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REVIEW ARTICLE

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Tailored treatment strategies for cancer patients during COVID-19 pandemic

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ABSTRACT

The global pandemic of respiratory disease caused by the novel human coronavirus (SARS-CoV-2) has caused indefinite global distress, uncertainty, and disturbance. This pandemic has had direct and indirect impacts for the healthcare systems across the world, but certain subgroups of patients have been particularly affected. Among these groups are patients with cancer, who as a result of their immunosuppressed status either from the disease itself or as a consequence of treatment, are at increased risk of severe COVID-19 infection and complications. The pandemic has also led to limited resources as medical services have been primarily directed to emergency care. In this context, physicians and healthcare providers have had to balance the importance of continuing treatment of cancer patients with the risk of virus infection.

In this review, we outline the treatment strategies for cancer patients during this pandemic, focusing on tailored treatment in this challenging situation of varying risks and benefits.

Key words: COVID-19; cancer; tailored treatment; chemotherapy; radiation therapy

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Introduction

In December 2019, a severe atypical type of pneumonia was reported in Wuhan, China. Subsequently, the source of this condition was determined to be an RNA enveloped beta-coronavirus designated as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The condition associated with the SARS-CoV-2 virus was named coronavirus disease 2019 (COVID-19). The World Health Organization (WHO) declared a pandemic of this virus in March 2020 [1].

COVID-19 was categorized as a pandemic in March 2020. Since that time actions have been taken to minimize the risk of infection via lockdown, social distancing, and the prioritization of provided medical services. During this pandemic, cancer patients face two major risks: compromised cancer services and an increased risk of infection due to their immunocompromised status. In many countries, primary care physicians have noted delayed cancer screening and reluctance to refer patients with a suspicion of cancer to secondary hospitals [2]. Cancer patients are more vulnerable to infection due to their immunocompromised status, either due to the disease itself or due to the side effects of cancer treatment. An immunosuppressed status makes cancer patients infected with COVID-19 more liable to serious complications and hospitalization, which may affect their prognosis [3]. Many recommen-

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dations have been issued to tailor cancer treatment protocols during the pandemic [4].

Risk of COVID-19 infection in cancer patients

Cancer patients are more liable to severe COVID-19 infection, with an approximately 3.5-fold increase in the possibility of mechanical ventilation, Intensive Care Unit (ICU) admission, or death, as reported by Liang et al. [4]. The increased incidence of severe complications could be explained by their immunosuppressed status caused by either the disease itself or as a complication of treatments such as cytotoxic drugs or surgery. It has been reported that severe events occur at a higher incidence in cancer patients who have received cytotoxic drugs or undergone surgery 30 days prior to COVID-19 infection [5].

A particularly high incidence of COVID-19 infection was found in leukemia patients, followed by those with non-Hodgkin's lymphoma and bronchogenic carcinoma, while a lower incidence was observed in those with thyroid cancer. In addition, a higher incidence of COVID-19 infection was observed among African Americans than among white patients; this ethnic variation was particularly pronounced in those with breast cancer, followed by those with prostate cancer and bronchogenic carcinoma [6].

The impact of the COVID-19 pandemic on delays in cancer diagnosis

In response to the declaration of the COVID-19 pandemic in March 2020, lockdown was introduced, with priority for medical care being placed on urgent diagnostic interventions for symptomatic cases, along with cancer screening programs being suspended. This shift was associated with a decrease of National Health Service (NHS) non-COVID-19 services, but raised increasing concerns about delays of diagnosis and intervention for other patient groups, especially cancer patients, whose outcome may be adversely affected by these delays [7]. Zadnik et al. reported significant declines of 43% for first referrals for oncological services and of 29% for histopathological diagnoses in the period between November 2019 and May 2020 [8].

Surgical interventions and prioritization

Combined with the increase in the number of COVID-19 cases, hospitals have become sites with substantial risk of disease transmission to cancer patients who have an immunosuppressed status either due to the disease itself or as a consequence of treatment. Cancer patients have twice the risk of being infected compared with the normal population. This makes the selection of surgical intervention and preoperative treatment for cancer patients particularly important during this pandemic [9].

