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Assessment of Side Effects of Radiation Therapy in Patients With COVID-19 Treated for Early-Stage Breast Cancer

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Purpose/Objective(s): The Covid-19 caused by the SARS-COV-2 coronavirus is at the origin of a global pandemic. This pandemic has prompted the current health system to reorganize and rethink the care offered by health establishments. We report the early and late toxicity in patients infected with COVID-19 treated at the same time for early-stage breast cancer (BC) toxicity.

Materials/Methods: This is a monocentric prospective study of patients treated in our hospital between March and June 2020. The monocentric registry was created for all cancer patients who were diagnosed with COVID 19 infection. The inclusion criteria of the patients evaluated were to be irradiated for early-stage breast cancer and to have a positive COVID diagnosis on a PCR test and / or a lung computed tomography (CT) scan and / or suggestive clinical symptoms. All of them needed 6 months follow up clinic after the end of the radiotherapy with clinical examination, mammogram, as well as CT scan to evaluate the lung status. Radiotherapy (RT) consisted of 50 Gy to the breast or chest wall with or without lymph node irradiation, as well as hypofractionated schemes adapted to pandemic situation. The treatment-related toxicity was graded according to the CTCAE (version 4.03).

Results: Three hundred fifty patients (pts) have been treated for early-stage BC in our Department between 03/2017 and 06/2020. Of them, 16 were presented with clinical symptoms of COVID 19 infection and of them 12 had clinical, CT scan and PCR confirmation. This entire cohort of 12 pts with median age of 56 (42-72) underwent their RT. All patients were invited to realize CT scan 6 months after the end of RT and to come in the hospital for clinical and radiological evaluation. During the radiotherapy, there were 9 pts presented radio dermatitis, of the 8 (66%): grade 1 and one (8%) grade 2. Two patients treated to the regional lymph nodes presented esophagitis de grade 2. The late toxicity as well as the lung radiological evaluation was realized 6 months after the end of the radiotherapy and there was no RT or COVID lung sequel on the CT scans. There was one patient who presented COVID related dyspnea, and 2 patients with post treatment fibrosis.

Conclusion: The half-year follow-up of prospective COVID19+ cohort, treated for early-stage BC demonstrated an acceptable toxicity profile with few low-grade adverse events. It seems that the COVID 19 infection does not appear to increase the side effects of RT. Therefore, the RT should not be delayed.

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Cardiac Substructure Delineation Based on Synthetic Contrast-Enhanced CT Generation Using Deep Convolutional Neural Network in Breast Cancer Radiation Therapy

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Purpose/Objective(s): Although radiation-induced cardiac toxicity is an important issue in breast radiation therapy (RT), the dose relationship between cardiac structures and its toxicity has not been fully elucidated, partially because many centers do not routinely administer intravenous (IV) contrast for breast RT, which preclude substructure delineation and detection of potential correlations. In this study, we attempted to generate the synthetic contrast-enhanced CT ($CECT_{syn}$) from the non-contrast CT (NCT_{real}) using deep convolutional neural network (DCNN) and to investigate whether $CECT_{syn}$ can take a supportive role in case the studies for the cardiac toxicity induced by radiation is needed for the patient whose $CECT_{real}$ cannot be obtained.

Materials/Methods: For this study, 22 NCT_{real}-$CECT_{real}$ cardiac scan-pairs have been prepared of which the volume size was $\sim 512 \times 512 \times 400$ and the resolution was $\sim 0.75 \times 0.75 \times 1$ mm^3 on average. Of the 22 data-sets, 13/2/7 were used for training, validation, and testing, respectively. After matching the structure of paired scans using the deformable image registration (DIR), the area near the heart was cropped and used for training the deep learning model. We adopted the modified 2D fully convolution DenseNet (FC-DenseNet) as our backbone and trained it in the conditional generative adversarial network (cGAN) framework. The similarity between $CECT_{syn}$ and $CECT_{real}$ was evaluated first, and all NCT_{real}, $CECT_{syn}$, and $CECT_{real}$ were applied to pre-trained cardiac auto-segmentation models to obtain the substructures of the heart, which is used for dose assessments in each of them. Finally, dose evaluations were conducted on $CECT_{syn}$ and $CECT_{real}$ with the dose distributions which are from clinical treatment plans and the manually modified contours of cardiac substructures.

Results: Firstly, the peak signal-to-noise ratio (PSNR) and the structural similarity index measure (SSIM) between $CECT_{syn}$ and $CECT_{real}$ were 23.96 and 0.772, whereas those of NCT_{real} and $CECT_{real}$ were 22.25 and 0.748, respectively. Secondly, the results of applying the pre-trained cardiac auto-segmentation model were obtained, and the dice similarity coefficient (DSC) of $CECT_{syn}$ was 0.762 on average which is superior to 0.267 of NCT_{real} and comparable to 0.843 of $CECT_{real}$. We could distinguish the L/R ventricles, L/R atriums, left anterior descending artery (LAD), and right coronary artery (RCA) clearly on $CECT_{syn}$. Finally, the dose differences between $CECT_{syn}$ and $CECT_{real}$ were on average 0.4/2.0 Gy in D_{mean} and D_{max}, and 2.1/1.3/0.6/0.4/0.3/0.1/0.0% in V5 Gy, V10 Gy, V20 Gy, V30 Gy, V40 Gy, V50 Gy, and V60 Gy, respectively.

Conclusion: DCNN model proposed here showed the feasibility of $CECT_{syn}$ generation from NCT_{real} and potential for cardiac substructure delineation such as ventricles, atriums, LAD, and RCA on NCT_{real} for breast RT. Furthermore, it is shown that $CECT_{syn}$ can play a supportive role when the studies for the radiation-induced cardiac toxicity is needed.

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Predictors of Acute Radiation Dermatitis and Esophagitis in African American Patients Receiving Whole Breast Radiotherapy

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Purpose/Objective(s): Adjuvant whole breast radiotherapy following breast conserving surgery is standard of care in the management of early-stage breast cancer. Two common acute toxicities of breast radiotherapy are esophagitis and dermatitis. African Americans are at higher risk for experiencing treatment-related toxicity and are often under-represented in clinical trials. This study investigates clinical factors associated with increased incidence of Grade 2+ radiation esophagitis (G2RE) and dermatitis (G2RD) in African American breast cancer patients undergoing adjuvant breast radiotherapy.

Materials/Methods: An institutional database was developed to include all African American patients with history of breast cancer or DCIS undergoing adjuvant radiotherapy at a single institution from 2013-2019. Records were reviewed to identify patient age, BMI, radiation dose, prone vs supine position, inclusion of boost, and inclusion of regional nodal irradiation (RNI). Radiation treatment plans were reviewed to identify breast size, and volume of breast receiving > 105% and > 107% prescription dose (V105%, V107%). For the subset of patients who received RNI, esophageal dosimetry was reviewed to identify mean/max dose to esophagus (Dmean/Dmax) and volume of esophagus receiving 5 Gy, 15 Gy, 25 Gy, 35 Gy, and 45 Gy (V5 Gy, V15 Gy, V25