Original Article

Impact of COVID-19 on cancer services and patients' outcomes: a retrospective single-center study

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Background: Our main objective was to assess the impact of the coronavirus disease 2019 (COVID-19) on cancer services and cancer patients in terms of disease severity, morbidity and mortality. Secondary objectives were to characterize cancer type, affected age groups, gender, comorbidities, infectivity, and to identify cancer treatment delay and its complications after COVID-19 infection.

Methods: A retrospective analysis of electronic health records of polymerase chain reaction (PCR)-confirmed severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) infected cancer patients from April 2020 to March 2021 was done. The following parameters were investigated upon—new and follow-up cases during the pandemic and its preceding years (2018–2019, 2019–2020), age, sex, type of cancer, comorbidities, presentation, symptomatology and treatment for COVID-19, time to recovery, complications, delay in treatment and survival outcome. Statistical analysis using chi-square testing was done on the above variables.

Results: There was a 50.49% reduction in the number of new and follow-up cases as compared to that of the previous years. Seventy-four out of 310 (23.87%) COVID-19 positive cancer patients were aged in their sixth decade with the commonest type being hematological malignancies. A proportion of 84.8% (n=263) patients were asymptomatic. Univariate analysis was statistically significant for mortality with regard to age ≥60 years (P=0.034), type of malignancy (P=0.000178), hypertension (P=0.0028), symptomatology of COVID-19 infection (P=0.0016), site of treatment and oxygen/intervention (P<0.0001). There was an average delay in treatment time of 5 to 6 weeks. Multivariate analysis showed that gastrointestinal (GI) and hepato-pancreato-biliary (HPB) malignancies and oxygen requirement (>2 L/min) were responsible for the 20.65% mortality rate.

Conclusions: The pandemic significantly affected the care of cancer patients with decreased cases, late

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presentation, delayed treatment with potentially worse mortality outcome. Although they have decreased immunity, majority were asymptomatic. Most of the fatalities were in the GI and HPB malignancies.

Keywords: Coronavirus disease 2019 (COVID-19); cancer; comorbidities; morbidity; mortality

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Introduction

The impact of coronavirus disease 2019 (COVID-19) on cancer patients has been an unknown entity with little knowledge that cancer patients overwhelmingly represent a potentially high-risk group. There is still a lack of data on cancer patients with COVID-19 and systemic fungal infections (1). The pandemic has impacted healthcare systems worldwide, disrupting usual care in many healthcare facilities, putting vulnerable cancer patients at significant risk. Despite a multi-pronged approach to preventing the spread, including lockdowns, social distancing, hand hygiene and masks, large sections of the population have been affected in almost all countries. The severity of the spread and complications varied from country to country. Within a year, many countries had already experienced a second wave. The understanding of the behavior of this novel virus was very vague, and research work was being carried out in a rushed way worldwide to find out the mode of spread in order to develop strategies for its prevention, including possible vaccines and curative treatment (2-6).

Whether cancer patients would do worse was not known to us, although the common belief was that they were high risk group considering the low immunity. It was assumed that the people with comorbidities will have worse outcomes. It was important to know for oncology centers about the actual risks of cancer patients of their susceptibility to infections and developing complications. Here, we present the first comprehensive one-year study among cancer patients affected with COVID-19 in Indian sub-continent. We present this article in accordance with the STROBE reporting checklist (available at https://atm.amegroups.com/article/view/10.21037/atm-22-5876/rc).

Highlight box

Key findings

- This retrospective analysis reported that the overall percentage of services was reduced by >50% at a Cancer Institute in Eastern India.
- It also demonstrated a 60.84% reduction in detection of new malignancies.
- Multivariate analysis showed that gastrointestinal and hepato-pancreato-biliary malignancies were responsible for a 20.64% mortality rate.

What is known and what is new?

- It is known that cancer patients are at a higher risk and more susceptible to infection with COVID-19.
- We should be more aware of the specific type of malignancies and facilitate the necessary preventive measures for these patients.

What is the implication, and what should change now?

