Impact of the COVID-19 pandemic on non–small-cell lung cancer pathologic stage and presentation

Joshua A.J. Keogh, BSc
Allison D. Chhor, BHSc
Housne Begum, PhD
Noori Akhtar-Danesh, PhD
Christian Finley, MD

Correspondence to:
C. Finley
St. Joseph's Healthcare
50 Charlton Ave E
Hamilton ON L8N 4A6
finleyc@mcmaster.ca

Background: It is believed that the cessation of normative cancer care services during the COVID-19 pandemic may be resulting in pathologic upstaging and higher long-term mortality rates. We aimed to understand how the pandemic has affected our patients diagnosed with non–small-cell lung cancer (NSCLC).

Methods: We conducted a single-centre retrospective analysis to assess how the COVID-19 pandemic has affected patient referrals, pathologic stage of NSCLC, mortality rates and surgical procedures at our cancer care centre in Ontario, Canada. At our centre, physicians advocated for and followed recommendations that operations in cancer patients should be among the last procedures to be delayed. Patients were included if they were aged 18 years or older, were not receiving palliative care, and had been screened, diagnosed and treated for NSCLC (primary tumours). We compared outcomes between a prepandemic period (January 2019 to February 2020) and a period during the pandemic (March 2020 to February 2021).

Results: A total of 695 patients were included for statistical analysis, of whom 650 underwent surgery. There was no statistically significant difference in any of the outcomes of interest between patients seen before (*n* = 330) and during (*n* = 320) the pandemic.

Conclusion: Cancer care services at our centre were maintained during the COVID-19 pandemic, and potential adverse effects on prognosis and survival that have been seen in other countries were avoided. The results inform health care providers how the effects of future pandemics can be blunted by using proactive preservative strategies and surgeon advocacy.

Contexte : On croit que l'interruption des soins normatifs aux personnes atteintes de cancer durant la pandémie de COVID-19 pourrait avoir mené à des diagnostics à un stade pathologique plus avancé et à une hausse des taux de mortalité à long terme. Nous avons cherché à mieux comprendre les répercussions de la pandémie sur nos patients ayant reçu un diagnostic de carcinome pulmonaire non à petites cellules (CPNPC).

Méthodes : Nous avons mené une analyse rétrospective monocentrique pour déterminer l'incidence de la réponse à la pandémie de COVID-19 sur les demandes de consultation auprès d'un spécialiste, le stade pathologique du CPNPC, le taux de mortalité et les interventions chirurgicales dans notre centre d'oncologie situé en Ontario (Canada). Nos médecins ont réclamé puis suivi des directives recommandant que les opérations oncologiques soient parmi les dernières interventions à être retardées. Pour être inclus, les patients devaient être âgés de 18 ans ou plus, ne pas recevoir de soins palliatifs, et avoir reçu un diagnostic de CPNPC après dépistage et être traités pour cette maladie (tumeurs primitives). Nous avons comparé les issues avant (janvier 2019 à février 2020) et pendant (mars 2020 à février 2021) la pandémie.

Résultats : Au total, 695 patients ont été inclus dans l'analyse statistique, et 650 d'entre eux ont subi une intervention chirurgicale. Nous n'avons observé aucune différence statistiquement significative pour les issues à l'étude entre les patients vus avant (*n* = 330) et pendant (*n* = 320) la pandémie.

Conclusion : Notre centre a maintenu la prestation de soins aux personnes atteintes de cancer durant la pandémie de COVID-19, et nous avons pu éviter les effets indésirables potentiels qui ont affecté le pronostic et la survie dans d'autres pays. Ces résultats montrent aux professionnels de la santé que les répercussions d'éventuelles pandémies pourront être atténuées par l'utilisation de stratégies proactives de préservation des services et les efforts de représentation des chirurgiens.

