



ORIGINAL ARTICLE

Colon cancer treatment in Sweden during the COVID-19 pandemic: A nationwide register-based study

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INTRODUCTION

The COVID-19 pandemic has impacted health care systems worldwide due to the prioritization of COVID-19 treatment over other diseases. Modelling studies have raised concerns that diagnostic delay

and decreased access to treatments will lead to increased mortality from cancer, possibly even exceeding that from SARS-Cov-2 [1,2]. Colorectal cancer has an excellent prognosis when diagnosed and treated in early stages. Reduced access to colonoscopy and surgery may lead to stage migration and reduced survival for the patients.

Abstract

Aim: The COVID-19 pandemic has reduced the capacity to diagnose and treat cancer worldwide due to the prioritization of COVID-19 treatment. The aim of this study was to investigate treatment and outcomes of colon cancer in Sweden before and during the COVID-19 pandemic.

Methods: In an observational study, using the Swedish Colorectal Cancer Registry, we included (i) all Swedish patients diagnosed with colon cancer, and (ii) all patients undergoing surgery for colon cancer, in 2016–2020. Incidence of colon cancer, treatments and outcomes in 2020 were compared with 2019.

Results: The number of colon cancer cases in Sweden in April–May 2020 was 27% lower than the previous year, whereas no difference was observed on an annual level (4,589 vs. 4,763 patients [−4%]). Among patients with colon cancer undergoing surgery in 2020, the proportion of resections was 93 vs. 94% in 2019, with no increase in acute resections. Time from diagnosis to elective surgery decreased (29 days vs. 33 days in 2020 vs. 2019). In 2020, more patients underwent a two-stage procedure with a diverting stoma as first surgery (6.1%) vs. (4.4%) in 2019 ($p = 0.0020$) and more patients were treated with preoperative chemotherapy (5.1%) vs. (3.5%) 2019 ($p = 0.0016$). The proportion of patients that underwent laparoscopic surgery increased from 54% to 58% ($p = 0.0017$). There were no differences in length of stay, surgical complications, reoperation, ICU-stay or 30-day mortality between the years.

Conclusion: Based on nationwide annual data, we did not observe adverse effects of the COVID-19 pandemic on colon cancer treatment and short time outcomes in Sweden.

KEYWORDS

colorectal cancer, colorectal surgery, covid-19, ostomy, surgery pandemic

There is a scarcity in data regarding factual outcomes for colorectal cancer patients during the pandemic, with the majority of publications being recommendations [3–5], audits [6], surveys [3,7] and case reports [8]. A few population-based studies have been published, reporting disruptions in the management of colorectal cancer in England [9], Korea [10], and Spain [11]. Also in Sweden, the pandemic put the healthcare system under severe strain, with tens of thousands of operations being postponed [12].

The Swedish Cancer Register has reported a 12% reduction of cancer cases March–August 2020 compared to 2019 [13] but there are, to date, no reports on how colon cancer treatment was affected by the pandemic. The aim of this study was to assess colon cancer incidence, treatment and outcomes for year 2020 compared to the preceding 4 years, with focus on differences between 2019 and 2020.

METHODS

Study design

In this observational population-based cohort study we report incidence, stage, treatment, and short-term outcomes for colon cancer in Sweden 2016–2020. We used the RECORD checklist [14] for the report.

Setting

Sweden is a high-income country with a population of 10 millions in 2020. Healthcare is mainly tax-funded with universal access to care [15]. The first wave of the COVID-19 pandemic peaked in April–May 2020, and the second in October–December the same year. Screening for colorectal cancer with stool test, applied in some regions, was paused from May to August [16], and surgery for pre-malignant and benign conditions postponed. Temporary guidelines for colorectal cancer surgery were established 3 April 2020 with recommendations in three different scenarios of escalating COVID-19 [17].

Data sources and participants

The Swedish Colorectal Cancer Registry (SCRCR) was used as data source. This register has extensive information on patient characteristics, pre- and postoperative tumour staging, tumour location, surgical and oncological treatment and recurrences for colon cancer nationwide since 2007 [18,19]. Data was extracted 20 May 2021. The coverage for cancer incidence was estimated at 100% for all years, and the coverage of surgical treatments at 97% for year 2020.