- As the pandemic evolves, we are gaining more knowledge and improve our understanding on the impact of COVID-19 on cancer patients.
- That should lead to greater remote care and use of technology in the delivery of cancer care, research and education.

Methods

The primary objective was to find out the impact of COVID-19 on cancer services and cancer patients to determine the severity, morbidity and mortality with survival outcome. Secondary objectives were to find out the type of cancer affected most by COVID-19, the most common age group and gender. We also aimed to ascertain the correlation in cancer patients with other pre-existing co-morbidities and to determine the delay in treatment of cancer care and complications—if any—from cancer treatment following COVID-19 infection.

Study design and participants

We conducted a retrospective, observational cohort study at our Comprehensive Cancer Institute in Eastern India, which caters to approximately 60,000 patients affected with cancer every year. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Ethics Committee of the Saroj Gupta Cancer Centre and Research Institute in Kolkata,

India (IEC SGCCRI REF No. 23/04/2021/NON-REG/BS/07), and the requirement for individual consent was waived. That decision was made given that the research could not be carried out practicably without the waiver, and equally the waiver would not adversely affect the rights and welfare of the subjects.

Data collection and analysis

After clearance from the Institutional Ethics Committee (IEC), we accessed electronic health records of all the cancer patients affected by COVID-19 from 1st April 2020 to 31st March 2021. Our data collection included new and follow-up cases during the pandemic and its preceding year, total number of reverse transcription polymerase chain reaction (RT-PCR) tests performed, total number of positive cases and a detailed demographic profile of all positive cancer patients which included the age and sex of the patient, diagnosis of cancer with the cancer site, stage and pre-existing co-morbidities. We also looked into the symptomatology at presentation, treatment modalities for COVID-19 (oxygen requirement, escalation to critical care, ventilation), time to negativity and mortality in cancer patients affected with COVID-19.

Statistical analysis

Associations between categorical data were tested using Chi-squared test. All tests were conducted with the two-sided 0.05 level with no adjustments for multiple comparisons. We assessed all study variables to analyze correlations with mortality using logistic regression. Also, the correlation of delay in treatment with other variables were analysed with linear regression. All analyses were performed using Python 3.0.

Results

Cases

The total annual cases was found to be 47,564 during the period of 2019–2020. This included 9,484 new registered cases and 38,080 follow-up cases, whereas the average annual cases during the pandemic year included 6,444 new registered cases and 16,848 follow-up cases with the total cases adding up to 23,292. Therefore, the reduction of overall cases was by 50.49%, of which the follow-up cases were reduced by 54.25% and the new cases by 37.17% (*Table 1*).

The follow-up cases who were under surveillance included patients in the follow-up category of cancer services. Those undergoing treatment, i.e., chemotherapy or radiotherapy were included in the study cohort where complete analysis and profiling was done (n=395).

Test and infectivity rate

From April 2020 to March 2021, a total of 5,401 RT-PCR tests were performed to detect COVID-19. The total

Table 1 Total number and footfall of patients availing oncological services at SGCCRI during the year 2018–2019, 2019–2020 and the pandemic hit 2020–2021

Oncology services	2018–2019	2019–2020	2020–2021	% reduction in 2020–2021 due to COVID-19*
Out-patient services				
Total number of patients	46,852	47,564	23,292	50.49
Old follow-up consultations	35,580	38,080	16,848	54.25
New patients	11,272	9,484	6,521	37.17
Malignancies detected in new patients	8,326	7,006	3,002	60.84
Speciality wise numbers				
Radiation oncology	1,448	1,154	597	48.27
ENT/head and neck	570	481	277	42.41
Gynaecological	730	636	334	47.48

Table 1 (*continued*)

Table 1 (*continued*)

