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Cytoreductive Surgery (CRS) and Hyperthermic Intraperitoneal Chemotherapy (HIPEC) for peritoneal malignancy during the COVID-19 Pandemic

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Abstract

Aim

COVID-19 has instigated rapid alterations in surgical care. Performing CRS-HIPEC for peritoneal metastases during such challenging times has required several perioperative changes. We report our early experience of undertaking CRS-HIPEC during the COVID-19 pandemic.

Methods

A retrospective review of all patients undergoing CRS-HIPEC was conducted (1st April/20 – 28th May/20). Data was retrieved from a prospectively maintained peritoneal malignancy database.

Results

Twelve patients (M:F, 5:7; median, 56yr (26-70yr)) underwent CRS-HIPEC. Five patients had peritoneal metastases of colorectal origin, with a median peritoneal-carcinomatosis-index (PCI) of 12, while four patients had advanced pseudomyxoma peritonei (median, PCI 23). Patients were pre-operatively assessed for SARS-CoV-2. Operating theatres (OT) with laminar-air-flow-systems and high-efficiency-particulate-air-filters were utilized. Essential personnel were permitted through a one-way entry/exit pathway. Double plume extractors were used to remove surgical smoke throughout the operation. HIPEC was conducted using the closed rather than open abdomen technique. Patients were transferred via a modified critical care pathway to HDU. Early results have identified no significant COVID-related complications.

Conclusion

Initial experience of surgery for peritoneal malignancy in the COVID-19 era is encouraging. We will continue to carefully audit our perioperative outcomes as our experience builds.

Introduction

Coronavirus disease 2019 (COVID-19) was first reported in Wuhan, Hubei Province, China in November 2019. The illness rapidly disseminated through over 160 countries in subsequent months and was declared a global pandemic by the World Health Organisation on March 11, 2020. In Ireland the death toll associated with COVID-19 is approximately 1,691 with over 25,000 people affected.[1] Public health authorities swiftly rationalised resources and increased hospital capacity to accommodate for the surge of COVID-19 patients. The Association of Coloproctology of Great Britain and Ireland (ACPGBI) guidelines initially recommended the cancellation of elective surgeries in order to create adequate resources and facilities to care for patients with COVID-19 requiring hospitalisation and critical care support.[2]

General and colorectal surgery has been particularly impacted given the wide variety of elective procedures offered by the specialty, with the majority deemed non-urgent. Peritoneal malignancy, however, is a progressive disease that requires urgent surgical assessment and management, as delays can lead to a higher tumour load and a reduced possibility of achieving a complete cytoreduction. Although the benefits of performing CRS-HIPEC for peritoneal malignancy during the pandemic remain unchanged, the risks have increased substantially. The COVIDSurg Collaborative group published a study in the Lancet evaluating the outcomes of 1,128 patients undergoing surgery with perioperative SARS-CoV2 infection. They reported a 23.8% 30-day mortality rate,[3] with demonstrable alterations in the risk-to-benefit ratio of surgery for individual patients based on their disease status, age, frailty, and comorbidities. The availability of healthcare staff and facilities, such as ICU/HDU bed capacity is a key factor when approaching decision making for treating patients during the COVID-19 pandemic. Utilizing already depleted critical care resources may lead to added pressures on the healthcare system and should therefore only be considered when these resources are not required for COVID-19 patients. Lastly, a relatively high proportion of COVID-19 cases in Ireland are healthcare workers, thus emphasizing the importance of protecting healthcare staff, especially in high-risk settings.[1] The detection of SARS-CoV-2 in gastrointestinal tissue, faeces and, more recently, peritoneal fluid affirms CRS-HIPEC's status as a high-risk procedure that requires strict compliance with infection prevention and control (IPC) measures to maximise patient and staff safety.[4]

Adaptation to the COVID-19 pandemic has led to the implementation of several pre-, intra- and postoperative changes to facilitate the protection of healthcare staff and patients. We describe our experience of performing CRS-HIPEC during the COVID-19 pandemic.

