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Radiation therapy services during the COVID-19 pandemic

Relevance: The outbreak of a new respiratory disease SARS CoV-2 (COVID-19), reported by China in December 2019, significantly impacted cancer treatment. However, modern radiotherapy techniques remain in use during the COVID-19 pandemics. They include intensive modulated radiation therapy (IMRT, VMAT), image-guided radiation therapy (IGRT), stereotactic radiosurgery, and radiotherapy (SRS and SRT).

The research aimed to compare the techniques used and the throughput of the linear accelerator before and during the COVID-19 pandemics.

Results: The results were measured during nine months of operation of Almaty Oncology Center before the pandemic (April-December 2019) and the similar period during the pandemic in 2020. The amount of high-tech radiotherapy services provided before and during the COVID-19 pandemic equaled to (amount of sessions/ number of patients): conformal (3D) radiotherapy – 6510/335 vs. 6005/286; IGRT – 9171/524 and 8977/551; IMRT and VMAT – 4208/190 vs. 5992/287.

The share of more complex methods of radiation therapy (IMRT, VMAT) has increased from 39.3% of sessions before the COVID-19 pandemic to 49.9% during the pandemic. The number of SRS and SRT procedures performed/patients served has also increased from 14/6 to 47/13.

The average amount of services per patient before and during the COVID-19 pandemic has changed as follows: conformal radiation therapy – from 19.4 sessions to 21.0, IMRT and VMAT – from 22.1 to 20.9, IGRT – from 17.5 to 16.3.

Conclusion: During the COVID-19 pandemic, there was no decrease in the amount of radiotherapy services provided; the use of more high-tech radiotherapy techniques has increased 1.4 times.

Keywords: Radiation therapy, pandemic, COVID-19, cancer, linear accelerator.

Introduction: In December 2019, China informed WHO of a new respiratory tract disease caused by SARS CoV-2 (COVID-19, severe acute respiratory syndrome coronavirus-2 [1]. This acute infectious disease with an aerosol-drop-let and contact-household transmission mechanism and tropism for lung tissue is caused by a new virus strain from the SARS CoV-2 genus of coronaviruses [2]. A rapid global spread of the infection – more than 7360200 confirmed cases of the disease and 416,000 deaths as of June 11, 2020 [3] – has prompted the WHO to declare a pandemic at the beginning of March 2020 [4]. Due to the limited testing capabilities of truly global infection rates and mortality, there are probably many more actual confirmed cases [5]. The fear and anxiety caused by the COVID-19 outbreak led to a significant shift in cancer care: hospitals have reduced patient visits and introduced telemedicine, postponed surgery, systemic and radiation therapy (RT), and routine follow-up [6]. Unfortunately, epidemiological data indicate that the pandemic will continue for months, if not years [7]. According to world research data, patients with cancer have a higher risk of contracting COVID-19 [8]. In addition, many cancer guidelines recommend changes in the practice of specific anticancer therapy to minimize immune

compromise effects that can predispose to serious complications during a pandemic [9]. According to a nationwide analysis conducted in China, chemotherapy or surgery was associated with a higher risk of clinically severe COVID-19 events in cancer patients compared to those who received no chemotherapy or surgery (75% vs. 43%, $p = 0.0026$) [10]. The only treatment that can be safely applied with a relatively low effect on the immune system is RT since almost 50-60% of cancer patients ultimately need RT throughout their lives [11, 12]. The delay in chemotherapy and surgery raises the importance of RT in treating many types of cancer. The up-to-date RT techniques and radiation therapy such as intensive-modulated radiation therapy (IMRT, VMAT), image-guided radiation therapy (IGRT), stereotactic radiosurgery (SRS), and stereotactic radiotherapy (SRT), remain relevant during the COVID-19 pandemics.

The research aimed to compare the techniques used and the throughput of the linear accelerator before and during the COVID-19 pandemics.

Materials and methods: This full-design retrospective study involved 1086 patients of the radiation therapy day hospital of the Almaty Oncology Center (Almaty, Kazakhstan). Of the, 535 patients were treated before the

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COVID-19 pandemics, and 551 patients – during the pandemics. The results were measured during nine months of operation of Almaty Oncology Center before the pandemic (April-December 2019) and the similar period during the pandemic in 2020.

Patients received five fractions per week on a TrueBeam STx ver. 2.7 linear accelerator (Varian, USA) (Figure 1).

The study was conducted in accordance with the ethical principles of the Helsinki Declaration of Patient Safety and Good Clinical Practice procedures.

Figure 1 – Radiological Department of the Almaty Oncology Center with a TrueBeam STx linear electron accelerator

Results and Discussion:

In total, 10718 RT sessions were provided in April-December 2019 vs. 11997 (+11.9%) sessions over nine months during the pandemic. The amount of high-tech radiotherapy services provided before and

during the COVID-19 pandemic equaled to (amount of sessions/ number of patients): conformal (3D) radiotherapy – 6510/335 vs. 6005/286; IGRT – 9171/524 and 8977/551; IMRT and VMAT – 4208/190 vs. 5992/287 (Figure 2).

Figure 2 – Distribution of patients who received radiation treatment, by the method of treatment, in similar periods before and during the COVID-19 pandemics

The share of more complex methods of radiation therapy (IMRT, VMAT) has increased from 39.3% of sessions before the COVID-19 pandemic to 49.9% during the pandemic. The number of SRS and SRT procedures performed/patients served has also increased from 14/6 to 47/13.