What does this paper add to the literature?

The COVID-19 pandemic has reduced the capacity to diagnose and treat cancer. How the treatment and outcomes of colon cancer in Sweden before and during the COVID-19 pandemic was affected has been analysed, using the Swedish Colorectal Cancer Registry. Colon cancer management and treatment was maintained in Sweden during 2020.

Inclusion criteria

We constructed two different cohorts; (1) all incident colon tumours diagnosed 2016–2020, and (2) all surgical procedures performed for colon cancer 2016–2020.

Variables

Baseline characteristics included age, sex, tumour localization, tumour stage, and participation in colorectal cancer multidisciplinary conference (CRC-MDC). Operation data included type of surgical intervention, acute/elective surgery, ostomy formation, neoadjuvant treatment, time from colon cancer diagnosis to surgery, hospital stay, 30-day complications (defined as Clavien-Dindo ≥ 2) [20], ICU-care, reoperation, readmission, and mortality.

Bias

Misclassification due to registration errors and underreporting are assumed to be similar between the years.

Study size

All patients in Sweden with colon cancer diagnosed during the study period were included.

Missing data

Analyses were performed with an available case strategy.

Statistical analysis

Categorical variables are presented as number and percent and continuous variables as median and interquartile range (IQR). As each tumour is registered separately, and some patients had two

tumours, results are reported both as number of diagnosed patients and as number of diagnosed tumours. Categorical variables were compared using χ^2 test and continuous variables with the Wilcoxon signed rank test. The incidence proportion of colon cancer per year was estimated by dividing the number of patients diagnosed with colon cancer by the number of Swedish inhabitants on 31 December the year before (as reported by Statistics Sweden). All statistical tests were two-sided, and $p < 0.05$ was considered statistically significant.

RESULTS

Incidence and stage at diagnosis

The number of diagnosed cases of colon cancer in April and May was 27% lower in 2020 than in 2019, but increased over the following months (Figure 1). In 2020, 4589 patients were diagnosed with colon cancer, corresponding to an incidence proportion of 0.044% (0.044%–0.047% in 2016–2019; Table 1). The patients' age, sex, and tumour locations were similar between the years. The incidence of cT4 tumours increased from 16% in 2016 to 23% in 2020, but with no significant increase between 2019 and 2020 (21%–23%, $p = 0.11$). During the same period the incidence of cTx tumours decreased, but with no change between 2019 and 2020. Similarly, cN1–N2 increased from 37% to 41% in 2016 to 2019 and further to 43% in 2020, and cNx decreased ($p = 0.02$). The proportion of patients with synchronous metastases increased from 21% in 2019 to 22% in 2020 ($p = 0.01$). No change in the number of patients assessed in CRC-MDC was seen between 2019 and 2020 and the proportion of patients undergoing surgical intervention during the year of diagnosis was the same in 2020 and 2019 (74%).

Treatment and short-term outcomes

The number of interventions for colon cancer (including all procedures, e.g., polypectomy and nonresection surgery) was at its lowest point in May 2020 but the annual number was similar to previous years (Figure 2). The number of operations was 3,964 for year 2020 and 4,016 for year 2019 with similar proportions of resection surgery over calendar years (93% in 2020 vs. 94% 2019; Table 2). We did not observe any increase in acute surgery during year 2020, nor any difference in types of resections. The time from diagnosis to surgery in elective cases was shorter in 2020 (29 days, IQR: 22–41) than in 2019 (33 days, IQR: 22–43; $p < 0.0001$). In 2020, a larger proportion of patients underwent a 2-stage procedure with a defunctioning stoma as first surgery (6.1%) compared to 2019 (4.4%; $p = 0.0020$). These patients had predominantly left-sided tumours (80% in 2020 vs. 82% in 2019, $p = 0.69$). The proportion of patients receiving a stoma at resection surgery was 19% in 2020 vs. 18% in 2019, $p = 0.09$, data not shown). Similarly, preoperative chemotherapy was more common in 2020 compared with 2019 (5.1% vs. 3.5%, $p = 0.0016$). The proportion of patients treated with laparoscopic surgery continuously increased over the years from 39% in 2016 to 54% in 2019, and further to 58% in 2020 ($p = 0.0017$). The length of hospital stay was 5 (3–8) days both for 2019 and 2020. There were no statistically significant differences in surgical complications, ICU-care, reoperation or 30-day mortality between 2019 and 2020.

