Intensity Modulated Radiation Therapy for Nasopharyngeal Carcinoma (NPC)

Tai-xiang Lu, MD
Department of Radiation Oncology
Cancer Center, Sun Yat-sen University
Guangzhou, China
**IMRT Get a Advantage Over 2D-CRT in Treatment of Patients with NPC**

- **Dosimetric Evaluation**
  - Targeting the high dose to the tumor and reduces normal tissue exposure
  - Reduced normal tissue exposure decreases toxicity and permits a safe increase of tumor dose

- **Clinical Research**
  - Improved local-regional control
  - Protected normal tissue
Clinical data
- 2001.2~2006.8
- 400 cases
  - 86 Females and 314 Males
  - The median age was 43 years (range 13~78 years)
  - The median follow-up time 30 months
    (range 6~72 months)
- Stage of disease (2002 6th edition UICC/AJCC)
  - I in 28 cases (7.0%)
  - II in 110 cases (27.5%)
  - III in 192 cases (48.0%)
  - IVa in 70 cases (17.5%)
- Treatment
  - RT only 177 cases (44.3%)
  - RT+CT 223 cases (55.7%)
**IMRT for Patients with Primary NPC in Cancer Center of SYSU**

**Clinical data**

- **T- and N-distribution of the patients**

<table>
<thead>
<tr>
<th></th>
<th>N0</th>
<th>N1</th>
<th>N2</th>
<th>N3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>28</td>
<td>11</td>
<td>3</td>
<td>1</td>
<td>43</td>
</tr>
<tr>
<td>T2</td>
<td>44</td>
<td>55</td>
<td>50</td>
<td>4</td>
<td>153</td>
</tr>
<tr>
<td>T3</td>
<td>33</td>
<td>64</td>
<td>42</td>
<td>2</td>
<td>141</td>
</tr>
<tr>
<td>T4</td>
<td>16</td>
<td>27</td>
<td>19</td>
<td>1</td>
<td>63</td>
</tr>
<tr>
<td>Total</td>
<td>121</td>
<td>157</td>
<td>114</td>
<td>8</td>
<td>400</td>
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</table>
IMRT for Patients with Primary NPC in Cancer Center of SYSU

- Target volume defined and delineated
  - Using CT, MRI and PET/CT

![CT, MRI, PET/CT images with annotations CTV1, GTVnx, GTVnd, CTV2]
**IMRT for Patients with Primary NPC in Cancer Center of SYSU**

- **Dose prescribed to target volumes**
  - $GTV_{nx}$ 68Gy/30fractions.
  - $GTV_{nd}$ 60~66Gy/30fractions.
  - $CTV_1$ 60Gy/30fractions.
  - $CTV_2$ 54Gy/30fractions.

- **Dose limited to normal tissue**
  - Brain stem
  - Spinal cord
  - Parotid
  - TMJ
  - ......

  Maximum dose $<$ TD5/5
**IMRT for Patients with Untreated NPC in Cancer Center of SYSU**

- **DVH delivery to the targets**
  - $\text{GTV}_{\text{nx}}$ 73.3 $\pm$ 2.2Gy/30frs.
  - $\text{GTV}_{\text{nd}}$ 66.2 $\pm$ 2.7Gy/30frs.
  - $\text{CTV}_1$ 68.4 $\pm$ 2.9Gy/30frs.
  - $\text{CTV}_2$ 62.1 $\pm$ 2.2Gy/30frs.

- **DVH delivery to the Critical structures**
  - Brain $D_5$ 46.53Gy(37.59-56.18)
  - Spinal cord $D_{1cc}$ 39.49Gy(30.46-47.52)
  - Left parotid $D_{33}$ 36.47Gy(27.62-53.08)
  - Right parotid $D_{33}$ 36.72Gy(26.75-51.64)
  - Left TMJ $D_{33}$ 34.49Gy(19.99-52.90)
  - Right TMJ $D_{33}$ 34.57Gy(24.57-54.33)
IMRT for Patients with Primary NPC in Cancer Center of SYSU

- Local and regional control rates

Local failure in 11 pts  Regional failure in 9 pts

**Local Control (LC):**
- 1-yr: 98.46%
- 3-yr: 97.74%
- 5-yr: 93.90%

**Regional Control (RC):**
- 1-yr: 98.97%
- 3-yr: 97.42%
- 5-yr: 95.92%
IMRT for Patients with Primary NPC in Cancer Center of SYSU

- Local Control in different T-classification

<table>
<thead>
<tr>
<th>P value</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
</tr>
</thead>
<tbody>
<tr>
<td>T2</td>
<td>0.373</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T3</td>
<td>0.261</td>
<td>0.604</td>
<td></td>
</tr>
<tr>
<td>T4</td>
<td>0.046</td>
<td>0.015</td>
<td>0.071</td>
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</table>
IMRT for Patients with Primary NPC in Cancer Center of SYSU

Local Control in different Volume of GTVnx

<table>
<thead>
<tr>
<th>Volume of GTVnx</th>
<th>P value</th>
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<tbody>
<tr>
<td>≤20cm³</td>
<td>20.01-40cm³</td>
</tr>
<tr>
<td>20.01-40cm³</td>
<td>0.828</td>
</tr>
<tr>
<td>≥40.01cm³</td>
<td>0.023</td>
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</table>
IMRT for Patients with Primary NPC in Cancer Center of SYSU