Methods

A retrospective review of a prospectively maintained registry was conducted on all patients who underwent CRS-HIPEC at the National Centre for Peritoneal Malignancy between 1st April 2020 – 28th May 2020. Anaesthetic risk was stratified using the American Society of Anaesthesiologists (ASA) score. The peritoneal carcinomatosis index (PCI) was calculated in accordance with the Peritoneal Surface Oncology Group International (PSOGI).[5] At the end of the operation, the completeness of cytoreduction (CC) was assessed.

Results

Patients

Demographic, operative and pathological data was obtained from electronic patient chart (Table 1). Twelve patients (5 male, 7 female; median age, 56 years) underwent CRS with 11 receiving HIPEC during the study period, a comparable workload to the same period during the previous year. The majority of patients had an ASA score of 2 (n=10, 83%*)*. Five patients had peritoneal metastases of colorectal origin, while 4 had pseudomyxoma peritonei. A median PCI of 12 was noted for the colorectal cases. The patients with pseudomyxoma peritonei had a higher overall tumour burden with a median PCI of 23. The remaining 3 patients had gastric (n=2) and ovarian (n=1) pathology. Ten patients (*83%*) underwent a complete cytoreduction (CC-0/1). Of the remaining 2, one was deemed inoperable and the other underwent major tumour debulking for advanced pseudomyxoma peritonei. The median length of hospital stay (LOS) in CRS patients was 12 days (range, 6-20 days).

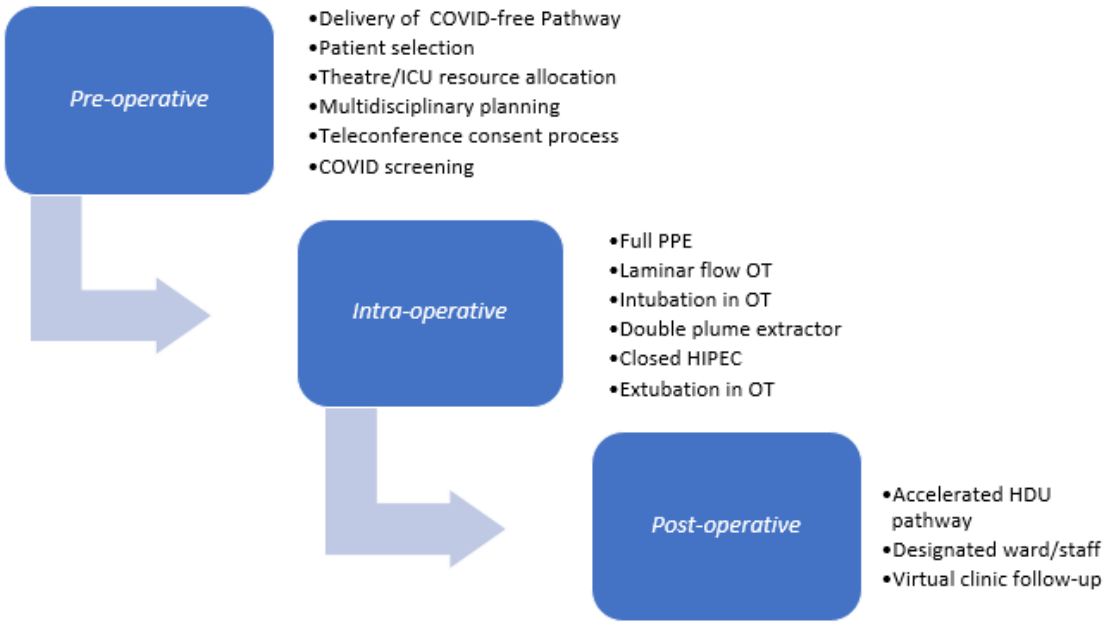
Explanatory variables	CRS +/- HIPEC Patients (*n = 12)*
Age (median (range))	56yrs (26 – 70)
Gender (n (%))	
Male	5 (42%)
Female	7 (58%)
Origin of Peritoneal Malignancy (n)	
Colorectal	5
Pseudomyxoma	4
Ovarian	1
Gastric	2
Peritoneal Carcinomatosis Index (n)	
PCI $<$ 5	3
5 $\geq$ PCI $<$ 10	4
PCI $\geq$ 10	5
Completeness of Cytoreduction (n)	
CC-0	6
CC-1	4
CC-2	0
CC-3	2
Performed HIPEC (n)	
Yes	11
No	1
Operating Time (median ((range))	325m (75 -603)
Morbidity (n)	
Epidural blood patch	1
Pleural tap	1
Length of Hospital Stay (median(range))	12 days (6-20)

