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MRI IN MEDICAL PRACTICE AND ITS FUTURE USE IN RADIATION ONCOLOGY

RADIOTHERAPY AND IMMUNOTHERAPY IN CANCER

E. Acosta (H. Sant Pau Barcelona)

X. Druet (IC Montpellier)

I. Membrive (Parc de Salut Mar. Barcelona)

L. Tilea (H. Sant Pau Barcelona)

A. Modesto (I. U. du Cancer Toulouse – Oncopole)

I. Linares (ICO-L'Hospitalet)

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MRI IN MEDICAL PRACTICE AND ITS FUTURE USE IN RADIATION ONCOLOGY

1. **MRI in medical practice.**

2. **MRI and Radiotherapy.**

3. **MRI-4D: Control of movement in RT.**

4. **MRI scan fusion (location off head and neck).**

1. MRI in medical practice.

- Diagnosis (liver, ovary, pancreas, rectum and gynecological tumors)
- Staging.
- Response evaluation.

2. MRI and Radiotherapy

- State of art in MRI-guided radiotherapy (RT 3D, IMRT and 4D)
- Simulation with MRI-guided radiotherapy.

Table 1. Difference between MRI diagnostic and MRI simulation

Typical diagnostic MRI	Needs for simulation
Reduced field of view	Full Imaging
Thick slices, interslice spacing, non-axial	Thin, contiguous, axial slices
Artifacts	Limit artifacts
Large field of view distortion	Distortions quantified and mitigated
Auxiliary systems	Mimic RT geometry
Bandwith	High bandwith
Curved couch	Flat tabletop
No lasers	Lasers

2. MRI and Radiotherapy

- Potential indication of MRI-guided radiotherapy.
  - Pancreas
  - Liver tumors
  - Abdominal Tumors
  - Gynecological tumors

3. MRI-4D: Control of movement in RT.

- Liver Stereotactic Radiotherapy Procedure (SBRT).
- Limitations of the current procedure.

4. MRI scan fusion (location off head and neck).

- In 2011, *Martin Dolezel et al*

*(*Planning based on MRI using fusion of CT and MRI data in patients with cervical cancer treated with Brachytherapy 3D)

- In 2011, *Daniel M. Trifiletti et al*

(MRI-based pre-planning in patients with cervical cancer treated with three-dimensional brachytherapy)

- In 2016, *Lauren M. Tait et al*

*(*The use of MRI deformable image registration for CT-based brachytherapy in locally advanced cervical cancer)

MRI IN MEDICAL PRACTICE AND ITS FUTURE USE IN RADIATION ONCOLOGY

Conclusiones:

- Recomendada en algunas guías clínicas para la planificación del tratamiento.

- La fusión (rígida o deformable) de RM y CT es factible para caracterizar mejor ciertos tumores.

- El flujo de trabajo y la forma de obtener la RM deben adaptarse según las condiciones y necesidades de cada centro.

- Software capaz de hacer un registro de calidad rígido o deformable.

- Puede hacer la planificación más precisa, mejorando así la calidad de los tratamientos

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1. **Radiotherapy and Immunotherapy in cancer**

2. **Association of Radiochemotherapy and Immunotherapy in unresectable Oesophageal cancer: ARION a multicentric randomized phase II trial**
   IMRT 50 Gy + FOLFOX 6 cycles +/- anti PD-L1 (Durvalumab) during RT-CT and as adjuvant treatment (1 year)

3. **Immunotherapy and Radiotherapy in Melanoma**

4. **Translational research ICO**

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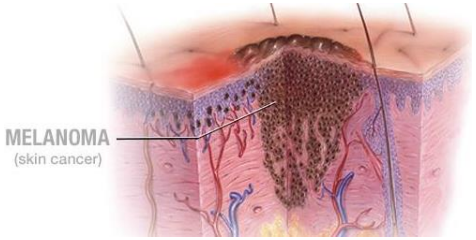

3. Immunotherapy and Radiotherapy in Melanoma

Phase I studies

- Pembrolizumab and Stereotactic Radiosurgery (SRS) for Melanoma or Non-Small Cell Lung Cancer Brain Metastases
  - pembrolizumab at day 1 and every 3 weeks for at least 2 years
  - three radiotherapy prescriptions compared: 6Gy x 5 fractions, 9 Gy x 3 fractions, 18-21 Gy x 1 fraction