Oncology services	2018–2019	2019–2020	2020–2021	% reduction in 2020–2021 due to COVID-19*
Hemato-oncology	912	914	419	54.16
Palliative care	53	35	37	15.91
Medical oncology	333	358	165	53.91
Surgical oncology numbers				
Head and neck	612	533	419	21.39
Breast	800	696	397	42.96
GI	1,327	1,143	646	43.48
Urogenital	398	318	181	43.08
Orthopaedic	161	194	97	50.00
Others	1,095	892	526	41.03
In-patient services—admitted and treated at hospital				
Paediatric	1,005	1,168	383	32.79
Adults	16,623	16,026	7,050	56.01
Surgical oncology services				
Minor procedures				
Biopsies	255	652	172	73.62
Procedures under L/A or G/A	590	216	338	42.71
Major procedures				
Breast	202	185	93	49.72
GI and HPB	214	220	123	44.09
Urogenital	57	52	21	59.61
Gynaecological	80	102	51	50.00
Thoracic/orthopaedic/others	52	107	22	79.44
Head and neck	218	220	106	51.82
Endoscopy				
GI and HPB endoscopic interventions	1,240	1,022	510	50.10
Urological endoscopic interventions	270	240	24	90.00
Gynaecological endoscopic interventions	47	33	4	87.88
Head and neck endoscopic interventions	1,068	1,011	384	62.02

*, the percentage of reduction of oncological services has been calculated as the average reduction in comparison to year 2018–2019 & 2019–2020. COVID-19, coronavirus disease 2019; ENT, Ear, Nose and Throat; GI, gastrointestinal; G/A, general anaesthesia; HPB, hepato-pancreato-biliary; L/A, local anaesthesia; SGCCRI, Saroj Gupta Cancer Centre and Research Institute.

Table 2 Univariate and multivariate analysis of factors influencing the primary outcome (death) in cancer patients affected with COVID-19

Variables	Subcategories	Death*, n (%)		P value	
		Yes (n=64)	No (n=246)	Univariate analysis	Multivariate analysis
Sex	Males	27 (19.01)	115 (80.99)	0.514	0.919
	Females	37 (22.02)	131 (77.98)		
Age >60 years	Yes	12 (34.29)	23 (65.71)	0.034	0.656
	No	52 (18.91)	223 (81.09)		
Type	Breast	7 (25.00)	21 (75.00)	0.000178	0.001
	GI and HPB	21 (36.84)	36 (63.16)		
	Gynaecological	6 (17.14)	29 (82.86)		
	Head and neck	5 (12.20)	36 (87.80)		
	Hematology	18 (28.57)	45 (71.43)		
	Others	7 (18.42)	31 (81.58)		
	Routine	0	48 (100.00)		
Hypertension	Yes	44 (54.32)	37 (45.68)	0.0028	0.474
	No	20 (8.73)	209 (91.27)		
Diabetes mellitus	Yes	50 (60.24)	33 (39.76)	0.0927	0.683
	No	14 (6.17)	213 (93.83)		
Chemotherapy	Yes	52 (46.02)	61 (53.98)	0.3098	0.019
	No	12 (6.09)	185 (93.91)		
Symptomatic	Yes	6 (21.43)	22 (78.57)	0.0016	0.780
	No	48 (18.25)	215 (81.75)		
	SOB	10 (52.63)	9 (47.37)		
Place of treatment	Home	12 (7.02)	159 (92.98)	<0.0001	0.761
	Hospital	52 (37.41)	87 (62.59)		
Oxygen/intervention required	Yes	22 (75.86)	7 (24.14)	<0.0001	0.021
	No	0	230 (100.00)		
	Intervention	42 (82.35)	9 (17.65)		

*, figures included in columns with parenthesis indicates frequency percentage. COVID-19, coronavirus disease 2019; GI, gastrointestinal; HPB, hepato-pancreato-biliary; SOB; shortness of breath.

number of positive cases was 395 out of 5,401 (7.31%), of which complete medical records were available for 310 patients.

Age and gender

Among the total 310 COVID-19 positive cancer patients, 142 (45.8%) were male and 168 (54.2%) were female (P=0.514 on univariate analysis with respect to mortality) (*Table 2*). The highest number of positive cases was recorded in the 51–60 age group, which was 74 (23.87%), followed by those over 60 (n=67, 21.61%) who did have the highest mortality rate. The lowest incidence was found in the second decade age group (n=17, 5.48%). The oldest positive patient was 87 years old and the youngest 2 years old, with the mean age of the study population being 48 years.