The timely presentation, diagnosis and treatment of lung cancer is associated with improved prognosis and survival rates.[1–9] In addition, delayed diagnosis of cancer often results in stage migration, as this pathologic condition is typically discovered incidentally.[1–4,6–8] The COVID-19 pandemic has posed serious challenges to the delivery of cancer care globally.[2,4,5,7,10–15] Diagnostic and screening services have been delayed or suspended, and patients have become reluctant to seek primary care from general practitioners to avoid potential viral exposure.[5,11] Moreover, ongoing treatment pathways for symptomatic patients with cancer have been altered to minimize potential exposure, such that diagnostic tests and elective surgical procedures have been postponed, and only patients deemed urgent have received the necessary operations.[2,5] In addition, there has been an overall deprioritization of nonurgent or symptomatic cases of cancer, and concomitant reallocation of health care focus toward COVID-19.[5,6,10] Cumulatively, the disruptions to cancer care have resulted in suboptimal or delayed treatment and will likely continue to do so, which may ultimately lead to more severe effects in the mid and long term.[12,13]

Indicative of these potential long-term consequences owing to underlying upstaging of cancer, the United States is expecting 10 000 excess deaths from colorectal and breast cancer alone between 2020 and 2030.[6] Sharpless[6] assumed that COVID-19 would cause only a moderate disruption in the provision of care, which would resolve completely after 6 months; however, this estimation may not be representative of the timelines and perturbations to care experienced in other nations. This trend in upward mobility of pathologic stage, worsened prognosis and, ultimately, higher predicted mortality rates in the long term has also been seen in emerging studies in other regions around the world.[4,7,13] However, many underpinning factors (e.g., differences between tumour types; variation in lockdown duration and public policy; and nonlethal upstaging, resulting in worsened quality of life) were not accounted for in recent studies, and, thus, these estimates largely understate the overall impact of COVID-19 on cancer care. With these extraneous factors taken into account, it is thought that worsened prognosis and mortality rates may be of greater concern than currently predicted and will vary according to geographic location and cancer type.[5,7,12,14]

To our knowledge, researchers in Canada, and Ontario specifically, have yet to investigate the potential consequences of the COVID-19 pandemic on the pathologic stage and overall prognosis of lung cancer. The primary objective of this study was to assess the regional impact of COVID-19 on referrals for and pathologic stage of NSCLC at a cancer care centre in Ontario. The secondary objectives were to assess changes in mortality rates and how these differed from those in predefined periods before and during the pandemic; and to analyze whether the invasiveness of surgical operations was influenced over time, and how the method of surgery (open v. thoracoscopic v. robotic) was affected, which may indirectly indicate patient prognosis. We hypothesized that there was significant pathologic upstaging of NSCLC and a concomitant reduction in patient referrals during the pandemic compared to before the pandemic. For our secondary objectives, we hypothesized that there were significantly higher mortality rates and more invasive surgical procedures during the COVID-19 period than before the pandemic as a result of pathologic upstaging.

Methods

The Division of Thoracic Surgery at our centre is the largest thoracic centre in Canada and is located in Ontario, one of the provinces most affected by the COVID-19 pandemic.[16,17] At our centre, physicians advocated for and followed recommendations that operations in cancer patients should be among the last procedures to be delayed.[18]

This project was a single-centre retrospective analysis of surgical patient data. All patients aged 18 years or older who were screened and diagnosed, and underwent anatomic lung resection or received alternative treatment for NSCLC from January 2019 to February 2021 were included in the study. Patients who did not meet these criteria, as well as those with secondary lung tumours resultant of a primary metastasis and those receiving palliative care, were excluded.

We obtained the referral data from the database of the Lung Diagnostic Assessment Program, an innovative project that aims to shorten wait times to diagnosis and management for patients with suspected lung cancer (https://www.stjoes.ca/hospital-services/chest-program/lung-diagnostic-assessment-program). Patients were screened for inclusion, and oncologic information, including pathologic stage of NSCLC, screening and diagnostic procedures, surgical procedures, treatment timelines, comorbidity scores and mortality rates, was obtained. We stratified the referral data monthly, as well as by study period (before the pandemic [January 2019 to February 2020] and during the pandemic [March 2020 to February 2021]). We extracted other patient data from the local surgery data set and the medical charting system. When pathologic TNM staging was reported but the resultant stage of cancer was not, we used the eighth edition lung cancer stage classification[19] to determine the pathologic stage of NSCLC given the size of the tumour, the number of lymph nodes involved and whether the cancer had metastasized.

