

## **Components of a safe cystectomy service during COVID-19 in a high volume centre**

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## **ABSTRACT**

### Objective:

Delivery of a safe cystectomy service is a multidisciplinary exercise. In this article we detail the measures implemented in our institution to deliver a cystectomy service for bladder cancer patients during COVID-19.

### Methods:

A 'one-stop' enhanced recovery clinic had been established at our hospital, consisting of an anaesthetist, an exercise testing service, urinary diversion nurses, clinical nurse specialists and surgeons. During COVID-19, we modified these processes in order to continue to safely provide urgent cystectomy for bladder cancer. We collected patients' outcomes prospectively measuring demographic characteristics, oncological and perioperative outcomes, the presence of COVID-19 symptoms and confirmed COVID-19 test results.

### Results:

From March to May 2020, 25 patients underwent radical cystectomy for bladder cancer. Twenty-four procedures were performed with robotic assistance and one open as part of a research trial. We instituted modifications at various multidisciplinary steps including patient selection, pre-operative optimisation, enhanced recovery protocols, patient counselling and peri-operative protocols. Thirty-day mortality was 0%. The 30-day rate of Clavien  $\geq$  3 complications was 8%. Post-operatively, none of the patients developed COVID-19, based on WHO criteria and testing.

### Conclusion

We safely delivered a complex cystectomy service during the peak of COVID-19 without any COVID-19 related morbidity or mortality.

Level of evidence: 2b

## 1. INTRODUCTION

The COVID-19 pandemic has resulted in over 7.5 million confirmed cases and 420,000 deaths worldwide. In the UK alone, over 290,000 cases have been confirmed with over 44,000 deaths.(1) The resulting pressure on UK hospital services has been unprecedented. Elective surgery was discontinued in most centres as a consequence of resource reallocation and concerns regarding peri-operative COVID-19 risk during the pandemic. An international study revealed a concerning 30-day mortality rate of 19% in patients undergoing non-emergency surgery who had COVID-19 diagnosed peri-operatively.(2) Concerns have also been raised about the safety of laparoscopic/robotic surgical approaches, with potential aerosolization of virus particles by abdominal insufflation.(3) Consequently, over 2 million UK, and 28 million worldwide operations have been postponed or cancelled.(4,5)

The potential impact of COVID-19 on bladder cancer is of great concern. Bladder cancer is diagnosed in over 10,000 people per year in the UK, with 20% having muscle invasive disease at presentation.(6) Delayed definitive treatment (radical cystectomy) of more than 12 weeks from diagnosis results in up to a 1.6-fold increase in cancer specific mortality at 5 years.(7) In high-risk non muscle invasive bladder cancer, treatment delay incurs risk of progression to muscle invasive disease with decreased likelihood of cure with radical treatment.(8) In light of concerns regarding the safety of surgery, and the effects of delaying radical treatment for bladder cancer, the British Association of Urological Surgeons (BAUS) recommended that patients with muscle invasive disease be treated with radical radiotherapy, with cystectomy reserved only for salvage cystectomy following radiotherapy.(9) However, the risks of COVID-19 exposure associated with repeated hospital attendances for radiotherapy are unknown.

Despite the adverse environment, and in line with recommendations from the Royal College of Surgeons of England (10) processes and infrastructure were put in place to prioritise patients and minimise risk relating to COVID-19.

In March 2020 NHS England commissioned the formation of three London Cancer Hubs to ensure equal access to cancer care for all patients. A key element of

this plan was the use of facilities physically separated from Emergency Departments, wards and Intensive Care Units that would be used for patients with COVID-19.

One of our buildings, previously used only for urological and thoracic surgery, was therefore repurposed as a COVID-19 Cold Site for the provision of pan-specialty cancer surgery. As a result of these measures, there was no COVID-19-related mortality in a cohort of 500 patients treated during the peak of the pandemic at our centre.(11)

Herein, we describe the measures taken across the bladder cancer MDT and treatment pathway, reconfigured at the onset of lockdown, that allowed us to continue to provide a safe cystectomy service to 25 patients during the COVID-19 pandemic.

