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ORIGINAL ARTICLE

Did the COVID-19 lockdown result in a delay of colorectal cancer presentation and outcomes? A single centre review

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Abstract

Purpose The COVID-19 pandemic and resultant lockdown measures potentially delay management of non-communicable, life-limiting diseases like colorectal cancer (CRC) through avoidance of healthcare facilities by the public and diversion of resources within healthcare systems. This study aims to evaluate the impact of Singapore's "Circuit Breaker (CB)" lockdown measures on CRC disease presentation and short-term surgical outcomes, while comparing Singapore's approach against other countries which employed similar lockdown measures.

Methods Patients whose initial diagnosis of CRC was made within the 6-month pre-CB (6/10/19–6/4/20) ("pre-CB group") and post-CB (7/4/20–7/10/20) ("post-CB group") period were enrolled retrospectively. The groups were compared based on severity of disease on presentation and short-term operative outcomes.

Results In total, 105 patients diagnosed with CRC were enrolled in this study. When comparing pre-CB and post-CB groups, there was no significant difference in stage of CRC on presentation ($p = 0.850$). There was also no increase in need for emergent operations ($p = 0.367$). For patients who had undergone an operation, postoperative morbidity was not significantly higher in the post-CB group ($p = 0.201$). Both groups of patients had similar length of stay in the hospital ($p = 0.438$).

Conclusion Unlike similar high-income countries, Singapore did not see later stage disease on presentation and poorer operative outcomes after lockdown measures. Possible reasons include lesser healthcare avoidance behaviours amongst Singaporeans, and adequate preparation of resources and contingency plans formed by hospitals after previous pandemics.

Keywords COVID-19 · Lockdown · Colorectal cancer · Outcomes

Introduction

Countries around the world have been adjusting to a new way of life with the ongoing COVID-19 pandemic. Social distancing measures are one of the most advocated measures for curbing the spread of COVID-19 [1]. Hence, at the height of community transmission, many countries have adopted "lockdown" measures to reduce face-to-face social interaction. This has ranged from closing offices and commercial facilities to restructuring healthcare facilities. Singapore is no different, having enforced its own "Circuit Breaker (CB)" lockdown measures from 7 April 2020 to 1 June 2020.

The impact of the COVID-19 pandemic and subsequent lockdown measures on healthcare was two-fold—through changes in healthcare-seeking behaviour amongst the public and the need to divert resources and modify existing protocols within healthcare systems.

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Firstly, COVID-19 may affect public health-seeking behaviour for even non-COVID-19-related symptoms, with some patients choosing to delay or even defer seeking treatment entirely. Globally, this effect has been widely reported across patients with varying healthcare needs—spanning patients presenting with acute illnesses [2], chronic diseases requiring regular follow-up [3], and those actively receiving treatment [4]. This shift in mindset has been attributed to various public beliefs. Some were fearful of contracting COVID-19 from hospitals [2, 4], while others were afraid to over-burden healthcare systems [5]. Regardless of the underlying reasons for this mindset change, it is apparent that a decrease in healthcare attendance is in part due to deliberate avoidance of healthcare facilities by the public.

Secondly, different countries have implemented various strategies to ease the impact of COVID-19 on their healthcare systems, and to reduce the chance of COVID-19 transmission from within hospitals to the community via patients. In other high-income countries [6–10], one strategy has been through restricting the availability of cancer screening. In addition, an international study by Glasbey et al. spanning 20,006 solid organ cancer patients across 61 countries demonstrated that full lockdowns due to COVID-19 directly delayed elective cancer operations in 1 in 7 patients [11]. In contrast, Singapore has adopted a more liberal approach, with no deliberate restrictions imposed on the management of essential conditions, including cancer screening and elective cancer operations. Instead, Singapore, including our institution Sengkang General Hospital (SKH), had focused on employing safe practice measures and team restructurings with segregation [12]. The reasons for not needing to compromise on patient care is due to preparedness and preemption, due to lessons learnt from the 2003 severe acute respiratory syndrome (SARS) outbreak [13].