As the risk of COVID-19 infection is increased in hospitals, it is important to shorten the time spent there by cancer patients [10]. To reduce direct communication, telephone or video calls could be implemented especially for pretreatment discussions and follow-up. Meanwhile, hospitals with a low patient burden could be used to collect important blood samples. Moreover, shifting to electronic prescriptions with extended periods will help to reduce patients' visits. Furthermore, when preoperative radiotherapy is needed, hypofractionated protocols should be used to minimize patients' visits [11].

In abdominal surgery, there was controversy about the choice between open and laparoscopic approaches, as it was thought that COVID-19 transmission could occur via peritoneal fluid. However, a recent article reported that COVID-19 virus was not detected in peritoneal fluid [12]. The initial intercollegiate surgical guidance from the UK during the COVID-19 pandemic resulted in significant changes to practice. Avoidance of laparoscopy was recommended, to reduce aerosol generation and risk of virus transmission; however, with appropriate protective measures, laparoscopic surgery is safe for patients and staff during the COVID-19 pandemic. The laparoscopic approach maintains an advantage of shorter length of hospital stay compared with open surgery [13].

The use of the laparoscopic approach is one of the most controversial topics during the COVID era [14–15]. In the absence of evidence of COVID-19 in surgical smoke, Marco et al. [16] kept performing laparoscopy following the rules of good surgical practice established almost 25 years ago, such as avoiding desufflation of the abdomen without a smoke evacuation system to reduce postoperative pain, minimize the risk of tumor cell seeding at the

trocar sites in oncologic patients [17, 18] and, at the same time, protect from potential virus spreading. During the postoperative course, no patient or OR staff was infected by COVID-19 [16]. It has been stated that laparoscopic surgery can be performed in the COVID-19 setting, by an experienced laparoscopic surgeon using specialist equipment. In order to safely evacuate pneumoperitoneum gases, suggested equipment can be: the closed circuit of a pressurized intraperitoneal aerosol chemotherapy system, extension lines with water sealed containers, or an ultrafiltration system [19, 20].

Surgical intervention for breast cancer during the COVID-19 pandemic

In many countries affected by COVID-19, the triaging of breast cancer patients has occurred according to their need for urgent surgery or the initiation of neoadjuvant treatment, with surgery deferral until the pandemic is resolved. This could limit the risk of infection and allow resources to be allocated to emergency cases. A recent publication on the recommendations for breast cancer treatment during the pandemic advised neoadjuvant endocrinal therapy for early breast cancer patients at T1N0 stage (ER-positive, Her2neu-negative) and the consideration of it for T2 or N1 disease (ER-positive, Her2neu-negative) [21].

Another study by Mitch et al. analyzed data of many presurgical endocrine therapy trials to identify patients who may have insufficient endocrine sensitivity and need to be prioritized for early surgery or neoadjuvant chemotherapy, as well as those who could safely start neoadjuvant endocrine therapy with deferral of surgery until the pandemic subsides. Analysis of the data supported the use of ER and PR status in categorizing postmenopausal patients, where the group with ER 8/8 and PR ≥ 6/8 were found to be appropriate for neoadjuvant hormonal treatment [22].

Surgical intervention for colorectal cancer

Colorectal surgeries are categorized according to their priority as emergency, urgent with imminent emergency, and elective. Urgent and imminent emergent cases should proceed to surgery as long as the resources are available. In accordance with standard practice, elective cases and stage II and III rectal cancer metastatic cases could start nonsurgical treatment with deferral of surgery for 6 to 8 weeks safely. With regard to urgent oncological cases, management can be postponed from 6 to 8 weeks without affecting the outcome. Outside the established principles, deferral of surgery and the initiation of nonsurgical modalities are not justified and could affect patient outcome [23].

Surgical intervention for head and neck cancers

There are many barriers for safe head and neck surgeries, including limited ability to screen for COVID-19 in order to select negative cases and a long incubation period, which extends to 5 days [23, 24]. In addition, between 7% and 13% of patients are asymptomatic [25]. Convalescent cases for whom the sensitivity of COVID-19 testing is questionable may shed the virus for weeks [26]. In addition, viral replication usually occurs in the nasopharynx and oropharynx, which are the common sites for head and neck surgeries [27, 28]. There is also a high possibility that the virus could be aerosolized and remain airborne for at least 3 h during head and neck surgery [29].