We assessed an array of comorbidities to provide a comprehensive overview of the patient population in

the present study, and to adjust for this as a potential underpinning variable. When assessing comorbidities, we grouped pulmonary comorbidities (asthma, emphysema, interstitial lung disease and chronic obstructive pulmonary disorder) together owing to the high specificity with lung function and relevance to patients diagnosed with NSCLC; all remaining comorbidities (diabetes mellitus, cardiac disease, renal disease, hypertension, cardiovascular disease, previous cancer and previous thoracic surgery) were grouped as "Other" for statistical analysis. Lung functionality was assessed with the forced expiratory volume in 1 second and diffusing capacity of the lung for carbon monoxide diagnostic tests.

Patients' ability to carry out activities of daily living was assessed with the Eastern Cooperative Oncology Group (ECOG) Performance Status Scale. The Charlson Comorbidity Index was a measure indicative of an overall comorbidity score that adjusts for the risk of death.[20,21]

Statistical analysis

We used descriptive statistics to characterize the patient population where applicable. We compared the outcomes between the 2 study periods (January 2019 to February 2020, and March 2020 to February 2021). For univariate analysis, we used the χ^2 test to assess the association between outcomes of interest and categoric variables, and the t test for comparing continuous variables between the 2 study periods. We conducted all statistical analyses using Stata/SE 16.1 (StataCorp.).

RESULTS

A total of 1638 patients were screened for inclusion, of whom 988 were excluded after screening and data extraction. The reasons for exclusion were having undergone a thoracic surgical procedure between January 2019 and February 2021 for a disorder other than malignant NSCLC (e.g., benign upper gastrointestinal tumour, malignant upper gastrointestinal tumour, mediastinal tumour) (n = 681); having undergone a diagnostic procedure (e.g., bronchoscopy) without a subsequent thoracic surgical procedure for treating malignant NSCLC (n = 93); presentation with malignant NSCLC secondary to a primary tumour that had metastasized (n = 61); presentation with small-cell lung cancer (n = 30); and having been seen for treatment for NSCLC but been admitted to the lung diagnostic assessment program before the period of interest (n = 123).

A total of 650 patients (388 women [59.7%] and 262 men [40.3%]) were deemed eligible and were included for statistical analysis. The mean age at the time of diagnosis was 68.8 years (standard deviation [SD] 9.6 yr, 95% confidence interval [CI] 68.0–69.5 yr), and the mean body

mass index was 28.1 (SD 6.0, 95% CI 27.6–28.5). Other patient characteristics are presented in Table 1.

Patient referrals

The mean number of patients referred per month during the pre-COVID-19 period was 55.9 (SD 13.7), compared to 50.5 (SD 10.1) during the pandemic, a nonsignificant difference (p = 0.3) (Figure 1). When we tested the pattern of referrals based on month before and during the pandemic, we found no significant trends; p values for slope were 0.4 and 0.4, respectively.

Pathologic stage

There was no statistically significant difference between the 2 study periods in tumour size, number of lymph nodes involved or the resultant pathologic stage of cancer (p = 0.9, p = 0.3, and p = 1.0, respectively) (Table 2).

Mortality and comorbidities

There was no significant difference in mortality between the 2 study periods (p = 0.9) (Table 1). The ECOG Performance Status Scale and the Charlson Comorbidity Index were the only comorbidity variables that showed a significant difference between the 2 study periods: the mean ECOG Performance Status Scale grade was higher before the pandemic than during the pandemic, whereas the mean Charlson Comorbidity Index score was greater during the pandemic (p = 0.02 for both).

Surgical procedures

There was no statistically significant difference between the 2 study periods in the minimally invasive surgery categorization, type of surgery or hospital length of stay (p = 0.2, p = 0.9 and p = 1.0, respectively) (Table 3 and Appendix 1, available at www.canjsurg.ca/lookup/doi/10.1503/cjs.016721/tab-related-content).

DISCUSSION

We found no significant difference in patient referrals, pathologic staging, surgical approach and type, or comorbidity scores and mortality rates between patients diagnosed with NSCLC at a local centre in Ontario before the COVID-19 pandemic and those diagnosed during the pandemic. These findings are contrary to our hypotheses that the disruptions caused by the pandemic would have resulted in increased patient referrals and pathologic upstaging, more invasive surgical procedures and heightened mortality rates.