## **2. METHODS**

### **2.1 The Cystectomy Pathway Pre-COVID-19**

The cystectomy referral pathway was introduced in 2016 to reduce length of stay (LOS), streamline patient appointments, incorporate Enhanced Recovery After Surgery (ERAS) protocols and improve patient experience and cost efficiency.(12) After referral and multidisciplinary team (MDT) discussion, patients attended a dedicated cystectomy clinic for face-to-face discussion of their diagnosis and treatment options with a consultant or post CCT senior fellow urologist, with a clinical nurse specialist (CNS) present. Following this, eligible patients who selected cystectomy attended a second face-to-face appointment at a dedicated ERAS MDT Clinic. This is staffed by consultant level urologists, anaesthetists, and clinical nurse specialists (CNS) including urinary diversion nurses. The clinic is 'one-stop' and patients are reviewed by an exercise physiologist for cardiopulmonary exercise testing (CPET). A patient education seminar is delivered by the CNS team, and covers topics such as expected length of stay, the enhanced recovery protocol on the ward, and longer term post-operative recovery at home following discharge. On the same week, patients attend for day case examination under anaesthesia (EUA) following which a preliminary date is arranged for cystectomy. If neoadjuvant chemotherapy (NAC) is indicated, the timing of clinic attendance is adjusted accordingly. Under this pathway,

pre-COVID-19, patients attended a minimum of three face-to-face appointments with the team prior to undergoing cystectomy.

Pre-COVID-19, post-operative follow up was conducted according to NICE Guidance (13), with a face-to-face appointment at six weeks, and three-monthly review thereafter.

## **2.2 Changes to the Cystectomy Pathway during COVID-19**

Our principal aim throughout the pandemic was to maintain a streamlined pathway that met the needs and expectations of our patients, and prioritised both patients and staff safety (summarised in Table 1).

We increased our use of telephone clinics and remote working using our electronic medical records system in line with trust recommendations to reduce footfall and face-to-face contact. Following referral and MDT discussion, an initial telephone clinic review took place followed by a face-to-face ERAS MDT clinic closer to the date of surgery. Delivery of the patient education seminar by the CNS team remained unchanged from the pre-COVID-19 pathway. The ERAS anaesthetist was able to conduct further assessments to decide on fitness for surgery based on electronic medical records, telephone consultations, CPET results and pre-assessment. Using this updated approach, patient contact after referral was reduced to one face-to-face pre-operative visit, and typically two telephone consultations.

No neoadjuvant chemotherapy (NAC) was delivered to patients with muscle invasive disease during this time due to the presumed risk of life-threatening COVID-19 infection complications associated with immunosuppression, although this has not been confirmed.(14)

Updates from management were communicated daily throughout the trust and relayed to patients when relevant (e.g. hospital visitor policy, self-isolation procedures). Clear information and instructions were communicated to patients depending on the latest pre-operative screening and isolation processes, and patients provided with several points of contact for *ad hoc* queries.

### **2.3 Preoperative workup and optimization**

Cases were prioritised on the basis of time from referral as well as a cancer-based risk stratification including clinical T stage, lack of response or progression during NAC (for those who had already commenced NAC prior to lockdown) and variant histology.(9) Ileal conduit, heterotopic and orthotopic neobladder urinary diversion options were offered depending on oncological characteristics, pre-operative counselling and assessment and patient choice.

We used tools such as the Surgical outcome risk tool (SORT)-Score (16) and, for all patients aged 65 and over, a Clinical Frailty Scale (17) to evaluate peri-operative risk. The National Surgical Quality Improvement Program (NSQIP) surgical risk calculator (18) gives a more specific prediction about post-operative morbidity. These tools were used by our ERAS anaesthetist to inform discussions with individual patients regarding peri-operative risk. During the COVID-19 pandemic, no patients were excluded from surgery based on these parameters.

Prior to COVID-19, all patients underwent CPET testing, and patients with comorbidities and an anaerobic threshold (AT) of  $\leq 6$  were excluded from surgery. During COVID-19, we only used CPET for selected patients in whom there were concerns about fitness for surgery. These patients were assessed and counselled carefully using CPET to help inform the MDT shared decision-making process as well as informing resource allocation. Patients identified with reduced cardiorespiratory reserve and increased risk of peri-operative complications and mortality received telephone prehabilitation consultations with the physiologist. In addition, the MDT considered whether patients were psychologically prepared for the undetermined risk of surgery during the pandemic.