All of these issues mean that head and neck surgery confers a high risk of COVID-19 infection among patients, physicians, and healthcare workers. As such, nonsurgical options are preferred for treatment when both such options and surgery are first-line options; however, for cases where surgery is the only first-line option, it is advisable for a multidisciplinary team assessment to be performed with consideration of possible nonsurgical treatment options [30]. A summary for the recommendations of surgical interventions according to disease site is shown in Table 1.

Chemotherapy protocols and tailored management

The immunosuppressed status of cancer patients raises a challenge for oncologists. During the past year, many recommendations to reduce the number of visits by cancer patients have been published, oral chemotherapeutic agents have been widely prescribed whenever possible, along with the use of hormonal treatment. As patients who are

Table 1. Surgical interventions recommendations according to disease site

Disease site	Surgical intervention recommendation
Breast cancer	Consider initiation of neoadjuvant treatment, with surgery deferral until the pandemic is resolved
Colorectal cancer	Urgent and imminent emergent cases should proceed to surgery as long as the resources are available Elective cases and stage II and III rectal cancer could start nonsurgical treatment with deferral of surgery for 6 to 8 weeks safely
Head and neck cancers	It is advisable for a multidisciplinary team assessment to be performed with consideration of possible nonsurgical treatment options
Lung cancer	For early cases of NSCLC, SABR can be curative in early cases if surgery is not possible

NSCLC — non-small cell lung cancer; SABR — stereotactic ablative radiotherapy

treated with chemotherapy are at increased risk of COVID-19 infection and are more liable to exhibit worse complications if they are infected, the decision regarding chemotherapy should be made on a case-by-case basis with consideration of the goals of chemotherapy and the possible risk of infection [31]. A meta-analysis on 46,499 patients with COVID-19 showed higher mortality among cancer patients [risk ratio (RR): 1.66; 95% confidence interval (CI): 1.33–2.07) and a higher incidence of ICU admission (RR: 1.56; 95% CI: 1.31–1.87) [32].

The type of treatment administered, cancer type, and stage of therapy (i.e., active treatment or follow-up) affect the immunosuppressive status and risk of acute respiratory syndrome from COVID-19. A study on COVID-19 and a cancer registry found that cancer patients who were in remission had a lower incidence of mortality from COVID-19 than patients under an active treatment protocol [33].

In the management of curable cancers in which treatment interruption could affect the outcome, delays should be avoided (e.g., pediatric acute lymphoblastic leukemia). When it is possible to choose between equally effective protocols, oral treatment protocols and those that require fewer infusions should be selected [34, 35].

The treatment units should work at the same capacity as usual to avoid delays in treatment. Patients who are receiving chemotherapy on an outpatient basis can undergo either oral or intravenous chemotherapy protocols; whenever possible, oral chemotherapy should be considered if it is a good alternative, such as replacing 5-flurouracil with capecitabine in rectal cancer treatment. This method will decrease the number of patient visits and, thus, lower the risk of exposure [36, 37]. The administration of chemotherapy at home should be considered if possible, to decrease the number of patient visits [38].

When using chemotherapy protocols that are associated with a moderate (10–20%) or high (> 20%) incidence of febrile neutropenia, prophylactic granulocyte colony-stimulating factor (G-CSF) should be used to avoid febrile neutropenia and, hence, avoid a visit to an emergency room and hospitalization [39].

It was reported that the administration of chemotherapy in general was not associated with severe COVID-19 events [hazard ratio (HR): 1.10; 95% CI: 0.73 to 1.60]. However, in hematological malignancies and lung cancer, higher incidences of critical COVID-19 events were observed (HR: 2.10; 95% CI: 1.50–3.10; and HR: 4.20; 95% CI: 1.70–11.00, respectively). Patients with lymphopenia or neutropenia were associated with worse COVID-19 outcomes. Moreover, more recently established types of chemotherapy were found to have a lower incidence of severe COVID-19 complications [40].