The average amount of services per patient before and during the COVID-19 pandemic has changed as follows: conformal radiation therapy – from 19.4 sessions

to 21.0, IMRT and VMAT – from 22.1 to 20.9, IGRT – from 17.5 to 16.3.

In 2020, we introduced the VisualCarePath (Varian, USA) algorithm to improve patient safety, organize their staged preparation for RT, and arrange paperless communication between RT specialists. During the COVID-19 pandemics, this allowed to improve the operation of RT specialists and reduce the number of patient visits.

Figure 3 – VisualCarePath algorithm stages for preparing a patient for radiation treatment

Conclusions: During the COVID-19 pandemic, there was no decrease in the amount of radiotherapy services provided; the use of more high-tech radiotherapy techniques has increased 1.4 times.

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ТҰЖЫРЫМ

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COVID - 19 пандемия кезіндегі сәулелік терапия қызметі

Өзектілік: 2019 жылдың желтоқсан айында Қытай жаңа тыныс алу жолдарының ауруы SARS CoV-2 (COVID-19) туралы жариялады, соның нәтижесінде қатерлі ісіктерді емдеу бірқатар маңызды өзгерістерге ұшырады. COVID - 19 пандемиясы кезінде сәулелік терапияның заманауи әдістерін қолдану жалғасуда: интенсифицирленген сәулелік терапия (IMRT, VMAT), кескіндеумен басқарылатын сәулелік терапия (IGRT), стереотаксикалық радиохирургия және сәулелік терапия (SRS және SRT).

Зерттеудің мақсаты: COVID-19 пандемиясына дейін және оның барысында қолданылатын әдістер мен сызықтық үдеткіштің өткізу қабілетін салыстыру.

Нәтижелер: Нәтижелер пандемия жарияланғанға дейін (2019 жылғы сәуірден бастап 2019 жылғы желтоқсанға дейін) және онымен қатар, COVID-19 пандемиясы жарияланғаннан кейін 2020 жылдың дәл осы кезеңінде Алматы онкология орталығының 9 айдағы жұмысы кезінде өлшенді. COVID-19 пандемиясына дейін сәулелік терапияның жоғары технологиялық қызметтерінің келесі саны орындалды (сеанстар саны/пациенттер саны): конформды (үш өлшемді) сәулелік терапия – 6510/335 және 6005/286, IGRT-9171/524 және 8977/551, IMRT және VMAT-4208/190 және 5992/287.

Сәулелік терапияның өте күрделі әдістерінің (IMRT, VMAT) үлесінің артуы байқалады: пандемияға дейін 39,3% сеанстан бастап, пандемия кезінде - 49,9% дейін. SRS және SRT-ге қатысты, көрсетілген процедуралардың қызмет көрсетілген емделушілердің саны көбейді: 14/6-дан 47/13 дейін.

COVID-19 пандемиясына дейін және оның барысында бір пациентке көрсететін қызметтердің орташа саны келесідей өзгерді: конформды сәулелік терапия бойынша-19,4 сеанстан 21,0 сеансқа дейін, IMRT және VMAT – 22,1 сеанстан 20,9 сеансқа дейін, IGRT-17,5-тен 16,3-ке дейін.

Қорытынды: COVID-19 пандемиясы кезінде сәулелік терапия қызметтерінің көлемінің төмендеуі болмады; жоғары технологиялық сәулелік терапия әдістері қызметтерінің 1,4 есеге өскені байқалды.

Түйінді сөздер: Сәулелі терапия, пандемия, COVID-19, ісік, сызықты үдеткіш.

АННОТАЦИЯ

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Услуги лучевой терапии во время пандемии COVID-19

Актуальность: В декабре 2019 года Китай сообщил о новой болезни дыхательных путей SARS CoV-2 (COVID-19), в результате чего лечение онкологических заболеваний претерпело ряд значительных изменений. Во время пандемии COVID-19 продолжают применяться современные методики лучевой терапии: интенсифицированная лучевая терапия (IMRT, VMAT), лучевая терапия управляемая по изображениям (IGRT), стереотаксическая радиохирургия и радиотерапия (SRS и SRT).

Цель исследования: сравнить используемые методики и пропускную способность линейного ускорителя до и во время пандемии COVID-19.

Результаты: Результаты были измерены за 9 месяцев работы Алматинского онкологического центра до объявления пандемии (с апреля 2019 по декабрь 2019 года) и за аналогичный период 2020 года после объявления пандемии COVID-19. До и во время пандемии COVID-19 было оказано следующее количество услуг высокотехнологичной лучевой терапии (количество сеансов/ количество пациентов): конформная (трехмерная) лучевая терапия – 6510/335 и 6005/286, IGRT – 9171/524 и 8977/551, IMRT и VMAT – 4208/190 и 5992/287.

Отмечается повышение удельного веса более сложных методик лучевой терапии (IMRT, VMAT): с 39,3% сеансов до пандемии до 49,9% во время пандемии. В отношении SRS и SRT, также увеличилось количество оказываемых процедур/обслуженных пациентов: с 14/6 до 47/13.

Среднее количество услуг на одного пациента до и во время пандемии COVID изменилось следующим образом: конформной лучевой терапии – с 19,4 сеанса до 21,0 сеанса, IMRT и VMAT – с 22,1 до 20,9 сеансов, IGRT – с 17,5 до 16,3.

Заключение: Во время пандемии COVID-19 не произошло снижения объема оказанных услуг лучевой терапии; отмечено увеличение применения более высокотехнологичных методик лучевой терапии в 1,4 раза.

Ключевые слова: лучевая терапия, пандемия, COVID-19, рак, линейный ускоритель.