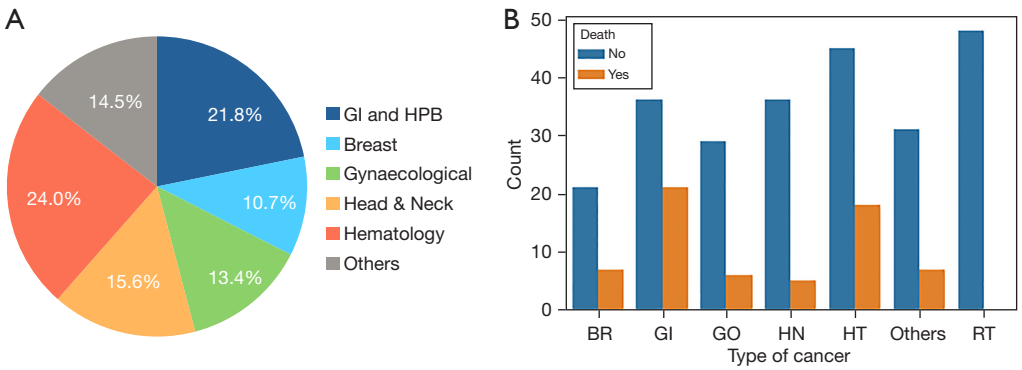

Figure 1 Distribution and incidence of COVID-19 among various types of cancer patients (A) and mortality caused in each of the groups (B). GI, gastrointestinal; HPB, hepato-pancreato-biliary; BR, breast; GO, gynecological; HN, head and neck; HT, hematology; RT, radiation oncology; COVID-19, coronavirus disease 2019.

Diagnosis (including type of cancer in positive patients)

Among 310 COVID-19 positive cancer patients, the highest number of incidences were found in hematological malignancies (n=63, 20.32%), followed by gastrointestinal (GI) and hepato-pancreato-biliary (HPB) cancers (n=57, 18.39%). In univariate analysis, the P value was 0.000178, while multiple logistic regression gave a P value <0.0001 (*Figure 1*).

Comorbidities

One hundred and seventy-seven out of 310 patients (57.10%) infected with COVID-19, had pre-existing comorbidities, such as hypertension (n=81, 26.13%; P=0.0028) and diabetes (n=47, 15.16%; P=0.0927) and have been on chemotherapy (n=73, 23.55%; P=0.3098). The remaining 42.90% (n=133) had no comorbidities.

Symptoms at presentation

Two hundred and sixty-three patients (84.84%) were asymptomatic, 28 patients (9.03%) had mild to moderate symptoms, while 19 patients (6.13%) developed severe symptoms including shortness of breath requiring ventilator support (P=0.0016).

Treatment for cancer

Compared to the previous year, there was a 53.05% reduction in surgery, 48.27% in radiotherapy and 53.92% in chemotherapy (*Table 1*). Home care was recommended for most palliative care patients.

Treatment done for COVID-19 infection

The modalities of COVID-19 management recommended by our hospital were based on the symptoms. Two hundred sixty-three patients (84.84%) were asymptomatic. Overall, 171 patients (55.16%) were primarily advised to self-isolate at home (P<0.0001), while the remaining 139 patients (44.84%) were all hospitalized because of cancer severity or COVID-19 along with comorbidities were hospitalized.

Delay in treatment time

Time to negativity on repeat RT-PCR testing was mostly within 4 weeks, although a significant number remained positive at 6 weeks. The mean delay in treatment was 5 weeks for surgery and radiotherapy and 6 weeks for chemotherapy.

Mode of treatment following negative report and outcome

After recovering from COVID-19 infection, 70 patients underwent active cancer treatment; 21 patients (6.77%) underwent surgery, 26 patients (8.39%) received chemotherapy, 13 patients (4.19%) received radiotherapy, while 2.65% of patients received palliative care at the end of life. In addition, 48 patients (15.48%) were undergoing chemotherapy as of the reporting date. The consumption of

narcotic analgesics has been reduced by 36%.