Previous studies predicted that outcomes of patients with cancer would be worsened during the COVID-19

Table 1. Characteristics of patients diagnosed with non–small-cell lung cancer before and during the COVID-19 pandemic who underwent surgery
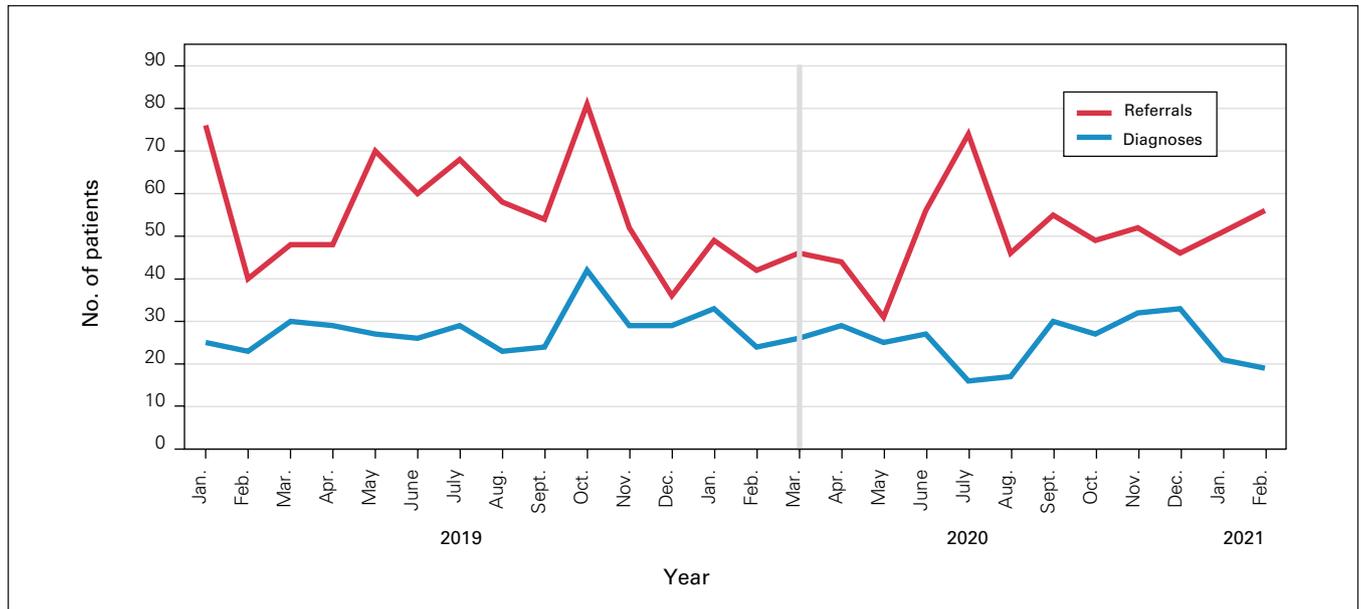
Characteristic	Period; no. (%) of patients*			
	Before COVID-19 pandemic† n = 330	During COVID-19 pandemic‡ n = 320	Overall n = 650	p value
Sex				0.4
Male	138 (41.8)	124 (38.8)	262 (40.3)	
Female	192 (58.2)	196 (61.2)	388 (59.7)	
Age, mean ± SD, yr	68.8 ± 9.2	68.7 ± 10.1	68.8 ± 9.6	0.8
Body mass index, mean ± SD	28.1 ± 5.9	28.0 ± 6.2	28.1 ± 6.0	0.8
Smoking history				0.1
Never smoked	31 (9.4)	47 (14.7)	78 (12.0)	
Past smoker	187 (56.7)	177 (55.3)	364 (56.0)	
Current smoker	111 (33.6)	96 (30.0)	207 (31.8)	
Missing	1 (0.3)	0 (0.0)	1 (0.2)	
Alcohol use				0.06
No	131 (39.7)	150 (46.9)	281 (43.2)	
Yes	199 (60.3)	168 (52.5)	367 (56.5)	
Missing	0 (0.0)	2 (0.6)	2 (0.3)	
FEV_1, mean ± SD, %	82.1 ± 19.9	84.5 ± 23.2	83.2 ± 21.6	0.2
DLCO, mean ± SD, %	74.7 ± 20.3	78.0 ± 70.3	76.3 ± 51.0	0.4
No. of pulmonary comorbidities				1.0
0	179 (54.2)	173 (54.1)	352 (54.2)	
≥ 1	151 (45.8)	147 (45.9)	298 (45.8)	
No. of other comorbidities				1.0
0	103 (31.2)	100 (31.2)	203 (31.2)	
≥ 1	227 (68.8)	220 (68.8)	447 (68.8)	
ECOG Performance Status Scale grade,§ mean ± SD	0.73 ± 0.66	0.59 ± 0.75	0.67 ± 0.71	0.02
CCI score, mean ± SD	5.61 ± 1.77	5.95 ± 2.03	5.78 ± 1.91	0.02
Survival				0.4
Alive	314 (95.2)	300 (93.8)	614 (94.5)	
Deceased	16 (4.8)	20 (6.2)	36 (5.5)	