Adopting RCS England guidelines,(19) we augmented our standard pathway to include an assessment of COVID-19 symptoms, two weeks of strict self-isolation, and a COVID-19 swab 48 hours before surgery. Initially, patients provided a swab and were then admitted to the ward 48 hours prior to their procedure. Subsequently, to adapt to new NHS England guidelines (20), patients had a COVID-19 swab 48 hours before surgery and remained self-isolated at home until admission. MDT assessment of patients' comorbidities was used to inform the peri-operative risk pathway, selecting

cases for either the high dependency unit (HDU) or the surgical ward post-operatively. Lower risk patients were transferred directly to the surgical wards post-operatively avoiding the need for HDU care. This was in contrast to our pre-COVID-19 practice, where all patients were admitted to HDU post operatively.

We and others have shown previously that approximately 50% of cystectomy patients are anaemic.(21,22) Prior to COVID-19, patients with a reversible underlying cause (commonly iron deficiency or chemotherapy-related) were referred to haematology outpatients for intravenous iron infusion. This has been shown to increase haemoglobin after 2-3 weeks and to improve patients' recovery profile.(23) During COVID-19 we discussed an appropriate dose with the haematology service and administered this intraoperatively.

#### **2.4 Intra-operative modifications**

Cystectomy surgery during COVID-19 required a number of changes during the intra-operative period. Staff undertook specific training on personal protective equipment (PPE) and traffic in theatres was minimized using dedicated pathways with only one possible route for entry and exit to the operating theatre. Specific entry points to theatre were stocked with PPE and any unnecessary equipment was moved away from patient transit routes. Patients were anaesthetised, intubated and extubated in theatres (rather than in anaesthetic bays), and non-anaesthetic staff excluded from the theatre for 20 minutes following intubation and extubation to minimise risk of aerosol exposure. A high frequency of air changes ( $\geq 25$  cycles per hour in accordance with modern operating theatre standards) was used to reduce the viral load within the operating theatres.(24)

All members of the theatre team used PPE according to Trust protocols, including level 2-3 filtering face piece (FFP) masks, full face shield, double gloves and full body protection. High risk staff were diverted to other lower risk activities (25) and numbers within theatres were minimised, including the exclusion of observers and visitors. We also had 2 anaesthetists per theatre list to avoid PPE fatigue.

Twenty-four patients underwent robotic-assisted cystectomy, and one patient open cystectomy using standard techniques.(26) Using a mechanical stapling

technique, all diversions were offered including ileal conduit, continent pouch with Mitrofanoff and orthotopic neobladder according to pre-operative indications. In case of long operations (>240 min) staff shifts were arranged to deal with uncomfortable PPE equipment.

A pressure barrier insufflator (Surgiquest Airseal) was used in all robotic-assisted cases, permitting low abdominal pressures and continuous smoke evacuation.(27) The Airseal insufflation system filter allows capturing of particles above 0.01 mcm and the SARS-CoV-2 aerodynamic size has been reported in the range of 0.06-0.14 mcm.(28) The electrocautery power settings were kept on low and bipolar cautery was preferred.(29) Particular attention was taken during insufflation and deflation of pneumoperitoneum to avoid staff exposure to aerosol.

During this period, training for registrars and senior fellows was still facilitated but minimised rotation at the console and used PPE to avoid cross infection between surgeons. The console surgeon adopted the same PPE equipment as the theatre staff with the exception of eye protection which would not have allowed an optimal binocular view.

Post-operatively, we modified our follow-up regime. On discharge, patients were provided with the contact details of the CNS team and on call urology registrar. If patients required urgent face-to-face review, this could be facilitated by the on call urology registrar either in the Emergency Department, or the Urgent Urology Unit, based at the main hospital site. The first routine post-operative appointment was carried out by telephone review with the CNS and surgical teams unless there were particular concerns, in which case a face-to-face review was arranged.

## **2.5 Data collection**

Having reorganised our cystectomy pathway, we evaluated patient outcomes prospectively. We included patients' characteristics, oncological and peri-operative data as well as the presence of COVID-19 symptoms and/or confirmed COVID-19 positive status. Statistical analysis was performed using SPSS software.