- Local Control in different doses to GTVnx

<table>
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<tr>
<th>Dose</th>
<th>P value</th>
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<td>≤72Gy</td>
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<tr>
<td>&gt;72Gy</td>
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IMRT for Patients with Primary NPC in Cancer Center of SYSU

Regional Control in different N-classification

<table>
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<th>N2</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1</td>
<td>0.124</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N2</td>
<td>0.433</td>
<td>0.467</td>
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<tr>
<td>N3</td>
<td>0.836</td>
<td>0.685</td>
<td>0.790</td>
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IMRT for Patients with Primary NPC in Cancer Center of SYSU

- Patterns of local and regional failures

- Local failure (11pts)
  - All of 11pts failed in GTVnx

- Regional failure (9pts failed in 13 sites)
  - 4 of 13 in GTVnd (Ⅱb)
  - 6 of 13 in CTV2 (1 in Ⅱa, 2 in Ⅱb, 1 in IV, 2 in V a)
  - 3 of 13 out of target (1 in I b, 2 in superior clavicle)
IMRT for Patients with Primary NPC in Cancer Center of SYSU

- Local failed in GTVnx
IMRT for Patients with Primary NPC in Cancer Center of SYSU

- Regional failed out of target
**IMRT for Patients with Primary NPC in Cancer Center of SYSU**

- **Distant metastases-free survival (DMFS)**

  - 44 pts developed DM
    - To bone in 15pts
    - To lung in 11pts
    - To liver in 4pts
    - To multi-organ in 12pts
    - To other site in 2pts

  - DMFS:
    - 1-yr 92.55%
    - 3-yr 87.86%
    - 5-yr 85.38%
**IMRT for Patients with Primary NPC in Cancer Center of SYSU**

- **DMFS in different N-classification**

<table>
<thead>
<tr>
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<th>N0</th>
<th>N1</th>
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</tr>
</thead>
<tbody>
<tr>
<td>N0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N1</td>
<td>0.170</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N2</td>
<td>0.001</td>
<td>0.045</td>
<td></td>
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<tr>
<td>N3</td>
<td>0.000</td>
<td>0.000</td>
<td>0.001</td>
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*Graph showing DMFS over time for different N stages.*
**IMRT for Patients with Primary NPC in Cancer Center of SYSU**

- **DMFS in different stage**

### P value

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>0.768</td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>0.177</td>
<td>0.032</td>
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<tr>
<td>IV</td>
<td>0.038</td>
<td>0.001</td>
<td>0.089</td>
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![Graph showing DMFS over time for different stages]
IMRT for Patients with Primary NPC in Cancer Center of SYSU

Overall survival rate

- 32pts have died
  - 5pts (15.6%) died of Local-regional failure
  - 25pts (78.1%) died of distant metastasis
  - 2pts (6.3%) died of other reasons

OS:
- 1-yr 97.91%
- 3-yr 90.15%
- 5-yr 86.88%
IMRT for Patients with Primary NPC in Cancer Center of SYSU

Prognostic factors for overall survival

- Gender
- Age ($\leq 45$ yrs, $> 45$ yrs)
- Histopathology (WHO I+II,III)
- T-classification (T1,T2,T3,T4)
- N-classification (N0,N1,N2,N3)
- Stage (I,II,III,IV)
- Treatment (RT, RT+CT)
- GTVnx ($\leq 20cm^3$, 20.1-40cm$^3$, $> 40cm^3$)
- Doses to GTVnx ($\leq 72Gy$, $> 72Gy$)
# Results

<table>
<thead>
<tr>
<th></th>
<th>univariate</th>
<th></th>
<th></th>
<th>multivariate</th>
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<tbody>
<tr>
<td></td>
<td>B</td>
<td>RR</td>
<td>P</td>
<td>B</td>
<td>RR</td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>0.516</td>
<td>1.675</td>
<td>0.176</td>
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<td>--</td>
</tr>
<tr>
<td>Age</td>
<td>0.047</td>
<td>1.048</td>
<td>0.895</td>
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<tr>
<td>Histopathology</td>
<td>-0.160</td>
<td>0.852</td>
<td>0.765</td>
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<tr>
<td>T-classification</td>
<td>0.548</td>
<td>1.729</td>
<td>0.005</td>
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<tr>
<td>N-classification</td>
<td>0.895</td>
<td>2.448</td>
<td>0.000</td>
<td>0.950</td>
<td>2.586</td>
<td>0.000</td>
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<tr>
<td>Stage</td>
<td>0.956</td>
<td>2.602</td>
<td>0.000</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Treatment</td>
<td>0.114</td>
<td>1.121</td>
<td>0.530</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
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<tr>
<td>Volume of GTVnx</td>
<td>0.752</td>
<td>2.120</td>
<td>0.000</td>
<td>0.793</td>
<td>2.210</td>
<td>0.000</td>
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<tr>
<td>Dose to GTVnx</td>
<td>0.027</td>
<td>1.027</td>
<td>0.943</td>
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Conclusions

- High locoregional control for NPC was achieved with IMRT
- Local control was associated with T-classification and volume of GTVnx
- Distant metastases are still the main impact on survival and it was associated with N-classification and Stage
- N-classification and volume of GTVnx were independent prognostic factors for overall survival
谢谢!