Mortality

The total number of deaths among COVID-19 positive cancer patients was 64 (20.65%), with the highest mortality rate found in the age group over 60 years (n=18, 28.1%). GI and HPB malignancies accounted for the highest number of deaths (n=21, 32.8%), followed by hemato-oncologic malignancies (n=18, 28.1%). No major mortality and significant morbidity were observed in patients undergoing definitive anticancer treatment after COVID-19 (*Figure 1*).

On univariate analysis, age over 65 years (P=0.034), type of malignancy (P=0.000178), hypertension (P=0.0028), symptoms of COVID-19 infection (P=0.0016), treatment location and oxygen/intervention (P<0.0001) proved statistically significant for mortality from COVID-19 infection. However, multiple logistic regression revealed only cancer type (P<0.001) and oxygen/intervention were statistically significant for death due to COVID-19 infection. Multivariate analysis of treatment delay for COVID-19 infection showed that oxygen/intervention and chemotherapy were statistically significant factors (P<0.05) (*Table 2*).

Discussion

In this single-center retrospective cohort study, we analyzed the cohort of cancer patients affected by COVID-19, mainly during the first wave of the pandemic, when the majority of the population was unvaccinated. COVID-19 has spread in low- and middle-income countries and particularly India due to limited resources, poor infrastructure, lack of healthcare providers and organized care teams, lack of medical supplies and personal protective equipment and in -equal access to technology (7-10). The turnover of patients in the hospitals was greatly reduced during the lockdown because they could not use public transport, many had lost their livelihoods, several cancer hospitals became COVID-19 hospitals and mainly because of the fear of contagion. In fact, this delay in screening and diagnosing cancer has severely impacted the outcome in many countries (11). In a pan-Indian study by Ranganathan *et al.*, involving the National Cancer Grid of India, the experience was similar in 283 cancer hospitals across the country (12). Many centres used telemedicine to advise their patients, especially to those who have already been treated, and to save them the trip to the hospital with the resulting risk of infection (13-16).

In our study, the overall frequency in the outpatient clinic (both new and recurrent cases) was reduced to 50.49% compared to the previous year, which mainly affects the recurrent cases. This means that although the newly diagnosed cancer patients decreased by 37.17%, they still managed to get to the hospital, while the follow-up cases, which decreased by 54.25%, went to teleconsultation and preferred to stay at home and only when clinically indicated were presented. The average stages of presentation were even later compared to the previous year. The experience was similar in most other studies (7-9). Because oncology care involves multiple hospital visits, patient infection rates tend to be higher. Another reason could be immunosuppression in cancer patients. A study by the Rajiv Gandhi Cancer Institute in Delhi has shown an incidence of COVID-19 in cancer patients of 6% compared to the national average of 0.32% (17). However, tests were only carried out there in patients with COVID-19 symptoms or with radiological changes in the chest. The incidence was 3 times higher in cancer patients compared to the general population, as shown in studies from Brazil and the US, and 15 times higher in a study that included all patients with active cancer and was presented to the network of cancer centers, which have been included in the UK Coronavirus Cancer Surveillance Project (UKCCMP) (18). In our study, it was 7.3% (23 times higher). Aside from the fact that this immunocompromised group has multiple hospital visits, another major reason for the higher positivity rate in most cancer hospitals like ours is that these patients are screened with RT-PCR testing prior to any invasive procedure (biopsies, endoscopies, surgeries), or long-term chemotherapy, while testing rates are much lower in the general population. Many of the cancer patients are asymptomatic as in the general population. In our series, 84.8% were asymptomatic, while 9.03% had mild symptoms and 6.12% had severe symptoms requiring admission to intensive care units, most of whom succumbed.