## **3. RESULTS**

Twenty-four patients were male, with 1 female patient. Median patient age was 63 years (IQR 55-72). The median BMI was 27 kg/m<sup>2</sup> (IQR 22.9-31.2) and almost half of the patients were either smokers or ex-smokers. Eighty percent were ASA score 2 and 44% had NAC. All 25 patients had negative pre-op testing for COVID-19 with 1 exception: a patient with COVID-19 symptoms (negative swabs but concerning appearances on CT thorax) was delayed for 2 weeks until asymptomatic and reconfirmed as swab negative. For those who underwent CPET testing (n=17), the mean anaerobic threshold, VO<sub>2</sub> peak and VE/VCO<sub>2</sub> were 9.6 ml/kg/min, 17.2 ml/kg/min and 34.4 respectively (Table 2).

Of the 25 patients only one case was deferred for three months because of risk of COVID-19; the patient required salvage cystectomy but was immunosuppressed (post splenectomy with pre-existing lung disease).

Pre-cystectomy staging showed pT2 in 72%(n=18), pT3 in 24% (n=6) and pT4 in one case. All cases were M0 and two patients were node positive on pre-operative imaging.

In robotic-assisted cases, the median overall and console operative time was 420 and 293 minutes respectively. Median estimated blood loss (EBL) was 300 ml (IQR 200-500) ml. Eighty-four percent of patients received an ileal conduit (IC), 8% received an orthotopic neobladder and 8% a heterotopic ileocolic pouch with Mitrofanoff diversion. Urethrectomy was performed in three (12%) cases. Median LOS was seven days (IQR 6.75-10.25). Seven patients experienced Clavien 1 complications (ileus and hospital-acquired pneumonia) and two patients had Clavien 3a complications (nephrostomy for urine leak and radiologically-guided Mitrofanoff catheter insertion). No high grade (Clavien 4-5) complications occurred in our series. No patients contracted COVID-19 at a minimum of two months' follow-up (Table 3).

Histopathological examination revealed urothelial disease in 63% of cases with T0, Ta, Tis, T2 and T3 disease in 24%, 16%, 4%, 16% and 32% of patients respectively. Sarcomatoid disease was present in 37% of cases and 24% had positive

lymph nodes. Concomitant prostate cancer was detected in almost half of our cohort: Gleason 6 in seven patients and Gleason 7 in three patients (Table 4).

## **4. DISCUSSION**

### **4.1 Best practice before COVID-19**

Pre-COVID-19 we followed an ERAS MDT model as the standard for all patients as it has been shown to reduce complication rates, decrease LOS and reduce time to return of bowel function.(30) It may also improve patient-reported quality of life.(31)

We focused particularly on patient evaluation and pre-assessment, including use of the risk and frailty calculators discussed above. These tools are extremely important during patient counselling, particularly those who are deemed extremely high risk. If there is any concern about cognitive difficulties, we use the Edmonton Frail Scale, which correlates very closely with geriatrician impressions of frailty.(32) The nursing staff in particular are sensitive in identifying patients who may have difficulty understanding instructions or learning the skills required to manage post-operatively. This MDT opinion can influence the decision to proceed to surgery in cases where a patient was borderline-fit.

The ERAS MDT also considers anticipated surgical difficulties which may prolong operative time, surgical options for urinary diversion and medical conditions affecting cardiopulmonary testing (such as diabetes, frailty and being elderly) to provide a clear, cohesive treatment plan prior to counselling patients.

### **4.2 Changes during COVID-19**

We used a robotic approach in 24 of 25 patients. One patient underwent open cystectomy due to randomisation in a study that commenced recruitment prior to the onset of COVID-19. Minimally invasive surgery has been shown to result in lower rates of infectious complications, quicker post-operative recovery and may therefore have additional value in the COVID-19 period.(33)

During COVID-19 we modified but maintained our usual pre-operative ERAS MDT approach with the increased use of telephone clinics, remote reviews for pre-operative nursing, anaesthetic and surgical assessment and minimised patient visits to hospital. Furthermore, we optimised nutrition, intra-operative measures, post-operative analgesia and early mobilisation according to our established ERAS protocol. (34)

This new pathway increased our capacity to provide cystectomy as we became more efficient in the use of telephone clinics and remote working; more flexible job plans due to reduced face-to-face patient contact and more theatre capacity as other benign urology and uro-oncology procedures had either reduced or stopped. As a result, suitable patients were able to have their surgery within one to two weeks of their first appointment, compared to the usual pathway of approximately four weeks pre-COVID-19. In addition, our increased capacity meant that we were able to accept an increased number of referrals from NHS Trusts outside our Cancer Network, who had become unable to continue their own cystectomy services. Five patients were referred from outside our usual network.