In cancer patients with acute COVID-19 infection or those who are in recovery, decisions about the administration of chemotherapy protocols are unclear and should be made on a case-by-case basis while weighing the risks and benefits. However, postponing treatment until the resolution of COVID-19 infection is recommended as prolonged shedding of the virus may occur in cancer patients [41].

Immunotherapy and COVID-19

Programmed death 1 (PD-1) blockade has improved the survival of patients with various incurable cancers, but there is uncertainty about the potential impact — harmful, beneficial, or neither — of immunotherapy in the context of COVID-19 [42]. A study by Luo et al. revealed that PD-1 blockade treatment was not associated with an increased risk of severity of COVID-19, and also PD-1 blockade did not appear to affect the severity of COVID-19 in patients with lung cancers [43].

However, one of the adverse events of immune checkpoint inhibitors is pneumonitis, which represents a challenge to differentiate it from COVID-19-induced pneumonitis. This distinction is important for appropriate patient management [44]. Another study showed that immunotherapy within the last 30 days before COVID-19 diagnosis did not increase the risk of severe disease or death in cancer patients [odds ratio (OR): 1.60; 95% CI: 0.72–3.52; p = 0.25; and OR: 1.12; 95% CI: 0.60–2.08; p = 0.72, respectively] [45].

Radiation therapy and appropriate treatment schedules

Hypofractionated radiotherapy courses during COVID-19 have been recommended in a large number of reports [46]. Radiation therapy courses usually take several weeks and require daily attendance to receive treatment, which confers a higher risk of exposure to infection. This is why hypofractionated regimens should be applied whenever possible. Treatment interruption early in the course may affect the outcome, so patients who have started their courses should continue them. Decisions about the start of treatment should be carefully balanced, so if a course is planned for curative intent, treatment should start with safety precautions; however, with a palliative intention for pain control, it is reasonable to think about a safe alternative, for example, using analgesics if possible. Also in cases when treatment could be postponed safely (as in prostate cancer, when it is possible to start neoadjuvant hormonal treatment), it is wise to postpone treatment [47]. In a study from Poland, the impact of preventive measures adopted in response to the COVID-19 pandemic on radiation oncology department performance and limiting the risk of COVID-19 transmission among patients and staff was studied. During the COVID-19 pandemic, the authors relied on assessing the overall number of patients irradiated and those who began treatment, both of which revealed a significant decrease as a result of these efforts [48].

Radiotherapy has three possible scenarios; (i) using an alternative to surgery when surgery is not possible, (ii) using a bridge to surgery until the pandemic slows down, and (iii) using an adjuvant or postoperative treatment [49].

Treatment with curative intent according to stage and performance status should be prioritized. In addition, decisions should be made based on a multidisciplinary team, considering the current pandemic situation or future similar crises [50-53]. A study in the United Kingdom (UK) analyzing radiotherapy data of the National Health Service (NHS) in 2020 in comparison with those in the corresponding months during 2019 revealed falls in weekly treatment courses by 19.9% in April, 6.2% in May, and 11.6% in June. In addition, there were increases in radiotherapy courses for the bladder, esophageal, and rectal cancers, reflecting a shift to nonsurgical management and greater use of hypofractionated courses [54].

Breast cancer radiation therapy in response to the pandemic

The safety and efficacy of various hypofractionated regimens are supported by a growing body of literature for either postmastectomy or whole breast radiotherapy. In addition, there is evidence supporting the omission of radiation in certain favorable risk subgroups [55].

The omission of radiotherapy could be considered in ductal carcinoma in situ (DCIS); (lesions < 2.5 cm in size, of low or intermediate grade, and with adequate ≥ 2 mm resection margins); this was based on postoperative observational studies [56] and randomized trials [57] showing no survival benefit. Therefore, in the pandemic context, the risk of infection must be weighed with benefit, considering other patient related characteristics, like age [58]. Multiple hypofractionated regimens are approved, including 42.56 Gy in 16 fractions, and 32 and 40 Gy in 15 fractions [59, 60], as well as a more accelerated daily regimen of 26 Gy in 5 daily fractions [61].