Nevertheless, there has been growing interest in how different COVID-19 restrictions across hospitals have affected the management of non-communicable diseases during this pandemic, particularly regarding cancer. Amongst high-income countries, colorectal cancer (CRC) is the 7th most common cause of death and 2nd most common cause of cancer-related deaths [14]. In Singapore, it is the most common cancer in males and 2nd most common cancer in females [15]. Delays in presentation of CRC are known to increase the mortality and morbidity of the disease, by resulting in a higher stage of CRC at diagnosis [16]. International studies have shown how a country's decision to reduce screening measures had resulted in more CRC patients presenting at a higher stage of disease or as an emergency admission [8–10].

There is scarce evidence to show how an approach like Singapore's will impact CRC disease presentation and surgical outcomes and how this compares to measures implemented by other countries. There has thus been little guidance for countries on the best way to limit the spread of COVID-19, whilst maintaining the ability to manage other life-limiting diseases such as cancer.

The primary aim of this study is to evaluate the impact of Singapore's CB measures on the severity of disease presentation and short-term surgical outcomes of CRC. The secondary aim was to compare Singapore's approach with that of other countries which implemented similar lockdown measures. The review of these measures and its impact on society would be important in the preparation for future waves of disease outbreaks—both COVID-19 related or unrelated.

Materials and methods

Study design and patient recruitment

This is a retrospective review of an institutional ethics review board–approved prospectively collected database for CRC of patients diagnosed at a single centre institution. SKH, established in 2018, serves a population of 900,000 and provides full subspecialty capabilities for CRC treatment. Inclusion criteria for the study included the following:

- Initial diagnosis of CRC made within the 6-month pre-CB (6/10/19–6/4/20) ("pre-CB group") or post-CB (7/4/20–7/10/20) ("post-CB group") period

Exclusion criteria for the study included:

- Revised diagnosis of non-CRC pathologies based on postoperative histology

All patients were managed according to National Comprehensive Cancer Network (NCCN) guidelines for tumour management and suitable patients were then recruited into the study by the surgical team. No expanded criteria for neoadjuvant treatment were adopted in management on patients. Patients were split into pre-CB and post-CB groups, with each group further divided into operative and non-operative subgroups. Patients were followed up during their inpatient stay at SKH and the relevant data was collected upon discharge. Patients were then observed for any re-admissions for surgical-related complications. A total of 105 patients across both pre-CB and post-CB groups were recruited for this study with the above inclusion and exclusion criteria applied.

The findings are reported as per the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) guidelines [17].

Variables analysed

Data regarding patient demographics, severity of disease on presentation and operative outcomes were collected.

Severity of disease at presentation was evaluated using the following surrogates: (1) firstly, the presence of symptoms (defined as any one of the following: abdominal distention, abdominal pain, diarrhoea, constipation, mucoid discharge, per rectal bleeding, small stool calibre, tenesmus, significant loss of weight) and tumour-related crises (specifically intestinal obstruction and perforation). Symptoms were recorded based on patient presenting complaints while tumour-related crises were based on clinical and radiological diagnosis as made by the attending physician. Further details were collected for patients deemed suitable for surgery. Surgery was performed by a team led by consultant-grade surgeons; (2) secondly, operative details which included operative urgency (elective vs. non-elective) and intended operative approach (open vs. minimally invasive surgery), and (3) thirdly, tumour staging that was based on the 8th edition American Joint Committee on Cancer (AJCC) pathological tumour/node/metastasis (pTNM) classification and staging system for CRC [18].

Peri-surgical parameters were obtained, including complications like anastomotic leak and short-term surgical outcomes like length of hospitalisation post-operation and 30-day mortality and morbidity. Morbidity was classified according to the Clavien-Dindo classification [19].

To evaluate the effect of the COVID-19 lockdown on patient presentation and subsequent operative outcomes, comparisons across the same aforementioned variables were made with an earlier cohort of patients who were diagnosed and managed by the same group of colorectal surgeons prior to the start of CB. Selection bias was minimised by including all patients who were diagnosed with colorectal cancer in the allocated timeframes.

Statistical analysis was performed using SPSS Version 26 (SPSS Inc., an IBM Company, Chicago, IL, USA). Pearson's chi-square test was used to analyses discrete variables, while the Mann–Whitney *U* test was used to analyse continuous variables. Statistical significance was defined as p value ≤ 0.05.