Training of uro-oncology fellows and registrars also continued safely during this period. However, the adoption of additional intraoperative safety measures led to a significant extension of the overall operative time and limited us to one procedure per theatre per day. Our median operative time increased from four hours pre-COVID-19 (for robotic cystectomy and intracorporeal ileal conduit) to approximately six hours.

### **4.3 Changes beyond COVID-19**

COVID-19 may pose a long-term problem and a new reality for surgical services. Looking ahead, in the advent that an anticipated surge in COVID-19, together with winter pressures materialises, it is necessary to establish centres for the delivery of complex surgery. Our pathway changes may therefore reflect the ongoing reality of delivering uro-oncology services in the COVID-19 era.

Cystectomy services must still be delivered promptly and efficiently, because of the adverse outcomes resulting from disease progression. Delays from the diagnosis of muscle-invasive bladder cancer (MIBC) to radical cystectomy (RC)

longer than 12 weeks result in higher mortality and shorter progression-free survival.(7) Moreover Sylvester *et al* showed increased risks of recurrence and progression of non-muscle invasive bladder cancer from 15% to 61% and 1 to 17% at one year and of 31% to 78% and 1% to 45% at 5 years respectively.(8)

This new pathway incorporates increased remote working, remote patient contact, more stringent pre-operative assessment, including COVID-19 testing, and a number of intra-operative modifications. It may also expedite time to surgery.

Disadvantages to the new pathway included less time for patients to come to terms with and understand their diagnosis, and less time for prehabilitation, medical optimisation and psychosocial referrals. These issues will need to be addressed if this streamlined pathway is formalised and used post COVID-19.

## **5. CONCLUSION**

Our results suggest that in the COVID-19 era it is possible to deliver a safe and efficient bladder cancer service that adheres to ERAS protocols to carry out cystectomy for high risk bladder cancer without compromising patient safety.

## 6. REFERENCES

1. COVID-19 Map [Internet]. Johns Hopkins Coronavirus Resource Center. [cited 2020 Jun 22]. Available from: <https://coronavirus.jhu.edu/map.html>
2. Archer JE, Odeh A, Ereidge S, Salem HK, Jones GP, Gardner A, et al. Mortality and pulmonary complications in patients undergoing surgery with perioperative SARS-CoV-2 infection: an international cohort study. *The Lancet*. 2020 May;S014067362031182X.
3. SAGES and EAES Recommendations Regarding Surgical Response to COVID-19 Crisis [Internet]. SAGES. 2020 [cited 2020 Jun 22]. Available from: <https://www.sages.org/recommendations-surgical-response-covid-19/>
4. Sample I. More than 2m operations cancelled as NHS fights Covid-19 [Internet]. *the Guardian*. 2020 [cited 2020 Jul 27]. Available from: <http://www.theguardian.com/society/2020/apr/26/more-than-two-million-operations-cancelled-as-nhs-fights-covid-19>
5. COVID-19 disruption will lead to 28 million surgeries cancelled worldwide [Internet]. [cited 2020 Jul 27]. Available from: <https://www.birmingham.ac.uk/news/latest/2020/05/covid-disruption-28-million-surgeries-cancelled.aspx>
6. Bladder cancer statistics [Internet]. Cancer Research UK. 2015 [cited 2020 Jun 22]. Available from: <https://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/bladder-cancer>
7. Chu AT, Holt SK, Wright JL, Ramos JD, Grivas P, Yu EY, et al. Delays in radical cystectomy for muscle-invasive bladder cancer. *Cancer*. 2019 Jun 15;125(12):2011–7.
8. Sylvester RJ, van der Meijden APM, Oosterlinck W, Witjes JA, Bouffieux C, Denis L, et al. Predicting Recurrence and Progression in Individual Patients with Stage Ta T1 Bladder Cancer Using EORTC Risk Tables: A Combined Analysis of 2596 Patients from Seven EORTC Trials. *Eur Urol*. 2006 Mar;49(3):466–77.
9. COVID19: Members' Information [Internet]. [cited 2020 Jul 27]. Available from: [https://www.baus.org.uk/mybaus/covid19\\_members\\_information.aspx](https://www.baus.org.uk/mybaus/covid19_members_information.aspx)
10. sitecore\jpadwat@rcseng.ac.uk. Clinical guide to surgical prioritisation during the coronavirus pandemic [Internet]. Royal College of Surgeons. [cited 2020 Aug 5]. Available from: <https://www.rcseng.ac.uk/coronavirus/surgical-prioritisation-guidance/>
11. Kasivisvanathan V, Lindsay J, Rakhshani-moghadam S, Elhamshary A, Kapriniotis K, Kazantzis G, et al. Evaluation of 30-day mortality for 500 patients undergoing non-emergency surgery in a COVID-19 cold site within a multicentre regional surgical network during the COVID-19 pandemic. *medRxiv*. 2020 Jan 1;2020.06.10.20115543.