Rectal cancer radiation therapy during the pandemic

It is usually recommended that locally advanced rectal cancer (T3 or T4 lesions or positive lymph nodes) undergoes multimodal treatment consisting of preoperative concurrent chemoradiation, surgery, and then adjuvant chemotherapy [62]. Regarding the course of radiation therapy, two treatment regimens are available with likely equal

efficacy [short-course (25 Gy in 5 fractions once daily for 5 days) and long-course (1.8–2 Gy fractions 5 days per week for 5 weeks)]. Multiple studies have demonstrated equivalence between these two regimens in terms of local control and overall survival [63, 64]. During the COVID-19 pandemic, the short-course is recommended as it lowers the number of sessions from 25 to only 5; hence, lowering the risk of infection and also allowing more patients to be treated [65].

Lung cancer radiation therapy and selecting the treatment schedule

Patients with lung cancer are at high risk of severe complications and mortality from COVID-19, so there is a need to reduce the number of visits in order to lower the risk of infection. Based on this, alternative hypofractionated regimens are recommended, which will also enable more patients to be treated [66].

A comprehensive systematic review of the method of optimizing lung cancer radiation treatment in COVID-19 outbreak highlighted the importance of patient screening before treatment, considering hypofractionation, and delaying postoperative RT for non-small cell lung cancer, and also the avoidance of twice-daily treatments and the possibility of delaying or delivering prophylactic cranial irradiation during radiotherapy and chemotherapy for limited-stage small cell lung cancer. It also suggested reviewing image-guided RT images for suspicious image findings, and the use of single-fraction RT for the palliative treatment of stage IV lung cancer patients [67].

For early cases of non-small cell lung cancer (NSCLC), stereotactic ablative radiotherapy (SABR) and hypofractionated radiotherapy courses can be considered. SABR can be curative in early cases if surgery is not possible, and can be delivered in one to three fractions based on the size and site of the lesion. Doses range from 30 to 34 Gy in one fraction for tumors < 2 cm and ≥1 cm from the chest wall [68-70] and from 48 to 54 Gy in three fractions over 1 week for peripheral lesions [71]. Mild hypofractionation (45–60 Gy in 4–8 fractions) could be considered for central and ultra-central lesions [72]. For stage II and III NSCLC, hypofractionated treatment schedules are considered in the form of 55 Gy/20 fractions, which are widely used in the UK [73].

Prostate cancer radiotherapy and tailored schedule

Multiple clinical trials have demonstrated that patients having very low-, low-, and favorable intermediate-risk disease have very favorable outcomes with watchful waiting. As such, treatment deferral for this group until improvement of the pandemic is thought to be safe [74, 75].

Unfavorable risk intermediate prostate cancer has survival rates similar to the high risk, so patients in both of these groups need an active treatment [76]. Regarding radiotherapy as an active treatment for localized Prostate Cancer, several trials demonstrated the non-inferiority of moderate hypofractionation (60 Gy in 20 daily fractions) compared with conventional fractionation (74–78 Gy in 37–39 daily fractions) [77, 78]. In the COVID-19 era, it is necessary to reduce hospital admissions in order to limit virus transmission. Short-course (6 months) neoadjuvant androgen deprivation therapy (ADT), which is part of the treatment strategy in unfavorable intermediate risk [79], allows for the start of radiotherapy to be delayed. The excessive prolongation of ADT use in this setting may increase the risk of morbidity (e.g. cardiovascular events), without influencing oncological outcome [80].

Neoadjuvant ADT (with preference for longer formulation, 3 or 6 months), followed by delayed external beam radiotherapy (EBRT) (6–12 months after) is a valid alternative to surgery for this setting [81].

The shortest safe EBRT regimen (which can include ultra-hypofractionation in 5 to 7 fractions) should be offered according to the 2020 NCCN guidelines, for patients without clinical lymph nodes involvement [82].