- SRS and Nivolumab in Treating Patients With Newly Diagnosed Melanoma Metastases in the Brain or Spine
  - nivolumab at day 1 and then each 14 days and SRS at day 8

- A Pilot Study to Evaluate the Safety and Efficacy of Combination Checkpoint Blockade Plus External Beam Radiotherapy in Subject With Stage IV Melanoma
  - ipilimumab + nivolumab each 3 weeks for 4 doses, followed by nivolumab in monotherapy each 2 weeks
  - RT given between first and second dose. Two fractions compared: 30 Gy in 10 fractions and 27 Gy in 3 fractions

- Study of Radiotherapy Administered in Combination With Ipilimumab in Patients With Unresectable Stage III of Stage IV Advanced Malignant Melanoma
  - Ipilimumab given at first, fourth, seventh and tenth week and then from week 24 each 12 weeks
  - Four fractions of RT compared: 9 Gy in 3 fractions, 15Gy in 3 fractions, 18 Gy in 3 fractions, 24 Gy in 3 fractions.

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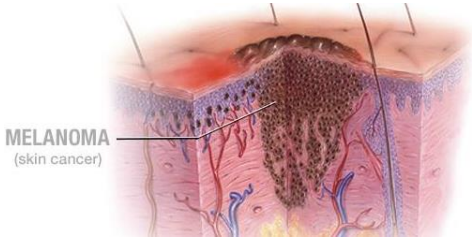
3. Immunotherapy and Radiotherapy in Melanoma



Phase II studies

- Concurrent Ipilimumab and Stereotactic Ablative Radiation Therapy (SART) for Oligometastatic But Unresectable Melanoma
  - ipilimumab plus SART followed by ipilimumab each 3 weeks for 24 weeks and then each 3 months

- Nivolumab Plus Radiotherapy in Advanced Melanoma
  - hypofractionated radiotherapy (3 x 6 Gy) in combination with nivolumab, compared with nivolumab alone

- SBRT Followed by Ipilimumab in Treating Patients With Stage IV melanoma
  - 3 fractions of SBRT and afterwards ipilimumab each 3 weeks for 4 doses

- GEM STUDY: Radiation And Yervoy in Patients With Melanoma and Brain Metastases
  - Ipilimumab each 3 weeks for 4 doses
  - RT given between first and second dose in 10 fractions of 3 Gy

RADIOTHERAPY AND IMMUNOTHERAPY IN CANCER

4. Translational research ICO

- INTRABEAM: Precision Hypo-fractionated Radiotherapy With a Systemic Immune Response
  - main objective: detect immunological changes in the peripheral blood before and after treatment with IORT
  - patients with breast cancer
  - three groups compared
    - (A) surgery + IORT 20Gy single fraction to the tumour bed
    - (B) surgery + IORT to the tumour bed + EBRT 40,05 Gy in 15 fractions on the whole breast
    - (C) surgery + EBRT 40,05 Gy in 15 fractions on the whole breast and EBRT 9Gy in 3 fractions to the tumour bed
  - lymphocyte phenotype,Treg cells and MDSCs studied with flow cytometry technique
  - circulating cytokines studied with ELISA technique

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4. Translational research ICO

- Immune Modulation by Brachytherapy in Blood and Tumor Microenviorment detection of immune modulation in the peripheral blood and the tumor microenvironment produced by high-dose rate (HDR) brachytherapy and dose pulse dose (PDR) in patients with cervical cancer
  - main objective: to detect immunological changes in peripheral blood and tumor tissue before and after brachytherapy-HDR and brachytherapy-PDR treatment
  - patients with cervical cancer
  - two groups compared:
    - (A) PDR-brachytherapy receiving 30-35 Gy with 0,7-0,7 Gy by pulse (1 implant and 3-4 days of hospitalization)
    - (B) HDR-brachytherapy receiving 21 Gy, 7 Gy by fraction (3 implants, fractions two times a week)
  - biopsies tissues studied with haematoxylin/eosin and immunohistochemistry