12. Tan WS, Tan M-Y, Lamb BW, Sridhar A, Mohammed A, Baker H, et al. Intracorporeal robot-assisted radical cystectomy, together with an enhanced recovery programme, improves postoperative outcomes by aggregating marginal gains. *BJU Int.* 2018 Apr;121(4):632–9.
13. Bladder cancer: diagnosis and management of bladder cancer: © NICE (2015) Bladder cancer: diagnosis and management of bladder cancer. *BJU Int.* 2017 Dec;120(6):755–65.
14. Lee LYW, Cazier JB, Starkey T, Turnbull CD, Kerr R, Middleton G. COVID-19 mortality in patients with cancer on chemotherapy or other anticancer treatments: a prospective cohort study. *The Lancet.* 2020 Jun;395(10241):1919–26.
15. Witjes JA, Bruins HM, Cathomas R, Compérat EM, Cowan NC, Gakis G, et al. European Association of Urology Guidelines on Muscle-invasive and Metastatic Bladder Cancer: Summary of the 2020 Guidelines. *Eur Urol.* 2020 Apr;S030228382030230X.
16. Surgical Outcome Risk Tool (SORT) - SOuRCe / NCEPOD [Internet]. [cited 2020 Jun 22]. Available from: [http://www.sortsurgery.com/SORT\\_home](http://www.sortsurgery.com/SORT_home)
17. Rockwood K. A global clinical measure of fitness and frailty in elderly people. *Can Med Assoc J.* 2005 Aug 30;173(5):489–95.
18. ACS Risk Calculator - Patient Information [Internet]. [cited 2020 Jun 22]. Available from: <https://riskcalculator.facs.org/RiskCalculator/PatientInfo.jsp>
19. sitecore\ppjadwat@rcseng.ac.uk. Tool 2: Safety considerations and risk assessment [Internet]. Royal College of Surgeons. [cited 2020 Jun 22]. Available from: <https://www.rcseng.ac.uk/coronavirus/recovery-of-surgical-services/tool-2/>
20. NHS England. Operating framework for urgent and planned services in hospital settings during COVID-19 [Internet]. [cited 2020 Aug 5]. Available from: <https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/05/Operating-framework-for-urgent-and-planned-services-within-hospitals.pdf>
21. Cui HW, Turney BW, Griffiths J. The Preoperative Assessment and Optimization of Patients Undergoing Major Urological Surgery. *Curr Urol Rep.* 2017 Jul;18(7):54.
22. Tan WS, Lamb BW, Khetrpal P, Tan M-Y, Tan ME, Sridhar A, et al. Blood Transfusion Requirement and Not Preoperative Anemia Are Associated with Perioperative Complications Following Intracorporeal Robot-Assisted Radical Cystectomy. *J Endourol.* 2017 Feb;31(2):141–8.
23. Baird-Gunning J, Bromley J. Correcting iron deficiency. *Aust Prescr.* 2016 Dec 5;39(6):193–9.
24. Wong J, Goh QY, Tan Z, Lie SA, Tay YC, Ng SY, et al. Preparing for a COVID-19 pandemic: a review of operating room outbreak response measures in

a large tertiary hospital in Singapore. *Can J Anesth Can Anesth*. 2020 Jun;67(6):732–45.

