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Radioterapia Oncologica: l'evoluzione al servizio dei pazienti

RESPIRATORY MANAGEMENT FOR LEFT-SIDED BREAST CANCER RADIOTHERAPY: PRELIMINARY DATA FROM AN ARTIFICIAL INTELLIGENCE ORIENTED DECISION PROCESS

C. Giandini[1], M. Lualdi[2], R. R. Colciago[1], S. Meroni[2], A. Cavallo[2], E. Pignoli[2], M.C. De Santis[1], L. Lozza[1]

1. Radiation Oncology, Fondazione IRCCS Istituto Nazionale dei Tumori, Milano
2. Unit of Medical Physics, Fondazione IRCCS Istituto Nazionale dei Tumori, Milano

Associazione Italiana
Radioterapia e Oncologia clinica

DICHIARAZIONE

Relatore: Carlotta Giandini

Come da nuova regolamentazione della Commissione Nazionale per la Formazione Continua del Ministero della Salute, è richiesta la trasparenza delle fonti di finanziamento e dei rapporti con soggetti portatori di interessi commerciali in campo sanitario.

- Posizione di dipendente in aziende con interessi commerciali in campo sanitario **(NIENTE DA DICHIARARE)**
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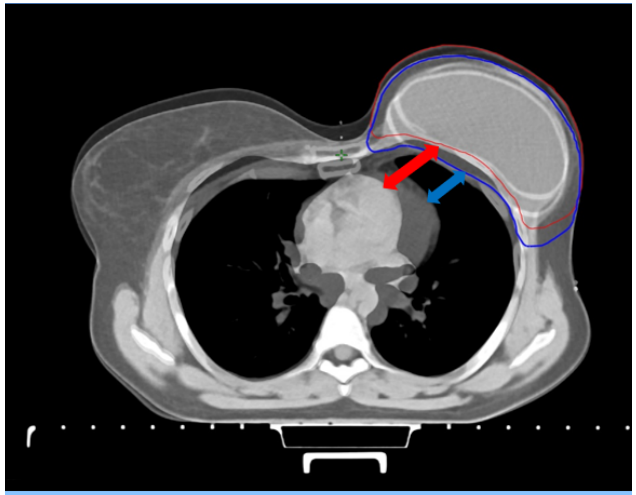
- Altro

INTRODUCTION

- Thoracic acute OARs toxicities and risk of secondary cancer for breast cancer (BC) radiotherapy (RT)
- OARs sparing is still a concern, especially for left-sided BC (LSBC) when using the traditional free breathing (FB) technique

POSSIBLE SOLUTIONS?

Dose optimization by reducing physiological organ motion → **Deep Inspiration Breath Hold (DIBH)**: patient inspiring to a specified pre-acquired threshold and then holding that level of inspiration while radiation is delivered → Favorable anatomical condition in the chest area, by increasing the space between the target volume and the heart



Red: DIBH, **Blue:** Free Breathing

Courtesy of Unit of Medical Physics, Fondazione IRCCS Istituto Nazionale dei Tumori, Milano

PITFALLS

- Not necessarily every patient benefits from a DIBH technique vs standard (FB)
- To select the most suitable technique for each LSBC patient acquiring two different simulation CT scan is usually needed
- This leads to double contouring time for the physician and double planning time for the medical physicist → **TIME CONSUMING!**
- Choosing between these techniques in case of dosimetric equivalent plans could be challenging for the radiation oncologist if only based on clinical experience

AIMS

- To build an automated decision-making model to select the most suitable treatment between DIBH and FB techniques in the setting of adjuvant radiotherapy for left-sided breast cancer (LSBC) with Volumetric Modulated Arc Therapy (VMAT)

MATERIALS AND METHODS 1

- Dosimetric data from VMAT DIBH and FB rival plans were retrospectively retrieved for 50 patients (pts) treated sequentially with adjuvant radiotherapy for LSBC.
- Risk of acute and late treatment-related clinically relevant toxicities was assessed by employing NTCP (Normal Tissue Complication Probability) models.
- Endpoint of NTCP models were lung pneumonitis and fibrosis, acute coronary events (ACE) and secondary lung and breast cancer.

