**Advances in Radiation Oncology**

A call for new 4R's based Radiation Oncology model in COVID-19 Pandemic

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Abstract:
A call for new 4R’s based Radiation Oncology model in COVID-19 Pandemic

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We are in the midst of an unprecedented crisis worldwide. Since its first reports in China on 31st December 2019, it spread extensively across the globe. As of 4th April 2020, over 1100,000 cases and over 60000 deaths are reported worldwide. These numbers continue to rise exponentially and the healthcare system is strained to maximum. Immunocompromised and elderly individuals are susceptible to COVID19 with a higher risk of mortality. Data shows an aggressive course of COVID19 and over 3 times higher risk of death in cancer patients. The Healthcare system is under enormous pressure to deal with this constantly changing and ever-evolving crisis. Several countries and provinces are reallocating resources and prioritizing available options in this emergency. Radiation Oncology is an integral part of Cancer care and expected to face significant challenges in the coming weeks as COVID19 continues to impact our lives.

Classical Radiation oncology is based on 4 classical Rs of repair, reassortment, repopulation and reoxygenation. In the COVID-19 pandemic and global emergency, we suggested 4 new R based radiation oncology model mitigate the impact of the current pandemic on our patients and cancer centers. The new 4R’s include [1] Remote / ViRtual care (reduce in-person consult / follow up / on treatment visits) [2] Ration radiation (offer radiation wisely and avoid RT where minimal benefit) [3] Rational defeRring of radiation (as appropriate) [4] Reduce fractions / hypofRactionate radiation (where applicable)

Significant emphasis is placed on minimizing in-person visits for patients and several Canadian provinces adopted Remote / viRtual care as a standard model in the current emergency. This will help minimize patient visits to the hospital and thus the risk of infection.
Radiation Oncologists should wisely Ration radiation and avoid radiation in cases where there is a minimal or questionable benefit. Favourable Ductal carcinoma in situ\(^9\) (mammographically detected, <2.5cm in size, low-intermediate grade, adequate resection margins), favourable lowgrade invasive breast carcinoma\(^10\) (age 70 years and older, primary <=3cm with negative resection margins, estrogen receptor +, node-negative and eligible to receive endocrine therapy), low-volume favourable intermediate-risk prostate carcinoma\(^11\) may be appropriate for active surveillance. There are several such potential scenarios where avoiding radiation should be strongly considered.

We should also diligently assess options of Rational deferRing of radiation as appropriate based on the clinical scenario. Ductal carcinoma in situ and invasive breast carcinoma could be safely delayed up to 12 weeks.\(^{12-14}\) Favourable intermediate-risk prostate cancer and unfavourable intermediate-risk prostate cancer could defer radiation for 3-4 months or longer. Androgen deprivation therapy could be used as a temporizing measure for radiation deferral in appropriate cases such as unfavourable intermediate-risk and high-risk prostate cancer.\(^{15-16}\)

In these unusual times, the use of reduced fractions/hypofractionation regimens is strongly recommended. Pre COVID19 era, for various reasons, the use of hypofractionated, was highly variable across the world despite supportive data. There is enough data to practice this regimen safely for common cancer sites as prostate, breast, rectum, lung and even palliative situations.\(^7,17,18,19,20,21,22\) The use of hypofractionated and ultra hypofractionated radiation could save potential 10-20 visits, thus lower the risk of infection and even mitigate the risk of treatment breaks and allow the radiation facilities with reduced manpower. With the expected resource and manpower constraints, this
model is gaining popularity. A clinical scenario where boost radiation adds minimal benefits to the outcomes is also another potential opportunity to reduce the number of fractions. Judicious resource allocation is paramount and hypofractionation regimens serve a vital purpose.

We used this model and proposed thoracic cancer specific provincial consensus. Prostate and breast cancer specific radiation guidelines were recently proposed. The new 4 R based model framework could help the several other disease site group design and use site-specific policies. This would help global radiation oncology community use the constrained resources efficiently, function and fight better, and ultimately flatten the curve of COVID-19 pandemic. May we all emerge victoriously.

REFERENCES:


8. Virtual care in Canada
https://www.cma.ca/sites/default/files/pdf/News/Virtual_Care_discussionpaper_v2EN.pdf


12. Shurell E, Olcese C, Patil S, McCormick B, Zee KJV, Pilewskie ML. Delay in radiotherapy is associated with an increased risk of disease recurrence in women with


schedule of whole breast radiotherapy compared with a standard 3-week regimen delivered in the UK FAST-Forward Trial. Radiother Oncol 2016;120: 114–118. doi: 10.1016/j.radonc.2016.02.027.