25. Ali Y, Alradhawi M, Shubber N, Abbas A-R. Personal protective equipment in the response to the SARS-CoV-2 outbreak - A letter to the editor on "World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19)" (*Int J Surg* 2020; 76:71–6). *Int J Surg*. 2020 Jun;78:66–7.
26. Collins JW, Tyritzis S, Nyberg T, Schumacher M, Laurin O, Khazaeli D, et al. Robot-assisted Radical Cystectomy: Description of an Evolved Approach to Radical Cystectomy. *Eur Urol*. 2013 Oct;64(4):654–63.
27. Nepple KG, Kallogjeri D, Bhayani SB. Benchtop evaluation of pressure barrier insufflator and standard insufflator systems. *Surg Endosc*. 2013 Jan;27(1):333–8.
28. Cascella M, Rajnik M, Cuomo A, Dulebohn SC, Di Napoli R. Features, Evaluation and Treatment Coronavirus (COVID-19). In: *StatPearls* [Internet]. Treasure Island (FL): StatPearls Publishing; 2020 [cited 2020 Jun 22]. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK554776/>
29. Zheng MH, Boni L, Fingerhut A. Minimally Invasive Surgery and the Novel Coronavirus Outbreak: Lessons Learned in China and Italy. *Ann Surg*. 2020 Jul;272(1):e5–6.
30. Tyson MD, Chang SS. Enhanced Recovery Pathways Versus Standard Care After Cystectomy: A Meta-analysis of the Effect on Perioperative Outcomes. *Eur Urol*. 2016 Dec;70(6):995–1003.
31. Brooks NA, Kokorovic A, McGrath JS, Kassouf W, Collins JW, Black PC, et al. Critical analysis of quality of life and cost-effectiveness of enhanced recovery after surgery (ERAS) for patient's undergoing urologic oncology surgery: a systematic review. *World J Urol* [Internet]. 2020 Jul 9 [cited 2020 Jul 16]; Available from: <http://link.springer.com/10.1007/s00345-020-03341-6>
32. Rolfson DB, Majumdar SR, Tsuyuki RT, Tahir A, Rockwood K. Validity and reliability of the Edmonton Frail Scale. *Age Ageing*. 2006 Sep 1;35(5):526–9.
33. Ficarra V, Novara G, Abrate A, Bartoletti R, Crestani A, De Nunzio C, et al. Urology practice during COVID-19 pandemic. *Minerva Urol E Nefrol Ital J Urol Nephrol*. 2020 Mar 23;
34. Vukovic N, Dinic L. Enhanced Recovery After Surgery Protocols in Major Urologic Surgery. *Front Med*. 2018 Apr 9;5:93.

**Table 1: Summary of changes to the Cystectomy pathway in the COVID-19 era**

Pre-COVID-19	During COVID-19
<b>Pre-operative</b>	
<ul style="list-style-type: none"> <li>• Referral &amp; MDT discussion</li> <li>• Face-to-face cystectomy clinic</li> <li>• Face-to-face ERAS MDT clinic, including education seminar, CPET testing (all patients), CNS, surgeon, anaesthetist and urinary diversion nurse review</li> <li>• Neoadjuvant chemotherapy according to standard indications</li> </ul>	<ul style="list-style-type: none"> <li>• Remote electronic medical records access for all team members</li> <li>• Referral &amp; MDT discussion</li> <li>• Telephone cystectomy clinic</li> <li>• One face-to-face pre-operative visit to ERAS MDT clinic, including education seminar, CPET testing (selected patients), CNS, surgeon, anaesthetist and urinary diversion nurse review</li> <li>• Pre-operative isolation and COVID-19 screening</li> <li>• No neoadjuvant chemotherapy</li> </ul>
<b>Intra-operative</b>	
<ul style="list-style-type: none"> <li>• Standard surgical PPE</li> <li>• Intubation in anaesthetic bay</li> <li>• Airseal insufflation system with particle filtering for minimally invasive surgery</li> </ul>	<ul style="list-style-type: none"> <li>• PPE, including full face visor, double gloving and FFP3 mask</li> <li>• Increased frequency of air changes</li> <li>• Intubation/extubation within theatre</li> <li>• 20-minute exclusion of non-anaesthetic staff from theatre following intubation/extubation</li> <li>• Minimally invasive surgery</li> <li>• Airseal insufflation system with particle filtering</li> <li>• Precautions during insufflation and deflation to prevent aerosol exposure</li> <li>• No observers/visitors to theatre</li> </ul>
<b>Post-operative</b>	
<ul style="list-style-type: none"> <li>• All patients admitted to HDU post operatively</li> <li>• Standard post-operative ERAS pathway</li> <li>• Face-to-face review at 6 weeks, and 3 monthly thereafter</li> </ul>	<ul style="list-style-type: none"> <li>• Selection of low risk patients for surgical ward care</li> <li>• Standard post-operative ERAS pathway</li> <li>• Access to CNS team and on call urology registrar by telephone following discharge</li> <li>• Urgent review at Emergency Department or Urgent Urology Unit available as required</li> <li>• Telephone clinics used for first post-operative visit and routine follow-up</li> </ul>