MATERIALS AND METHODS 2

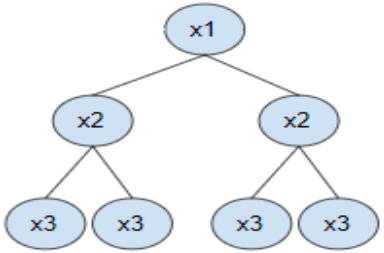
- Clinical data regarding cardiovascular risk factors (CRF - blood pressure, blood cholesterol levels, smoking and diabetes history) were also retrieved and combined in a **global Atherosclerotic Cardiovascular Disease (ASCVD) score.**
- Models features consisted of **relevant dosimetric data** (mean dose to: heart, ipsilateral and contralateral lung and, if present, contralateral breast, and dose to 1% of the volume of the left anterior descending coronary artery – LADCA D1%) **+ results of NTCP models + ASCVD scores** for each patient
- A **decision tree (DT) model** and an **artificial neural network (ANN) model** were then constructed to choose between DIBH and FB plans.

RESULTS 1

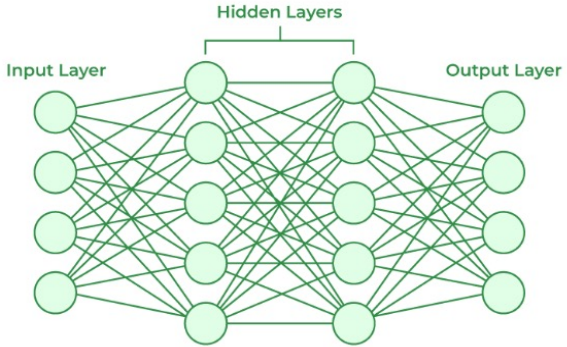
- The analysis was applied to 48/50 patients due to lack of necessary data.
- Delivered dose consisted of 40.05-42.4 Gy/15-16 fractions in 47/50 patients while 3/50 pts received 26 Gy/5 fractions as per Fast Forward schedule.
- **For the selected plans, physicians' choice was DIBH in 40/48 and FB in 8/48 cases respectively, based on clinical experience.**
- Median ASCVD score was 2.4 % (0.2-26.9). In 9/50 pts CRF were not retrievable
- NTCP values were compared with a Wilcoxon test: they were always statistically significant ($p < 0.05$) and in favour of DIBH, except for the risk of secondary ipsilateral lung cancer

RESULTS 2

➢ **After training the models, accuracy in predicting the choice between DIBH e FB plans was tested, resulting in 81% versus 84% for the DT model and the ANN model, respectively.**



DT model diagram: the decision path is linear and very similar to that of the radiotherapist



ANN model diagram:
the decision-making process is non-linear and exploits links between variables that are not always evident to the radiotherapist

DISCUSSION 1

LIMITS OF THIS STUDY:

- Double contouring and planning is still needed to produce dosimetric data required by the model, at least in this preliminary phase
- Small sample of pts and lack of data (best fit approach)
- Unbalance between clinical choice of DIBH vs FB plans → **possible bias in choosing the most technically advanced treatment, especially in younger patients**

DISCUSSION 2

MERITS OF THIS STUDY:

Availability of a mathematical model with objective parameters to make a more impartial choice between DIBH and FB, considering the **practical limits of DIBH** :