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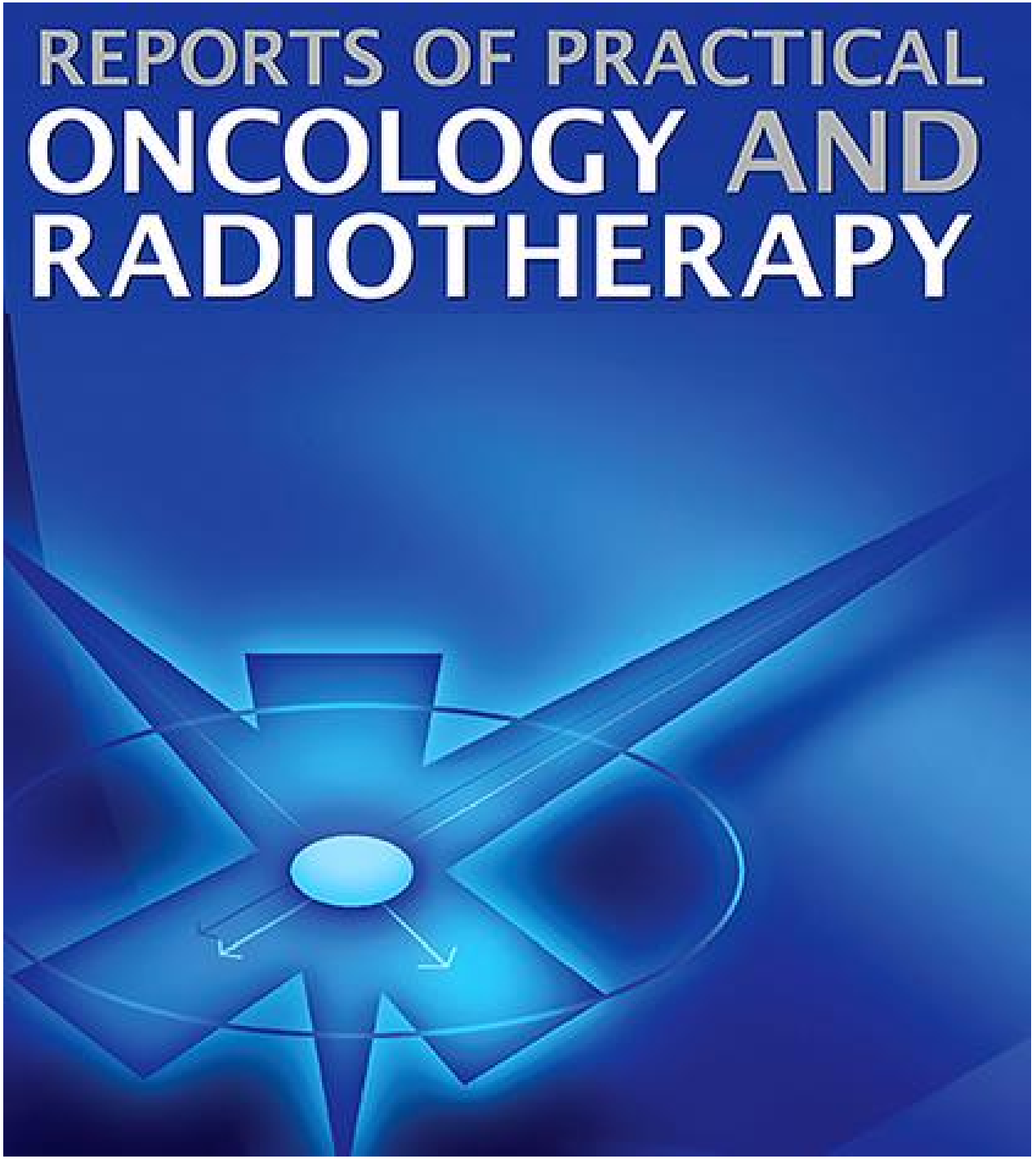
4. Translational research ICO

- Detection of Systemic Immune Response in Peripheral Blood Provided by High Radiation Doses Delivered over the Lung in Stereotactic Condition.
  - phase I pilot study
  - patients with lung cancer
  - different fractions are compared (SBRT)
    - (A) 34 Gy in a single fraction
    - (B) 54 Gy in 3 fractions
    - (C) 50 Gy in 5 fractions
    - (D) 60 Gy in 8 fractions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