Based on that, Ultra-hypofractionation is preferred for localized disease, oligometastatic, and low-volume metastatic cases, and moderate hypofractionation is preferred for postprostatectomy and clinical node-positive disease [83]. Ultra-hypofractionation refers to the delivery of 42.7 Gy in seven fractions, 3 days per week for 2.5 weeks [84]. Moderate hypofractionation refers to the delivery of 2.4–4.0 Gy per fraction, daily, over 4–6 weeks [85, 86]. A summary for radiation therapy recommendations during the pandemic is shown in Table 2.

Table 2. Radiation therapy recommendations during the pandemic

Type of cancer	Radiation therapy recommendation
Breast cancer	1. Omission of radiotherapy could be considered in DCIS; (lesions < 2.5 cm in size, of low or intermediate grade, and with adequate ≥ 2 mm resection margins) 2. Multiple hypofractionated regimens could be used including 42.56 Gy in 16 fractions, 40 Gy in 15 fractions, as well as a more accelerated daily regimen of 26 Gy in 5 daily fractions
Rectal cancer	Using short-course (25 Gy in 5 fractions once daily for 5 days)
Lung cancer	Early cases of NSCLC, SABR can be considered. SABR can be curative in early cases if surgery is not possible, and can be delivered in one to three fractions For stage II and III NSCLC, hypofractionated treatment schedules are considered in the form of 55 Gy/20 fractions
Prostate cancer	Moderate hypofractionation 60 Gy in 20 fractions can be considered Ultra-hypofractionation of 42.7 Gy in seven fractions, 3 days per week for 2.5 weeks can be considered for localized disease without lymph nodes involvement

DCIS — ductal carcinoma in situ; NSCLC — non-small cell lung cancer; SABR — stereotactic ablative radiotherapy

Effect of the pandemic on screening protocols

In response to the pandemic, many cancer dedicated screening programs were suspended. Yong et al. performed a study to estimate the effect of the suspension of screening protocols for breast and colon cancer in Canada. The simulation projected a possible increase in cancer diagnosis when screening resumes. For breast cancer, a 3-month suspension could increase the number of cases presented at an advanced stage by 310 and increase cancer deaths by 110. However, a 6-month suspension could increase the number of advanced cases at diagnosis by 670 and increase cancer deaths by 250 in the period 2020–2029. With regard to colon cancer, a 6-month interruption of screening could increase cancer diagnosis by 2200 cases and cancer deaths by 960 [87].

In a study analyzing the data coming from risk assessment companies providing cancer risk assessment services in the United States, breast cancer screening, surgery, and genetic counseling have been greatly affected by the pandemic and the measures taken to deal with it. Breast imaging demonstrated the most significant reduction, with an average weekly decline of 61.7% and a maximum decline of 94.6%, while breast surgery declined by 20.5% weekly. Finally, genetic counseling demonstrated a weekly decline of 39.9% compared with the level before COVID-19 [88]. Similarly, cervical cancer screening rates among approximately 1.5 million women in the Kaiser Permanente Southern California (KPSC) network decreased approximately 80 percent compared to baseline during the stay-at-home order in California. The decrease was comparable across all KPSC racial/ethnic groups and returned after reopening to near average [89].

Approved vaccination and current standards

With regard to COVID-19 vaccination for cancer patients, important issues to be explored include the possibility of vaccinating patients undergoing active treatment and patients under follow-up. At present, patients who are undergoing active cancer treatment, such as chemotherapy, immunotherapy, and radiotherapy as well as patients after bone marrow transplantation may be offered the vaccine as long as there is no contraindication for its components. They may receive the vaccine during the intervals between cycles. Meanwhile, patients under follow-up may be offered the vaccine as long as there is no contraindication to any of its components [90].

The Vaccination Advisory Committee in National Comprehensive Cancer Network (NCCN) recommended that patients with cancer should be prioritized for COVID-19 vaccination, and that even patients undergoing active therapy should receive the vaccine. They also identified reasons for vaccination delay which are similar to those that impede the vaccine delivery to the general public (e.g., recent exposure to COVID-19). Vaccination should be delayed for at least 3 months following hematopoietic cell transplantation (HCT) or engineered cellular therapy [e.g., chimeric antigen receptor (CAR) T cells] [91].