DISCUSSION

Our study shows that despite a reduction in performed surgery during the first wave of COVID-19 in Sweden in April–May 2020 this reduction was compensated for in June to December, and thus colon cancer treatment over the entire year was largely similar to 2019.

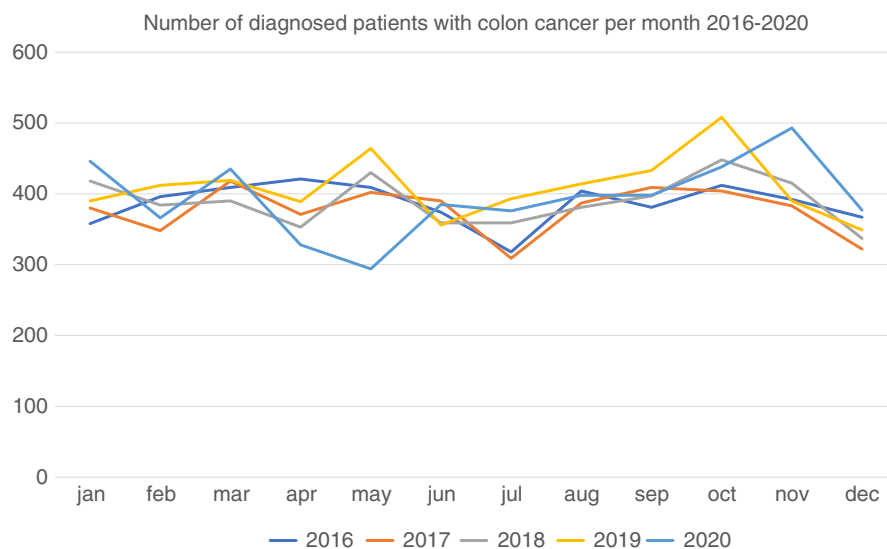


FIGURE 1 Number of diagnosed patients with colon cancer per month 2016–2020

TABLE 1 Characteristics of colon cancer tumours diagnosed in Sweden in 2016–2020

	2016	2017	2018	2019	2020	p-value for difference 2019–2020
Patients						
Number of diagnosed patients	4508	4407	4554	4763	4589	N.A.
Incidence proportion ^a	0.046	0.044	0.045	0.047	0.044	N.A.
Female sex, number (%)	2353 (51)	2231 (49)	2360 (49)	2500 (51)	2406 (51)	1.0
Age, mean (SD) median (IQR)	73 (11) 74 (66–81)	73 (11) 74 (66–81)	73 (12) 74 (67–81)	73 (12) 75 (67–81)	73 (11) 75 (67–81)	0.37
Tumours						
Number of diagnosed tumours	4641	4523	4671	4917	4734	
Location						
Right colon ^b	2202 (47)	2116 (47)	2279 (49)	2445 (50)	2303 (49)	0.41
Left colon ^c	2419 (52)	2390 (53)	2375 (51)	2459 (50)	2422 (51)	
Unknown	20 (0.43)	17 (0.38)	17 (0.36)	13 (0.26)	9 (0.19)	
cT stage						
T1–T2	849 (18)	1002 (22)	1083 (23)	1210 (25)	1091 (23)	0.11
T3	1672 (36)	1575 (35)	1646 (35)	1657 (34)	1576 (33)	
T4	723 (16)	780 (17)	876 (19)	1024 (21)	1067 (23)	
Tx	1397 (30)	1166 (26)	1066 (23)	1026 (21)	1000 (21)	
cN stage						
N0	1976 (43)	2124 (47)	2212 (47)	2254 (46)	2037 (43)	0.02
N1–2	1713 (37)	1686 (37)	1828 (39)	2008 (41)	2035 (43)	
Nx	952 (21)	713 (16)	631 (14)	655 (13)	662 (14)	
cM stage						
M0	3713 (80)	3408 (75)	3584 (77)	3762 (77)	3616 (76)	0.01
M1	911 (20)	927 (21)	929 (20)	1023 (21)	1031 (22)	
Mx	17 (0.37)	188 (4.2)	158 (3.4)	132 (2.7)	87 (1.8)	
CRC-MDC	3841 (83)	3748 (83)	3913 (84)	4155 (85)	4017 (85)	0.63
Any surgical intervention same year	3597 (78)	3395 (75)	3489 (75)	3614 (74)	3512 (74)	0.44