Results

The 105 patients across both pre-CB and post-CB groups recruited for this study were further subdivided into those that underwent either operative or non-operative management (Fig. 1).

Of the 64 patients in the post-CB group, the median age was 67 (30–87) years, and the majority were male ($n=42$, 65.6%). For comparison, 41 patients were recruited under the pre-CB group. The median age was 68 (40–83) years for the pre-CB group, and the majority were male ($n=26$, 63.4%). On univariate analysis, no significant difference in baseline patient demographics and tumour type was observed between the 2 groups (Table 1).

Effect of CB on severity of disease on first presentation

There was no significant difference in the severity of disease on presentation amongst patients in the pre-CB and post-CB groups. Comparing against the pre-CB group, patients in the post-CB group had comparable incidences of presenting symptomatically (86.0% vs 85.4%, $p=0.935$), in intestinal obstruction (23.7% vs 26.4%, $p=0.993$) and with intestinal perforation (9.6% vs 4.7%,

Table 1 Patient demographics

	Pre-CB (%)	Post-CB (%)	*p* value
N	41	64	
Median age, years (range)	68 (40–83)	67 (30–87)	0.498
Gender			0.817
Male	26 (63.4)	42 (65.6)	
Female	15 (36.6)	22 (34.4)	

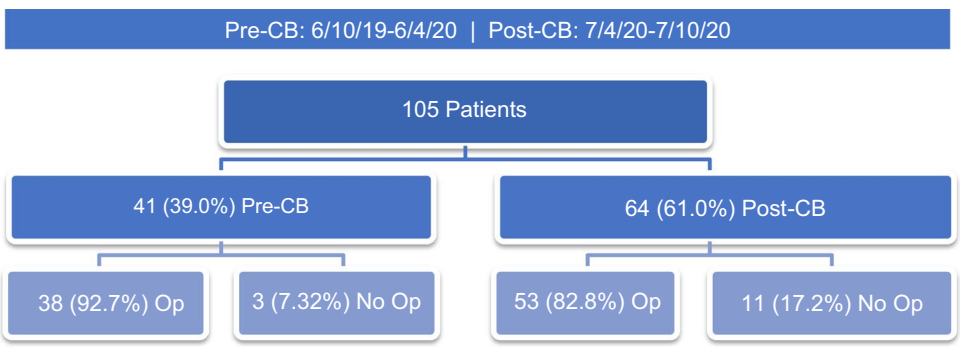

Fig. 1 Patients recruited under pre-CB and post-CB groups who underwent operative or non-operative management. Permissions: NA

Table 2 Symptoms on first presentation

	Pre-CB (%)	Post-CB (%)	*p* value
N	41	64	
Symptomatic	35 (85.4)	55 (86.0)	0.935
Intestinal obstruction	9 (22.0)	14 (21.9)	0.993
Perforation	4 (9.6)	3 (4.7)	0.310
Metastatic disease	5 (12.2)	12 (18.8)	0.374
Requiring emergent surgery on presentation			0.367
Y	7 (17.1)	7 (11.0)	
N	34 (83.0)	57 (89.0)	

Table 3 Surgical and histopathological characteristics

	Pre-CB (%)	Post-CB (%)	*p* value
N	38	53	
Type of surgery			0.264
Open	15 (39.5)	15 (28.3)	
Minimally invasive surgery (lap, TA, robot, converted)	23 (60.5)	38 (71.7)	
T stage			0.929
T1	2 (5.3)	2 (3.8)	
T2	5 (13.2)	7 (13.2)	
T3	23 (60.5)	31 (58.5)	
T4	8 (21.1)	12 (22.6)	
Others	0 (0.0)	1 (1.9)	
N stage			0.952
N0	22 (57.9)	28 (52.8)	
N1	9 (23.7)	14 (26.4)	
N2	6 (15.8)	10 (18.9)	
Others	1 (2.6)	1 (1.9)	
M1	4 (10.5)	6 (11.3)	0.905
AJCC stage			0.850
1	7 (18.4)	6 (11.3)	
2	15 (39.5)	20 (37.7)	
3	11 (28.9)	20 (37.7)	
4	4 (10.5)	6 (11.3)	
Others	1 (2.6)	1 (1.9)	

$p = 0.310$). Consequently, there was no significant difference in the proportion of patients in the post-CB group requiring upfront emergent surgery (11.0% vs 17.1%, $p = 0.367$). Details are reflected in Table 2.