Table 1: Baseline characteristics of CRS-HIPEC patients.

Pre-operative

Initial consideration was given to performing elective CRS-HIPEC at a COVID-free site. However, taking into account the complexity of cases and requirement for specialist expertise in radiology, pathology, and anaesthesia, it was decided that utilizing a COVID-free pathway within our current hospital would be more appropriate (Figure 1). Patients with peritoneal malignancy were discussed at the multidisciplinary meeting (MDM) and underwent rigorous preoperative anaesthetic assessment. In our cohort the majority of patients were young (median age, 56 yr), fit (n=11, 91% ASA ≤2), and deemed a low peri-operative anaesthetic risk. The operating surgeon performed a virtual consultation with patients to discuss the procedure and explain the consent process. Most notably, patients were informed of the increased risk of pulmonary complications and mortality from contracting COVID-19 perioperatively despite the establishment of "cold" pathways and strict IPC measures. Critical care resources were closely monitored, with limitations in healthcare staffing or ICU/HDU bed capacity precluding admission of patients for CRS-HIPEC. Suitable patients were admitted to an isolated room on a dedicated surgical ward the night before surgery, contingent on them having met the COVID-19 elective surgery criteria. This required strict social isolation for 14 days, a clinically asymptomatic period of 7 days prior to surgery, a pre-operative COVID-19 assessment and a negative COVID-19 swab within 72 hours, as part of our local hospital policy.

Figure 1: Flowchart of patient pathway.



Intra-operative

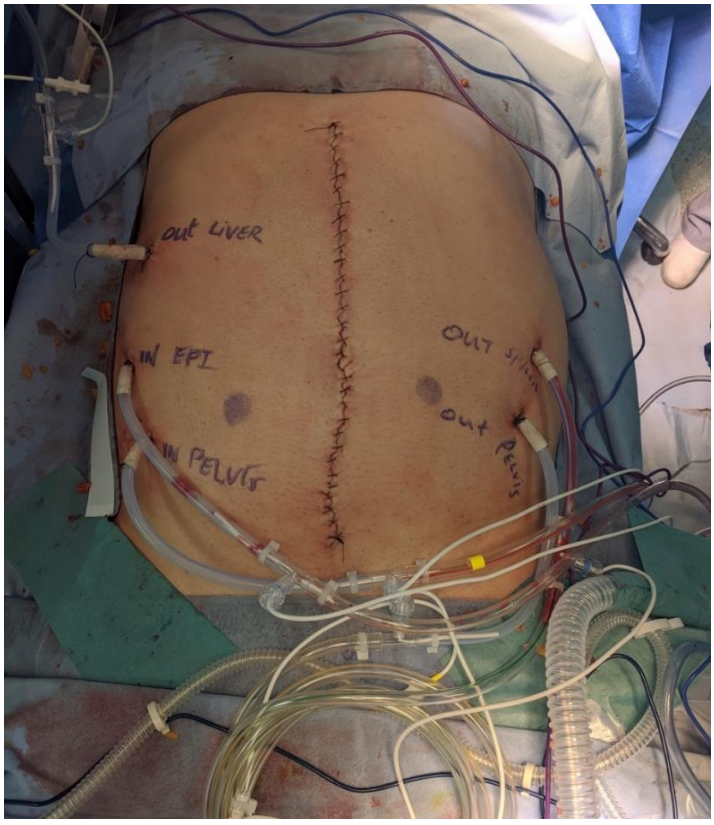
During the pandemic 4 out of 12 theatres were operational daily with the remaining theatre staff being redeployed to HDU, ICU, general or COVID wards. As our patients were deemed low-risk, standard operating theatres with ultra-clean laminar air-flow ventilation systems and high-efficiency particulate air filters were utilized.

