CRS and HIPEC has been reported in 7%—20% of published reports [5—11], although the impact on postoperative outcomes and long-term survival remains inconclusive. Studies have alternatively reported no differences in morbidity, operation time or overall survival (OS) [9], increased operation time without effect on morbidity or survival [8], increased risk of severe morbidity without an effect on survival [12] and increased operation time and risk of major complications, but with no effect on OS [11].

We aim to report on the experience of urological involvement and URR during CRS and HIPEC in a high-volume centre in South East Asia, and to evaluate the impact of these procedures on perioperative outcomes.

2. Methods

A prospectively maintained, Institutional Review Board (IRB) approved database of all patients who underwent CRS-HIPEC for peritoneal-based malignancies at a single institution from April 2001 to February 2016, was retrospectively reviewed. Demographics including age, gender, race, and tumour type were included in the database and reported.

Primary outcomes were the rate of major complications and the duration of stay in the intensive care unit (ICU) and hospital. Secondary outcomes were that of OS and prognostic factors that would indicate a need for URR.

2.1. Patient selection

Patients considered for CRS-HIPEC had to be of Eastern Cooperative Group (ECOG) performance status 0 or 1, with no distant metastases. All patients were recommended for CRS-HIPEC after evaluation in a multidisciplinary tumour board. The extent of disease of the abdomen and pelvis was examined on computed tomography (CT) scans and the absence of extra-abdominal disease was determined either via CT scans of the thorax or positron emission tomography (PET)-CT scans.

2.2. CRS and HIPEC

CRS-HIPEC proceeded according to previously published techniques [13]. The extent of disease was documented according to the peritoneal cancer index (PCI) [14]. Complete cytoreduction was attempted whenever possible, and the extent of cytoreduction was recorded by the completeness of cytoreduction (CC) score [15]. Chemotherapy was infused via a hyperthermia pump (Belmont) into a closed abdomen at a target temperature of 41 °C—42 °C for 60 min. The chemotherapeutic agent used was determined by a medical oncologist on the basis of malignancy type.

2.3. Urological procedures

Operative reports were individually reviewed to determine if preoperative ureteric stenting or a urological procedure was performed during the CRS. Urological procedures were defined as any resection or reconstruction of the genitourinary tract during the same anaesthetic as the CRS-HIPEC procedure. Ureteric stents were placed routinely after all ureteric reconstructions, and typically removed in the outpatient setting via a flexible cystoscopy between 4 and 6 weeks from the time of the CRS-HIPEC.

No distinction was made between urological organs removed due to involvement with tumour or iatrogenic injury.

Complications were categorized according to the Clavien-Dindo classification, with major complications defined as Clavien III and IV [16]. OS was defined as time from date of CRS-HIPEC to date of death from any cause. Survival was censored on date of death or last follow-up.

For the purposes of comparison, patients were divided into two groups based upon whether or not a urological procedure was included. Thirteen patients underwent more than one CRS-HIPEC procedure during the study period.

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