Most patients were able to undergo laparoscopic surgery, though this proportion difference was not significant between the pre-CB and post-CB groups (60.5% vs 71.7%, $p = 0.264$). There were also no significant differences in histopathological AJCC pTNM stages ($p = 0.850$). Details are shown in Table 3.

Effect of CB on operative outcomes

The length of hospital stay post-operation was similar in both groups (median 11 days (6–46) vs 9 days (5–49), $p = 0.438$). There was no 30-day mortality amongst both groups (0.0% vs 0.0%, $p = 1.00$). Postoperative morbidity, defined by the Clavien-Dindo classification greater than IIIb, in the pre-CB group was not significantly different than in the post-CB group (10.5% vs 3.8%, $p = 0.201$). Specifically looking at postoperative anastomotic leak rates, there was also no significant difference between the groups (2.6% vs 1.9%, $p = 0.811$). Details are reflected in Table 4.

Discussion

This study shows that in spite of new restrictions within hospitals in Singapore, the disease stage and severity of CRC patients presenting to SKH remains similar. Multiple reasons account from this, ranging from patient factors to hospital factors. In a study by Ozdemir et al. [20] involving 897 Singaporean adults, the COVID-19 pandemic and CB measures had a low impact on discouraging patients from hospitals, with only 33.8% reporting a changed mindset. In addition, SKH had been prepared for the increased CB restrictions in large part due to the lessons learnt from the SARS pandemic in 2003 [13], with pandemic- or crisis-response facilities considered during the design of the newest hospital in Singapore. These measures included physical modifications to

Table 4 Short-term operative outcomes

	Pre-CB (%)	Post-CB (%)	*p* value
N	38	53	
Anastomotic leak	1 (2.6)	1 (1.9)	0.811
Median length of postoperative hospitalisation, days (range)	11 (6–46)	9 (5–49)	0.438
30-day morbidity, Clavien-Dindo ≥ 3b	4 (10.5)	2 (3.8)	0.201
● IIIb	1 (2.6)	2 (3.8)	0.112
● IV	3 (7.9)	0 (0.0)	
30-day mortality	0 (0.0)	0 (0.0)	1.00

the operating theatres, use of thermal scanners at all hospital entrances and need for declaration of flu-like symptoms and travel history. Personal protective equipment (PPE) were also stockpiled prior to CB to ensure adequate supply. The hospital staff had also undergone training on PPE and were compliant to twice daily temperature declarations and segregation measures, where intermingling between teams was prohibited. The combined effect of these measures was adequate staff preparedness in response to the pandemic and CB. These resulted in minimal disruption to daily operations and the ability to accommodate patients. In addition, with clear response policies from hospital and ministerial leaderships, the confidence of patients seeking medical attention for CRC-related symptoms is not wavered. Hence, the disease stages and severities on presentation remained similar.

This study also found that operative outcomes for patients with CRC remained similar before and after the introduction of CB. Operative outcomes were determined by evaluating rates of anastomotic leak and duration for postoperative recovery, as well as significant postoperative mortality and morbidity. Since patients presented similarly pre- and post-CB, potential differences in outcomes would be attributed to challenges faced with the COVID-19 restrictions. In a bid to ensure the safety of healthcare professionals while minimising disruptions to patient care, measures taken for various colorectal procedures had to be re-evaluated [12]. These measures include the mandating of wearing full PPE during colorectal procedures and use of a dedicated negative pressure operating theatre. These were practiced in SKH throughout the CB period and did not show an impact on operative outcomes. In addition, subspecialty services were still preserved, made possible by appropriate staff segregation to ensure staff safety but also to ensure business continuity. The combined effect of these measures allowed SKH to accommodate the increased patient load that came together with the rising number of COVID cases [21]. Thus, it is observed that these new measures and changes to the working environment did not translate into an increase in operative complications.