CCI = Charlson Comorbidity Index; DLCO = diffusing capacity of the lung for carbon monoxide; ECOG = Eastern Cooperative Oncology Group; FEV_1 = forced expiratory volume in 1 second; SD = standard deviation.
*Except where noted otherwise.
†January 2019–February 2020.
‡March 2020–February 2021.
§Graded from 0 (fully active) to 5 (dead).

pandemic owing to disruptions, given the documented decrease in cancer diagnoses throughout the pandemic.[6,7,12,13] A recent study investigating the consequences of COVID-19 on cancer care in the United Kingdom showed that, during March–August 2020, about 3.4 million fewer key diagnostic tests (i.e., endoscopy, computed tomography imaging, nonobstetric ultrasonography and magnetic resonance imaging investigations) were performed, equivalent to a reduction of 35% compared to the same period the previous year.[7] The number of patients who waited 6 weeks or more for these procedures in August 2020 was estimated to be 10 times higher than in August 2019.[7] Maringe and colleagues[4] estimated that, compared to the prepandemic era, 4 different types of malignant disease, including lung cancer, would display increased mortality rates during the pandemic owing to delays in diagnosis. Sud and colleagues[3] reported similar results, showing the impact of diagnostic delays and resul-

tant upstaging of cancer on mortality rates. With the need for maximal capacity to manage patients with SARS-CoV-2 infection, patients with cancer have experienced delays in diagnosis and suboptimal treatment options and timelines in other nations.[12,13] The necessity to protect immunocompromised people from comorbidity has resulted in cessation of most practices for nonurgent cancer cases and patients with asymptomatic presentations (e.g., cancer screening services for nonemergent cases, adapting the provision of care such that it is being delivered in a telehealth format, and delaying or cancelling nonemergent surgical procedures).[12,13]

Our findings are contrary to those in other nations in that our institution experienced no significant reduction in the number of patients referred for screening and diagnostic procedures during the COVID-19 pandemic. As NSCLC is typically found incidentally, a reduction in patient referral rates would presumably result in the same

Fig. 1. Patient referrals and diagnoses before (January 2019–February 2020) and during (March 2020–February 2021) the COVID-19 pandemic. Vertical line indicates onset of the COVID-19 pandemic.

Table 2. Tumour stage, nodal stage and pathologic stage before and during the COVID-19 pandemic

Variable	Period; no. (%) of patients			
	Before COVID-19 pandemic *n* = 330	During COVID-19 pandemic *n* = 320	Overall *n* = 650	*p* value
Tumour stage				0.9
T1	132 (40.0)	133 (41.6)	265 (40.8)	
T2	114 (34.5)	113 (35.3)	227 (34.9)	
T3	39 (11.8)	40 (12.5)	79 (12.2)	
T4	28 (8.5)	23 (7.2)	51 (7.8)	
Missing	17 (5.2)	11 (3.4)	28 (4.3)	
Nodal stage				0.3
Nx	29 (8.8)	16 (5.0)	45 (6.9)	
N0	249 (75.4)	248 (77.5)	497 (76.5)	
N1	37 (11.2)	37 (11.6)	74 (11.4)	
N2	15 (4.5)	18 (5.6)	33 (5.1)	
Missing	0 (0.0)	1 (0.3)	1 (0.2)	
Pathologic stage				1.0
I	210 (63.6)	196 (61.2)	406 (62.5)	
II	58 (17.6)	59 (18.4)	117 (18.0)	
III	46 (13.9)	47 (14.7)	93 (14.3)	
IV	16 (4.8)	17 (5.3)	33 (5.1)	
Missing	0 (0.0)	1 (0.3)	1 (0.2)	

our team likely ensured the preservation of patient referrals for screening and diagnostic procedures, as well as consequent thoracic surgery for patients diagnosed with NSCLC, despite the cyclical nature of the lockdowns experienced in the province.[16,17]