<b>Table 2. Patient characteristics</b>		
Variable		n=25
Age at surgery (yr)		
	Mean ± SD (range)	62.8 ± 9.7 (41 - 77)
BMI (kg/m <sup>2</sup> )		
	Mean ± SD (range)	27.5 ± 6.3 (19 - 42)
Gender		
Male	n (%)	24 (96%)
Female	n (%)	1 (4%)
Smoking status		
Smoker	n (%)	4 (16%)
Ex-smoker	n (%)	7 (28%)
Never smoked	n (%)	14 (56%)
ASA		
2	n (%)	20 (80%)
3	n (%)	5 (20%)
Noadjuvant chemotherapy	n (%)	11 (44%)
Clinical Staging		
cT2	n (%)	18 (72%)
cT3	n (%)	6 (24%)
cT4	n (%)	1 (4%)
cN0	n (%)	23 (92%)
cN1	n (%)	2 (8%)
cM0	n (%)	25 (100%)
Hydronephrosis	n (%)	5 (20%)
CPET Parameters		
AT (ml/kg/min)	Mean ± SD (range)	9.6 ± 2.6 (6 – 16)
VO <sub>2</sub> Peak (ml/kg/min)	Mean ± SD (range)	17.2 ± 5.1 (11 – 26)
VE/VCO <sub>2</sub>	Mean ± SD (range)	34.4 ± 4.3 (28 – 40)

Abbreviations: CPET; cardiopulmonary exercise testing, AT; anaerobic threshold, VO<sub>2</sub> Peak; peak oxygen uptake, VE/VCO<sub>2</sub>; minute ventilation relative to CO<sub>2</sub> exhalation.

<b>Table 3. Peri-operative outcomes</b>		
EBL (mL)	Mean ± SD (range)	367 ± 184 (150 - 770)
Robotic Operative time (min)		
Overall	Mean ± SD (range)	426 ± 77 (300 - 540)
Console time	Mean ± SD (range)	293 ± 80 (195 – 480)
Urethrectomy	n (%)	3 (12%)
Diversion		
IC	n (%)	21 (84%)
ONB	n (%)	2 (8%)
Mitrofanoff	n (%)	2 (8%)
LOS (days)	Mean ± SD (range)	9.2 ± 4.1 (5 – 18)
Complications		
Clavien 1-2	n (%)	7 (28%)
Clavien 3-4	n (%)	2 (8%)

Abbreviations: EBL; estimated blood loss, IC; ileal conduit, ONB; orthotopic neobladder, LOS; length of stay

<b>Table 4. Oncological outcomes. n (%)</b>	
<b>Histology</b>	
Urothelial	12 (63%)
Sarcomatoid	7 (37%)
<b>Pathological Staging</b>	
pT0	6 (24%)
pTis	4 (16%)
pTa	1 (4%)
pT2	4 (16%)
pT3	8 (32%)
pT4	2 (8%)
pNx	1 (4%)
pN0	18 (72%)
pN1	2 (8%)
pN2	4 (16%)
<b>Lymphovascular invasion</b>	
	9 (36%)
<b>Concomitant Prostate cancer grade</b>	
Any Gleason	12 (48%)
Gleason 6	8 (32%)
Gleason 7 (3+4)	3 (12%)
Gleason 7 (4+3)	1 (4%)
Gleason 8-10	0 (0%)