Novel Discoveries Using the NCI's Cancer Imaging Archive (TCIA) Public Data Sets
Head and Neck Squamous Cell Carcinoma (HNSCC)

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Along with CME credit, this course offers SAMs credits -
To earn the SAMs credit…

• Have your badge scanned outside the course room & pick up the handout

• Scan the QR code or type in the URL to access the SAM test questions

• All SAM questions must be answered *during the live session*

• Attendees *also need to evaluate and finalize* all course CME credit claims via Credit Eval (access via the RSNA 2018 app or via Meeting Central online) or by contacting eval@rsna.org after Credit Eval closes.

• All SAM credit from the RSNA 2018 Annual Meeting will be able to be claimed until June 1, 2019.

• Questions? Ask the RSNA staff outside the room or contact eval@rsna.org
Overview

• Description of dataset
• Challenges and approaches
• CT-based body composition assessment
• Novel discoveries using this data set
• Future research opportunities
• 215 pts treated for HNSCC at MD Anderson between 2003-2011
• Stage I-IVB (TX, T1-4, N0-3, M0)
• Median follow up: 69.6 mo. (IQR 41.8-88.1 mo)
• Skull-to-thigh non-contrast anonymized CT scans extracted from routine diagnostic and follow up PET/CT scans
• RT Image, RT structure, RT plan, and RT dose exported from Pinnacle³ TPS

Grossberg Sci Data 2018
**GOALS**

- Establish public repository of fully anonymized and registered head and neck radiotherapy diagnostic and treatment data
- Investigate influence of anthropometrics and body composition on outcome in head and neck cancer

**CHALLENGES**

- Anonymization of DICOM from multiple sources (i.e. treatment planning software)
- Registration of many layers of DICOM-RT data
- Identifying and accounting for missing data
- Database management and culling of duplicates
APPROACHES

• ANONYMIZATION
  • RSNA CLINICAL TRIAL PROCESSOR
  • TAG SNIFFER
  • MANUAL REVIEW

• POSDA TOOLS
  • ID ERRORS & INCONSISTENCIES (INCORRECT FIELD ENTRY OR NUMBER OF ENTRIES)
  • DELETE DUPLICATES
  • VERIFY REGISTRATION
  • EXTRACT RESULTS
    195 OF 215 PTS HAD ERRORS
    3.17 REVISIONS/PT (RANGE 2-6)
Imaging assessment of body composition
Cross sectional area

**Skeletal muscle/lean mass**
- single axial slice at **L3**
  - (5 cm above L4/L5)

**Adipose tissue**
- axial slice at **S1**
  - (5 cm below L4/L5)

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Shen J Appl Physiol 2004

**Skeletal Muscle**
- $y = 0.166x + 2.142$
- $R^2 = 0.855$

**Adipose Tissue**
- $y = 0.068x + 4.142$
- $R^2 = 0.927$
Calculate Body Composition

1. Identify L3 Lumbar Level
2. Auto-Contour Skeletal Muscle & Adipose Tissue per HU Threshold
3. Verification MD reviewed
4. Cross-sectional area Muscle (SMI) & adipose (ADI)

Lean body mass (kg)

\[ \text{LBM}_{\text{CT}} = 0.3 \times \text{skeletal muscle CSA (cm}^2\text{)} + 6.06 \]

Fat body mass (kg)

\[ \text{FBM}_{\text{CT}} = 0.042 \times \text{[adipose CSA (cm}^2\text{)]} + 11.2 \]

SM depletion

- Male: SMI < 52.4 cm²/m²
- Female: SMI < 38.5 cm²/m²

Grossberg Sci Data 2018
Weight loss vs muscle loss

Weight-based metrics do not reliably predict underlying body composition.

Skeletal muscle mass normally preserved, except in conditions of cachexia or critical undernutrition.
Depleted Skeletal Muscle Mass in HNC OS, DSS, and LRC in 190 pts treated at MDACC 2003-2013

Skeletal muscle mass (pre- or post-RT) was prognostic for survival, independent of other known risk factors.

Better defined mortality risk than stage, smoking history, HPV status.

Grossberg JAMA Oncol. 2016
Weight Loss not prognostic

Obese patients lost significantly more weight, whereas patients with skeletal muscle depletion preserved their body weight.

Prado *Current Opinion in Supp & Palliative Care* 2009
RESEARCH APPLICATIONS

- **Radiotherapy and Outcome**
  - *Influence of Individual Treatment Design and Delivery on Oncologic and Functional Outcomes*

The diagram illustrates the process from diagnosis to recurrence, including steps for treatment planning and follow-up imaging.
HNSCC COLLECTION
DIAGNOSTIC, TREATMENT PLANNING, AND FOLLOW UP IMAGING FOR HEAD AND NECK SQUAMOUS CELL CARCINOMA PATIENTS TREATED WITH RADIOTHERAPY

RESEARCH APPLICATIONS

• Radiomics
  • Pre- and post-treatment radiomics signatures

Diagnosis
PET, CT DICOM
Intensity
Shape
Texture
Follow Up
PET, CT DICOM
Recurrence
PET, CT DICOM
RESEARCH APPLICATIONS

- **INTERACTION BETWEEN INDIVIDUALS’ TREATMENT FACTORS, RISK FACTORS, AND PHYSIOLOGIC RESERVE**

**Treatment Planning**

<table>
<thead>
<tr>
<th>Baseline Patient Characteristics</th>
<th>N</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years) Mean±SD</td>
<td>60.8±9.70</td>
<td>56.1</td>
</tr>
<tr>
<td>Sex</td>
<td>53 (79.1%)</td>
<td>107</td>
</tr>
<tr>
<td>Male</td>
<td>1 (1.5%)</td>
<td>2</td>
</tr>
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</table>

**RT IMAGE, RT STRUCTURE, RT PLAN, RT DOSE**
RESEARCH APPLICATIONS

- INTERACTION BETWEEN INDIVIDUALS’ TREATMENT FACTORS, RISK FACTORS, AND PHYSIOLOGIC RESERVE

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<tr>
<td>Cancer Site</td>
<td>Nasopharynx</td>
<td>1 (1.5%)</td>
<td>2 (</td>
</tr>
</tbody>
</table>

**Graph**

- Overall survival

- Patients Surviving %

- Time to Event, mo

- No. at risk
  - With normal SM: 123, 118, 105, 98, 88, 70, 60, 32
  - With depleted SM: 67, 62, 52, 46, 45, 37, 32, 18

- HR = 1.92
- 95% CI: 1.19 - 3.11
- Log-rank P = .007
RESEARCH APPLICATIONS

- **Validation data set for dosimetric analyses of H&N cancer radiotherapy**

Diagnosis

PET, CT DICOM

Treatment Planning

RT IMAGE, RT STRUCTURE, RT PLAN, RT DOSE

![Graphs showing overall survival and patients' survival](image-url)
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