Singapore is a city-country with a population of almost 5.5 million people [22]. In order to cater to this population, tertiary hospitals in Singapore have been spread evenly across the city-country. SKH is situated in the northeast region of the country and is estimated to have a catchment of 1.1 million Singaporeans. This even spread of institutions around Singapore combined with the consistent policies adopted by all tertiary hospitals across the island allows the experiences in SKH to be similar to that of Singapore as a whole.

Thus, this study has found that despite CB and its related restrictions imposed, the disease stage, severity of CRC patients and operative outcomes presenting to SKH remained similar. This is in contrast to other high-income countries where similar studies were conducted. In the UK, Morris et al. [8] demonstrated that the measures taken have had a profound effect on both presentation and management of a patient with CRC. The UK has seen reduced referrals to hospitals for CRC, increased need for stoma creation and increased proportion of emergency operations needed. Furthermore, Shinkwin et al.[10] found that more patients presented with T4 CRC and large bowel obstruction than before the COVID-19 measures was implemented.

Similar findings were also reported in other high-income countries. For instance in Spain, restrictions in screening measures resulted in a decrease in new diagnosis of CRC and an increasing proportion of CRC patients requiring emergency admissions [9]. Delays in presentation and emergency admissions are both predictors for poorer prognosis and postoperative outcomes [23, 24]. It is evident that the results of this study are contrary to what is seen in other high-income countries. Although the UK, Spain and Singapore have all implemented their own versions of a lockdown measure, a big difference in the execution is the handling of availability of healthcare resources and capacity to receive referral in tertiary institutions within the lockdown period. A factor contributing to this would be the availability of PPE in Singapore, whilst Nunoo-Mensah et al. [25] found 9.1% of surgeons worldwide have reported a PPE shortage in their hospital. By maintaining a similar operative capacity, SKH was able to avoid the same consequences faced by other centres in the world.

Limitations

Our study has several limitations. First, the sample size is limited and may not be sufficient to demonstrate statistically significant differences between groups. Second, this is a retrospective study that did not allow for confounding factors and full patient characteristics to be adequately analysed. The limited post-CB duration (6 months) may be insufficient for the impact of any delays in seeking medical attention for CRC-related symptoms to manifest. However, this was necessitated as in Singapore, subsequent changes in COVID cases and ever-changing lockdown measures were adjusted every 6 to 8 months, with each subsequent lockdown lasting less than the previous [26–28]. As such this time frame was chosen to minimise effect of later lockdown measures.

Future directions

In future, this study can be expanded to all other hospitals in Singapore and potentially Asia to give better reference to how Singapore has coped with managing CRC in such trying times as compared to other countries. This would reflect more accurately on Singapore as a whole and give a better

idea on the pandemic and lockdown impact on the country. Nevertheless, given how the approach towards CRC management during the COVID-19 pandemic in other developed countries in Asia has been largely comparable [21], similar outcomes could be expected.

Future studies can also be targeted towards how Singapore's choice to remain proactive on the screening of cancers has affected community spread of COVID-19 and hospital workload. This can be compared with other countries with similar lockdown measures to ascertain feasibility of such rulings in other countries.

On a larger scale, future studies can also adopt a helicopter view in analysing the total impact of this long drawn global COVID pandemic on CRC and other non-communicable diseases.

Conclusion

It is pertinent for countries around the world to balance curbing the spread of COVID-19 while maintaining adequacy in management of non-COVID-19-related conditions such as cancer. The pre-emptive measures adopted by SKH and Singapore could be the key reason that negated COVID-19-related disruptions to patient presentation to the hospital as well as poorer postoperative outcomes. These allowed Singapore to maintain its existing cancer screening measures and continue to provide quality management to CRC patients. These findings may translate into guidance on how Singapore and other countries can better prepare themselves for future pandemics or lockdown measures without compromising on time-sensitive non-life-threatening disease conditions like cancer.

Authors' contributions (I) Study conception and design: WJ Tan, FH Koh. (II) Acquisition of data: DZ Cheng, Lee T. (III) Analysis and interpretation of data: All authors. (IV) Drafting of manuscript: Lee T, DZ Cheng. (V) Critical revision of manuscript: All authors.

Declarations

Conflict of interest The authors declare no competing interests.

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