Mortality risk from COVID-19 and cancer patients

Cancer patients, especially those receiving anticancer treatment, were thought to be at higher risk

of dying from COVID-19. However, no study has been performed to support this. In a large prospective observational study including patients with active cancer presenting to the UK network of cancer centres, the analysis of 800 cases with symptomatic COVID-19 revealed that 42% had mild symptoms, the mortality rate was 28%, and the risk of death was significantly associated with advancing patient age, male sex, and the presence of comorbidities such as hypertension and cardiovascular disease. However, no significant relationships of risk of death with chemotherapy, hormonal treatment, immunotherapy, targeted therapy, or radiotherapy were identified [92]. Another study by Rogiers et al. evaluating the clinical impact of COVID-19 on patients with cancer treated with immune checkpoint inhibitors revealed that COVID-19-related mortality in the immune checkpoint inhibitor-treated population does not appear to be higher than previously published mortality rates for patients with cancer [93].

Implications of the pandemic for telemedicine

The COVID-19 pandemic together with the vulnerability of cancer patients to infection and the development of serious side effects due to their immunosuppressed status, together with government-imposed rules on social distancing and lockdown, led to the adoption of safe options for both patients and medical staff in many healthcare systems that depend mainly on limiting the exposure and hospital visits [94, 95]. Virtual care is defined as the interaction between clinicians and patients remotely using communication or information technologies that maximize the quality and effectiveness of patient care [96, 97]. Specialized oncology clinics usually depend on decisions by multidisciplinary teams. Virtual technology has also allowed these meetings to be held during the pandemic [98, 99]. Factors obstructing the use of telemedicine include limited access to the internet in some areas or among some patients, and the impossibility of carrying out clinical examinations [100].

The European Society of Medical Oncology (ESMO) issued guidelines concerning patient care during the pandemic [101]. For example, in breast cancer management, it was recommended to switch to telemedicine as much as possible for patients presenting new symptoms or side effects, despite these being considered high-to-medium-priority patients [102].

Telemedicine could open up a new era for oncology specialists, especially for clinics heavily loaded with breast cancer patients. After the pandemic, its application should be discussed further. Although it has some disadvantages, we can depend on it in other situations besides the COVID-19 pandemic [103].

A recent study showed that oncology patients receiving palliative care favored telemedicine visits and attributed their preference to the increased comfort and safety of their homes [104, 105]. Importantly, these visits allowed personalized care, improved quality of life [106, 107], and instilled greater confidence and support to patients› family members [108]. Telemedicine was also useful among patients with rare cancers who live far from specialized cancer centers [109].

Conclusion

In the background of global COVID-19 pandemic, with the specific circumstances and complexities of cancer care, the importance of having an organizational structure, planning, resilience, and a shared vision to continue providing patients with cancer treatment is highlighted. Accumulating evidence confirmed the significant impact of COVID-19 infection on cancer diagnosis, prognosis, and therapeutic outcomes. More research is needed to better understand and shape the relationship between COVID-19 and cancer. Further research into the efficacy and safety of COVID-19 treatment approaches in cancer patients is also needed. The risk of COVID-19 recurrence adds to the necessity of developing approaches to improve the management and care of COVID-19-positive cancer patients. Patients with some specific cancer types, like lung cancer, may have their clinical situation worsened owing to the SARS-CoV-2 virus's propensity for lung cells. Additionally, COVID-19 infection in malignancies that directly influence the immune system, like leukemia, lymphomas, and multiple myeloma, could represent a challenge in management. The management of cancer patients should be continued during the pandemic as the benefit outweighed the risk of infection, but modifications of treatment is advised. Cancer patients are

being protected in most current recommendations by limiting the access to hospital environs to those who are in dire need, and shifting for treatment strategies with less in-patient admission and exposure to infection. Although there are limited clinical data on COVID-19, it is known that social distance and the reinforcement of enhanced hygiene practices, such as hand washing, are the best ways to avoid it. Vaccines provide promise in reducing the impact of COVID-19 on cancer patients who are at risk from emerging virus strains. However, there are still certain limitations to consider, such as the efficiency of COVID vaccinations in immunocompromised patients, and potential vaccine-cancer interactions.

Conflict of interest

The authors have no conflicts of interest to declare.

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Author contributions

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