We did not find any significant difference in mortality rates between the 2 study periods. In a similar study in a patient population diagnosed with breast cancer, although increased time to operation was associated with increased pathologic upstaging, no change in overall patient survival was observed.[22] In a study in patients with prostate cancer, treatment interruptions of up to 6 months were not found to have any significant effect on overall survival.[23] Discordant with the findings of the present study, Sud and colleagues[24] modelled 10-year survival estimates for 20 different cancer types and postulated that a 2-month delay for a backlog of referrals of 25% would result in a significant increase in mortality. However, at this point, it is impossible to determine the true long-term impact of the COVID-19 pandemic, and studies documenting an actual increase in invasive surgical procedures or mortality rates have yet to emerge. It remains to be seen whether an excess in patient mortality will be observed in our patient population.

We observed no significant difference in most comorbidity variables and indices between the cohorts of patients diagnosed with NSCLC before and during the COVID-19 pandemic. Differences in smoking status and alcohol consumption (both were used less during the pandemic) reached near-significant values (*p* = 0.1 and 0.06, respectively). Interestingly, mean ECOG Performance Status Scale grades were significantly higher during the pandemic (indicating improved ability to carry out activities of

subset of patients being diagnosed at a later date, but at a heightened and potentially more fatal pathologic stage. Therefore, the null findings in this study in terms of pathologic staging before and during the pandemic may be attributable to the preservation of normative screening and diagnostic procedures offered. The prudent steps taken by

Table 3. Surgical procedures before and during the COVID-19 pandemic

Variable	Before COVID-19 pandemic			During COVID-19 pandemic			Overall	
	No. (%) of patients $n = 330$	Length of stay, mean ± SD, d	Length of stay, median, d	No. (%) of patients $n = 320$	Length of stay, mean ± SD, d	Length of stay, median, d	No. (%) of patients $n = 650$	p value
MIS categorization								0.2
Open	102 (30.9)	7.5 ± 9.6	5	88 (27.5)	7.9 ± 12.4	5	190 (29.2)	
Thoracoscopic	147 (44.5)	3.9 ± 7.2	2	164 (51.2)	3.9 ± 4.6	3	311 (47.8)	
Robotic	81 (24.5)	3.4 ± 2.3	3	68 (21.2)	3.4 ± 3.0	3	149 (22.9)	
Type of surgery								0.9
Sublobar	101 (30.6)	—	—	104 (32.5)	—	—	205 (31.5)	
Lobectomy	216 (65.4)	—	—	203 (63.4)	—	—	419 (64.5)	
Pneumonectomy	13 (3.9)	—	—	13 (4.1)	—	—	26 (4.0)	

MIS = minimally invasive surgery; SD = standard deviation.

daily living), whereas mean Charlson Comorbidity Index scores were significantly higher (indicating a higher mortality risk). A possible explanation for the Charlson Comorbidity Index result is that patient age is taken into consideration,[21] and the mean age of our patients at the time of diagnosis was 68.8 years. As such, this may have influenced the Charlson Comorbidity Index score, while differences in other comorbidities assessed remained statistically nonsignificant.

There were no statistically significant differences in thoracic surgery provision, type of operation or hospital length of stay before and during the COVID-19 pandemic in the present study. Although patients with COVID-19 did not undergo surgery at our institution, this had a negligible impact on operative postponements or cancellations. These findings are contrary to our hypothesis that surgical procedures would become more invasive and urgent owing to the predicted underlying pathologic upstaging. This is of relevance, as it was noted in a study in the UK that there was a reduction of about 37% in cancer treatment for cases deemed nonurgent, and that suboptimal treatment or changes to treatment should be considered in tandem with diagnostic delays when considering the impact of the COVID-19 pandemic on cancer care.[7] These delays in diagnosis and perturbations to cancer treatment in other nations will likely lead to exponential increases in excess deaths owing to pathologic upstaging, and overall worsened morbidity and mortality. In conformance with provincial directives,[25,26] as well as national advocacy by thoracic surgeons at our centre, our institution has prioritized cancer operations throughout the pandemic while pausing all other elective operations.[18,27] However, the resulting surgical backlog is estimated to take 84 weeks to clear.[27] Nonetheless, the preservation of critical cancer care services has allowed for volumes of cancer procedures similar to prepandemic volumes to be maintained at our centre throughout the pandemic, which appears to have curbed the detrimental effects on cancer care seen elsewhere.