Abbreviations: CRC-MDC, colorectal cancer multidisciplinary conference; IQR, interquartile range; N.A., not applicable; SD, standard deviation.

^aNumber of new cases/number of Swedish inhabitants 31 December the year before.

^bAppendix/caecum/ascendens/flexura hepatica.

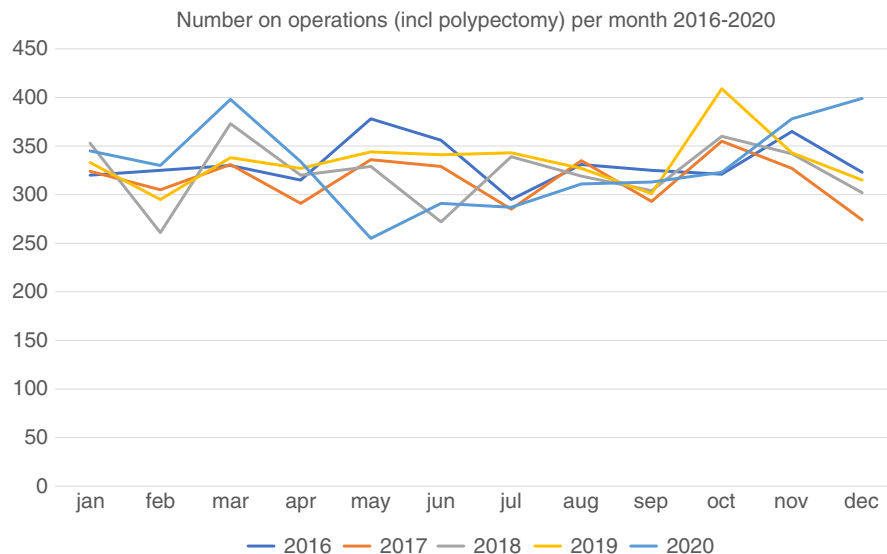
^cTransverse colon/flexura lienalis/descending/sigmoid colon.

We observed a change in treatment with more preoperative diverting ostomies and more preoperative oncological treatment, and an increase in the proportion of laparoscopic surgery.

There are, to date, no nationwide studies on colon cancer incidence for the entire year 2020. A study from England reported that 3500 fewer people had been diagnosed and treated for colorectal cancer than would have been expected from April to October 2020 [9]. In the Paris region in France, a 31% decrease in

referrals for colon cancer was observed from March to May relative to the average of the previous 2 years, and an 8% decrease in June to October [21]. Similarly, a tertiary care hospital in Spain has reported an almost halved incidence of colorectal cancer diagnosis during the first period of the pandemic [11], and surveys from Italy a 62% reduction in cases from 9 March to 17 May 2020 [6]. New Zealand, which actively pursued elimination of COVID-19 had a 40% decline in cancer registrations during a national shutdown

FIGURE 2 Number of operations (including polypectomy and nonresectional surgery) per month in Sweden in 2016–2020



in March–April 2020 but were back to preshutdown levels over the following months [22]. In Sweden there were 27% fewer colon cancer patients diagnosed during April–May 2020 compared to the year before, but this rapidly caught up during the rest of the year.

We did not observe any significant changes in surgical treatment of colon cancer in Sweden in year 2020, apart from an increase in the proportion of patients receiving a diverting stoma prior to resection surgery (6.1% compared to 4.4% the year before). More ostomies instead of anastomoses compared to the prepandemic period has also been reported from CovidSurg Collaborative, probably due to a wish to reduce complications [23]. In Sweden in 2020, proportionally more patients were diagnosed with locally advanced tumours, which also could explain the increase in use of preoperative diverting stoma.