Only essential staff were allowed into the theatre wearing full PPE in a one-way entry/exit pathway. All allocated personnel were required to sign-in their details for contact tracing if necessary. Only essential equipment was kept in the main operating theatre with the remainder in a side room in which a nurse 'runner' was present should any equipment be required.

Intubation and ventilation were performed via a secure closed circuit. Given that CRS-HIPEC generates more plume than routine surgical procedures[6] and SARS-CoV-2 RNA has been detected in gastrointestinal tissue, blood, stool and peritoneal fluid,[4] a plume extractor (RapidVac™, Covidien) was used on high power to reduce surgical smoke and potential aerosol transmission. In addition, we adopted disposable monopolar diathermy pencils (ClearVac™, ConMed) with integrated smoke evacuators.

Traditionally we routinely performed the open (Coliseum) HIPEC technique as it provides an even distribution of chemotherapy throughout the abdominal cavity and allows direct access to the abdominal contents and chemoperfusate.[7] The disadvantage of this technique is that there may be an increased risk of vapour dispersion from the abdominal cavity thereby potentially exposing theatre staff to carcinogenic and/or viral particles. By comparison, the closed HIPEC technique uses a closed-circuit method to reduce the risk of aerosol contamination in the OT. As neither technique has been proven superior regarding disease-free progression or overall survival,[8] we have now adopted the closed technique to reduce the exposure to chemoperfusate and aerosol transmission from COVID-19 (Figure 2).

Figure 2: Set-up for closed HIPEC.



Post-operative

Post-operatively, non-essential staff exited the room before the patient underwent extubation. Patients recovered in the operating theatre until ready to be transferred to ringfenced beds in the HDU. The conventional critical care pathway was modified to minimise patient contact with potential COVID-19 carriers. For example, a designated "cold" route from theatre was established to prevent vulnerable post-operative patients from inadvertently coming into close contact with a COVID-19 patient whilst in transit to the HDU. Individual nurses were allocated to specific patients in the HDU to minimise the variation in patient contact and potential spread of COVID-19. Once suitable for ward-level care, patients were transferred to a designated single room on a surgical ward with specified nurses. A select number of patients were recruited to an accelerated post-operative care pathway and transferred directly from the operating theatre to the ward and nursed in a single isolation room. Virtual clinic follow-up was arranged for 6 weeks post-discharge. During the study period, morbidity was low, with no COVID specific complications recorded. Two post-operative complications requiring minor intervention (Clavien-Dindo grade llla) were noted. Two healthcare workers directly involved in the treatment of CRS-HIPEC patients contracted COVID-19 in our institution during the study period. The early detection and fastidious implementation of the aforementioned precautions prevented the spread of COVID-19 to both healthcare staff and patients.

Discussion

The delivery of a peritoneal malignancy service is possible during COVID-19 when appropriately resourced with strict infection precautions. The restructuring of our traditional perioperative pathways has allowed us to maintain a high standard of healthcare for CRS-HIPEC patients, whilst ensuring minimal transmission of COVID-19 infection to patients and healthcare workers. In addition, applying unconventional methods, such as performing a closed HIPEC technique has additional benefits by reducing aerosol contamination in the OT, and the subsequent risk to healthcare staff during CRS-HIPEC cases. Our initial experience of CRS-HIPEC for peritoneal malignancy during the COVID-19 pandemic has been encouraging and we will continue to audit our perioperative outcomes as our experience builds.

Declaration of Conflicts of Interest:
All named authors hereby declare that they have no conflicts of interest to disclose.

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