Cancer management guidelines during the COVID-19 pandemic have been adopted by various societies around the world such as the Surgical Society of Oncology (SSO) in the US, the National Health Service (NHS) in the UK, the European Society of Medical Oncology (ESMO) and the Indian Association of Surgical Oncology (IASO) to reduce the likelihood of infection and the development of complications (19). Non-emergency surgeries were deferred when there was an option for neoadjuvant therapy, learning from China, which reported a 25% mortality

rate from chest complications in the postoperative period in the early stages of the pandemic. Death rates from COVID-19 are also generally much higher than predicted in cancer patients. A study from New York showed an overall mortality of 25% with highest fatality in lung and pancreatic cancers (55%) followed by hematological malignancies (37%), the least being in patients with breast cancer (14%) (20). The experience was similar in the UK, China and Italy (21-25). The majority of these patients had multiple comorbidities with a mean Eastern Cooperative Oncology Group (ECOG) score of 2 or greater. Cancer-related inflammation and the associated prothrombotic status of uncontrolled solid or hematological cancer growth could be considered responsible for the poor prognosis in hospitalized COVID-19 patients (13,26). It should be noted that cancer patients often coexist with comorbidities such as diabetes, hypertension, coronary artery disease, chronic kidney disease, which can further weaken the immune response and increase the risk of death from COVID-19 (27,28).

In our study, the highest incidence of COVID-19 infection was found in patients with hematological malignancies (20.32%), followed by GI and HPB malignancies (18.39%). The mortality in these cancer patients was 20.65% given their advanced type of malignancies and the severity of COVID-19 infection with or without comorbidities. The highest mortality was observed in patients with GI and HPB, followed by hematological malignancies (20.3% and 18.39%, respectively). With regard to the direct impact, our entire cohort included patients (n=395) with cancer, either newly diagnosed or previously known, who were affected due to COVID-19. Therefore, the impact of factors influencing variables like mortality or type of cancer have been analyzed here. Considering the indirect impact, the delay of cancer services was due to the general unavailability of medical services for investigations. Some of the external factors like government induced administrative lockdowns or lack of availability of adequate public transport led to this delay as well. Also, cancer patients harbouring COVID were treated in designated COVID centres. This throws light on the outcomes of the entire spectrum of cancer services affected by the pandemic between April 2020 to March 2021. The effects of the COVID-19 pandemic will have long-lasting repercussions in almost every aspect of oncology care. The National Cancer Institute (NCI) projected that there will be more than 10,000 cancer-related deaths over the next decade as a result of missed screenings, delays in diagnosis, and a reduction in oncology care due to the COVID-19 pandemic (29). As the pandemic evolves, we are gaining more knowledge that will improve our understanding of both the disease, i.e., COVID-19 as well as its impact on cancer. It will likely lead to major changes in healthcare, including oncology, which will involve greater remote care closer to home and greater use of technology in the delivery, research, education and corporate governance related to cancer care.

Conclusions

The pandemic led to a widespread decline in oncology services worldwide. Similar results were found in our study, where the overall percentage of services was reduced by more than 50%. The worst result among these was a 60.84% reduction in detection of new malignancies, resulting in patients emerging with late-stage malignancies after the first wave of the pandemic. As predicted, the most commonly affected age group was in the sixth decade, while the least affected was in the second decade. Delays in cancer treatment have also been shown to play an important role in the poor prognosis of cancer patients. Although the majority of our patients were asymptomatic, in these cases infection was only detected during routine testing before each procedure. Both conservative and interventional treatment modalities were used for the symptomatic patients. The incidence of COVID-19 infection was highest in hematological malignancies (20.3%), followed by GI and HPB (18.39%), the latter being responsible for the highest mortality. This suggests that while cancer patients are at a higher risk and more susceptible to infection with COVID-19 than the general population, there is a need to be more aware of the specific type of malignancies and to facilitate the necessary preventive measures for these patients to avoid them prevent any subsequent mortality.

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Footnote

Reporting Checklist: The authors have completed the

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://atm.amegroups.com/article/view/10.21037/atm-22-5876/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are 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. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Ethics Committee of the Saroj Gupta Cancer Centre and Research Institute in Kolkata, India (IEC SGCCRI REF No. 23/04/2021/NON-REG/BS/07), and the requirement for individual consent was waived. That decision was made given that the research could not be carried out practicably without the waiver, and equally the waiver would not adversely affect the rights and welfare of the subjects.

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