The proportion of patients who were treated with laparoscopic surgery increased from 54% to 58%, contrary to England [9] and Korea [10], who reported a decline in procedures performed with the minimally invasive technique during the COVID-19 pandemic. In the international survey from covidSurg Collaborative, the proportion of laparoscopic surgeries were comparable to the Swedish numbers (57.2%) [23]. The increase in laparoscopic surgery may be due to a general trend and not connected to COVID-19, although without the pandemic the increase might have been even greater.

Concerns have been raised that diagnostic delay due to the COVID-19 pandemic may decrease resectability in colorectal cancer, but we found no evidence of this occurring in Sweden. In the present study, more patients were diagnosed in stage cT4 in 2020 compared with 2019, but this trend was also seen during the preceding years and can be explained by a smaller proportion of unstaged patients. It is possible that the relative increase in proportion of cT4 tumours was due to a reduction of cases with less advanced tumours, and therefore, fewer symptoms. If the increase in cT4 tumours is, in fact, a sign of stage migration due to diagnostic delay will become evident during the following years.

Our study showed no difference in complication rate, ICU care, or 30-day mortality. This is in line with reports from Spain, where surgery was delayed but complications and mortality remained unchanged [24]. An international cohort study representing 40 countries, showed a higher 30-day mortality rate during the COVID-19 pandemic, but fewer anastomotic leakages. The mortality in case of anastomotic leakage was higher during the pandemic compared to the prepandemic period [23].

During the first wave of the COVID-19 pandemic, Sweden experienced a 9% reduction in overall cancer cases and a general reduction in patients seeking care for other conditions than COVID-19 [16]. The Swedish National Board of Health and Welfare published guidelines with the aim to guide physicians in prioritizing. All patients were to have an assessment of their condition. After the assessment, care could be delayed, but not for conditions that were assumed to have a large impact on life span or quality of life, that is, cancer care was prioritized [25]. This may explain why the quality of colon cancer treatment seems to have been maintained. An Australian review including data from 20 countries reported a 30% reduction in health care seeking during the pandemic [26]. For colon cancer patients in Sweden, the disruptions seem to have been mild. There was mainly a delay in diagnosis and treatment during the first wave of the pandemic due to the screening call off, and patient delay because of fear of COVID-19, but there was a quick return to normal activity and an increase in the number of diagnosed cases and surgeries during the end of the year. Time from diagnosis to surgery was shorter in 2020 than in 2019, possibly as a consequence of the prioritization of cancer care over other diseases.

The strength of the study is the use of prospectively collected register data with high validity and near complete coverage. Limitations include lack of information of patient characteristics that are not included in the register, for example, lack of data on the COVID-19 infection. Possible misclassification bias due to registration errors should be randomly distributed and not affect the results in any major way.