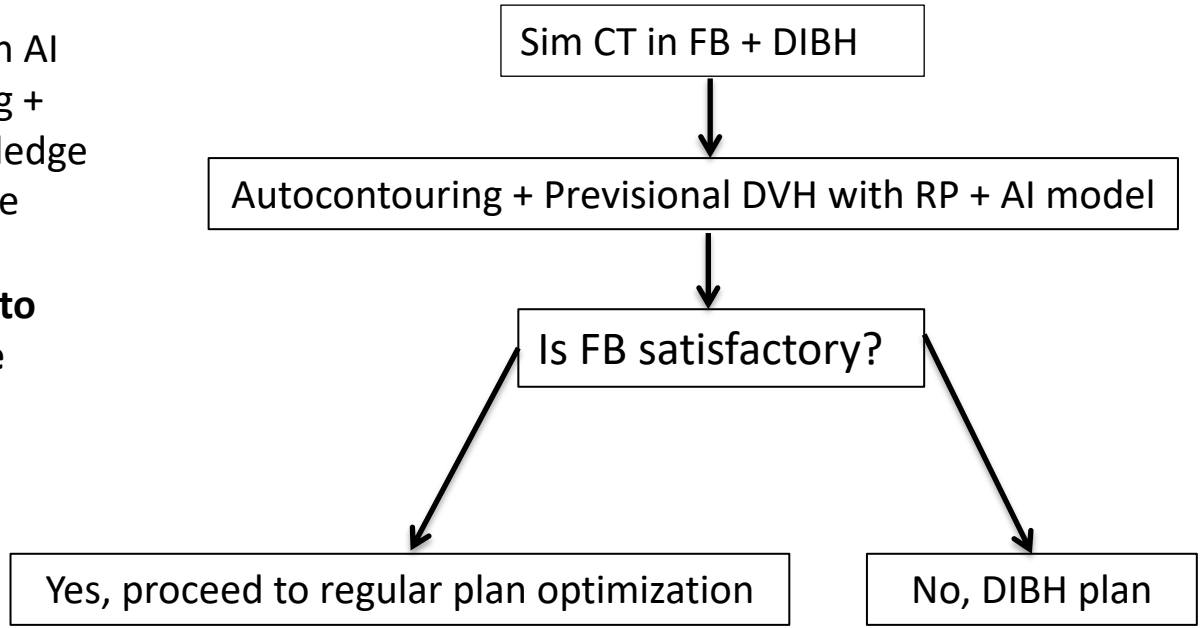
- Larger machine time slot
- Longer treatment time, depending on patients' performance
- Necessity of specific equipment
- Possible patients' discomfort

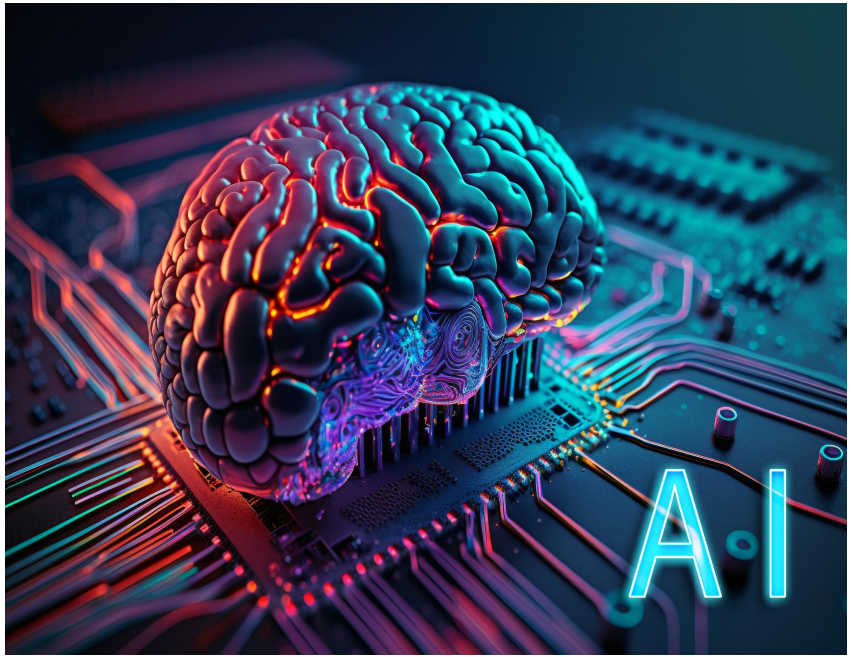
CONCLUSIONS

- Preliminary results for this artificial intelligence (AI) approach to support clinical decisions with objective data look promising.
- Clinical validation in a bigger dataset and further model training are warranted to confirm our results.

FUTURE DIRECTIONS

- **Planning workflow** with AI model + autocontouring + RapidPlan (RP), a knowledge based planning software based on anatomy and chosen field geometry, **to predict beforehand the benefit of DIBH**




AI


THANK
YOU