This study shows how proactive decisions made by surgeons and oncologists can reduce potential disruptions in cancer treatment observed during a pandemic, which otherwise may have resulted in worsened patient outcomes. This can serve to reassure patients, health care providers and policy-makers in Canada and other nations that the effects of future pandemics on patient prognosis can be moderated by advocating for the preservation of normative cancer care. Future research will be necessary in our patient population to determine whether any long-term effects on outcomes such as mortality will be observed. Studies to explore additional policies that other institutions have adopted to maintain outcomes of patients with cancer in the event of a COVID-19 resurgence or public health disruption would also be beneficial. We propose that, in the case of future disruptions to the health care system, surgical services such as cancer, emergency and trauma procedures continue to be prioritized. If disruptions were to continue, a redistribution of resources in other areas, such as nursing and allied health, should be considered before essential procedures are delayed. Overall, this approach can be applied to mitigate the risks of critical care disruptions and allow patient outcomes to be maintained.

Although this study offers a promising early view of maintained patient outcomes, more research is required to understand the long-term ramifications of the pandemic on cancer care. As such, the true outcomes of patients with cancer treated during the pandemic may not be seen for many more years. Additional studies in similar populations will better inform policies in the event of a future public health emergency that disrupts cancer care delivery. Future research would benefit from expanding both the inclusion criteria to provide a greater representation of late-stage cancer, and the periods before and during the pandemic to elucidate whether there have been any long-term ramifications (e.g., increased mortality rates) of the pandemic in patients with NSCLC or other malignant disorders.

Limitations

A strength of the study is that the use of retrospective data afforded certainty of patient outcomes up to the end of

the study period. In addition, the assessment of a homogeneous population of patients with NSCLC diagnosed and treated during the pandemic established a reliable association between the variables studied while limiting confounding factors.

The study had unavoidable limitations given that the study population selected comprised exclusively patients diagnosed with NSCLC. As shown by Neal and colleagues,[1] certain malignant disorders are more essential to identify at earlier clinical stages than others, which must be taken into account when assessing individual patient risks and benefits. Thus, it is important to take the results into context, as they are not necessarily generalizable to other tumour types.

As this was a single-centre study, the findings reflect the disruptions caused by specific provincial public health measures and institutional protocols. With variations in lockdown procedures and policies based on regional pandemic severity, certain regions were likely affected more than others.

Given that patients who presented with NSCLC secondary to a tumour that had metastasized from elsewhere in the body and those who did not receive surgical or alternative treatment were excluded from the study, there is the potential of a slight selection bias in favour of early-stage cancer. This potential selection bias is evident, as more than 60% of included patients presented with stage I NSCLC both before and during the pandemic. As such, there is the potential that the study design precluded the ability to detect a true difference between the 2 study periods in both surgical approach and pathologic upstaging.

CONCLUSION

We found no statistically significant difference in any of the outcomes of interest between patients diagnosed with NSCLC before and during the COVID-19 pandemic. Prioritizing cancer care throughout the pandemic may have moderated the adverse effects of potential disruptions due to the pandemic. The impact of the pandemic on cancer care will likely continue to be a point of concern within the oncologic community for the foreseeable future. As responses to the pandemic continue to change rapidly worldwide, further research should address the long-term impact of treatment disruptions in populations of patients with cancer.

Affiliations: From the Department of Kinesiology, McMaster University, Hamilton, Ont. (Keogh); the Division of Thoracic Surgery, St. Joseph's Healthcare, Hamilton, Ont. (Keogh, Begum, Finley); the Faculty of Health Sciences, McMaster University, Hamilton, Ont. (Chhor); and the School of Nursing, McMaster University, Hamilton, Ont. (Akhtar-Danesh).

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