TABLE 2 Surgical treatment of colon tumours in Sweden 2016–2020

	2016	2017	2018	2019	2020	p-value for difference 2019–2020
All surgical treatments n (%)	3984	3785	3874	4016	3964	N.A.
Appendectomy	17 (0.43)	9 (0.24)	18 (0.46)	8 (0.20)	8 (0.20)	0.29
Polypectomy/local resection	157 (3.9)	154 (4.1)	123 (3.2)	113 (2.8)	124 (3.1)	
Stent	40 (1.0)	30 (0.79)	24 (0.62)	29 (0.72)	28 (0.71)	
Laparotomy/laparoscopy without resection	139 (3.5)	93 (2.5)	97 (2.5)	91 (2.3)	109 (2.8)	
Other operation	50 (1.3)	6 (0.16)	2 (0.05)	1 (0.02)	6 (0.15)	
Resection surgery	3579 (90)	3491 (92)	3610 (93)	3774 (94)	3688 (93)	
Type of treatment missing	2 (0.05)	2 (0.05)	0 (0)	0 (0)	1 (0.03)	
Total number of ostomy constructions ^a	734 (18)	692 (18)	691 (18)	745 (19)	800 (20)	0.07
All resection surgery	3579	3491	3610	3774	3688	N.A.
Acute resection surgery ^b	544 (15)	500 (14)	508 (14)	511 (14)	515 (14)	0.46
Type of resection surgery ^c						
Ileocecal resection	37 (1.0)	23 (0.66)	26 (0.72)	23 (0.61)	24 (0.65)	1.0
Right-sided hemicolectomy	1982 (55)	1838 (53)	1962 (54)	2111 (56)	2039 (55)	
Transverse colon resection	58 (1.6)	57 (1.6)	60 (1.7)	54 (1.4)	54 (1.5)	
Left-sided resection	334 (9.3)	367 (11)	370 (10)	378 (10)	359 (9.7)	
Sigmoid resection	756 (21)	748 (21)	725 (20)	747 (20)	757 (21)	
Hartmann resection	109 (3.0)	126 (3.6)	89 (2.5)	117 (3.1)	120 (3.3)	
Anterior resection	121 (3.4)	133 (3.8)	147 (4.1)	135 (3.6)	134 (3.6)	
Colectomy	178 (5.0)	189 (5.4)	222 (6.2)	196 (5.2)	191 (5.2)	
Abdominoperineal resection	4 (0.11)	10 (0.29)	9 (0.25)	13 (0.34)	10 (0.27)	
Elective resection surgery	3033	2990	3102	3263	3171	
Diverting stoma preoperatively	135 (4.4)	124 (4.2)	149 (4.8)	142 (4.4)	193 (6.1)	0.0020
Preoperative chemotherapy	92 (3.0)	96 (3.2)	86 (2.8)	113 (3.5)	161 (5.1)	0.0016
Laparoscopic surgery	1168 (39)	1279 (43)	1499 (48)	1771 (54)	1845 (58)	0.0017
Number of days from diagnosis to surgery ^d median (IQR)	32 (22–43)	32 (22–46)	33 (24–44)	33 (24–44)	29 (22–41)	<0.0001
Days of hospital stay ^e median (IQR)	6 (4–10)	6 (4–9)	6 (4–9)	5 (3–8)	5 (3–8)	0.17
30-day outcomes						
Surgical complication	409 (13)	382 (13)	427 (14)	407 (12)	364 (11)	0.23
Treated in intensive care	152 (5.0)	141 (4.7)	134 (4.3)	108 (3.3)	97 (3.1)	0.57
Reoperation	229 (7.6)	223 (7.5)	245 (7.9)	234 (7.2)	201 (6.3)	0.20
Readmission	256 (8.4)	203 (6.8)	254 (8.2)	297 (9.1)	264 (8.3)	0.29
Death	41 (1.4)	50 (1.7)	40 (1.3)	44 (1.4)	34 (1.1)	0.36

Abbreviation: N.A., not applicable.

^aAll stomas created, including stoma as the only procedure and permanent and diverting stoma at resection surgery.

^bInformation on acute or elective surgery missing in two patients in 2016, one patient in 2017 and two patients in 2020.

^cAll resection surgery (acute and elective).

^dRestricted to patients diagnosed the same year.

CONCLUSION

On a nationwide level, we did not observe major adverse effects of the COVID-19 pandemic on colon cancer treatment and short

time outcomes in Sweden when comparing year 2020 to preceding years, indicating that quality of care for these patients was maintained, but the long-term consequences are not yet known. There were small increases in the use of preoperative chemotherapy and

ostomies, which may have future implications for quality of life in these patients.

CONFLICT OF INTERESTS

All authors have nothing to declare.

AUTHOR CONTRIBUTIONS

Guarantor of article: Åsa H Everhov. **Specific author contributions:** Conception and design: All authors. Acquisition of data: Åsa H Everhov, Karolina Eklöv. Statistical analysis: Åsa H Everhov, Interpretation of data: All authors. Drafting the manuscript: Karolina Eklöv, Åsa H Everhov. Critical revision for intellectual content: All authors. Final approval: All authors. Accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved: All authors.

ETHICS STATEMENT

The study was approved by the Regional Ethics committee in Stockholm (Dnr 2020-04169). Since this was a strictly register-based study, individual informed consent was not required.

DATA AVAILABILITY STATEMENT

KE and ÅHE had full access to data.

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