Radioterapia stereotassica ipofrazionata a livello extracranico: esperienza dell’Istituto Europeo di Oncologia

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Il 20-25% of the pts are not suitable for surgical intervention: Radiosurgery is an alternative.
New paradigm in oncology: chronic or even chronic curable cancer
MHI-TM2000 alias “VERO-System”

Brainlab AG and Mitsubishi Heavy Industries Ltd

Technical Overview

1. Laser for semi-automatic patient pre-positioning
2. Gimbal mechanism for isocenter calibration and tumor chasing
3. Dynamic micro MLC with low leakage and high drive speed
4. Ring
   - mechanically extremely stable
5. Ring rotation mechanism
   - +/- 60°
   - quick and precise switch from coplanar to non-coplanar treatments
6. EPID
   Electronic Portal Imaging Device for MV x-ray imaging
7. Beam stopper to reduce radiation shielding requirements
8. Patient positioning and diagnostic imaging system „Exactrac© Vero”
9. Couch
   Freedom of motion: 5D (lateral, longitudinal, vertical, roll & pitch)
10. ROBOTICS
    Allows fast robotic tilt adjustment of treatment tabletop for precise patient set-up
11. In-room monitor arm
12. Infrared real-time patient monitoring
Outstanding accuracy is maintained through the adoption of an O-ring shaped mechanical structure offering advantages in rigidity.
**MHI-TM2000 alias “VERO-System”**

- The X-ray head is mounted on a gimbals mechanism that allows fine adjustment of the radiation direction with tilt and pan rotation functions.
- Compact 6 MV linac, 38 cm long and 10 kg in weight.
- The beam delivery system also includes a multileaf collimator with 30 pairs of 5 mm leaves.
- Maximum field size: 15x15 cm.
- Fast treatment planning calculation.
MHI-TM2000 alias “VERO-System”

For IGRT, an (EPID) and two kV X-ray imaging devices with flat panel
MHI-TM2000 alias “VERO-System”
Our experience
From April 2012 to October 2012

Tot. Patients: 245

- Gynaecological cancer: 9 pts
- Prostate cancer: 81 pts
- Lung cancer: 31 pts
- M+ lymph-node: 38 pts
- Others (breast, gastrointestinal, sarcoma, bone): 86 pts
Gynecologic Oncology 120 (2011) 404–412

Gynecologic patients
April 2012- October 2012

• 9 pts (5 cervix boost and 2 pelvic boost after Trilogy 50.4 Gy, 2 radical treatment for recurrence of endometrial cancer)

• Dose: 5 Gy/ 5 fractions = EQD2= 31.3 Gy

... high dose treatment
VERO system (BrainLab/MHI)

Vaginal cuff recurrence
MRI fusion
CT simulation

CBCT

Shift during treatment
Prostate: high precision radiotherapy...

pre-CT era

post-CT era

60 Gy

70 Gy

80 Gy

90 Gy

> 90 Gy?

3D-CRT

IMRT

pre-CT era

post-CT era

60 Gy

70 Gy

80 Gy

90 Gy

> 90 Gy?
Localized prostate cancer

**Table 1. Distribution of pretreatment and treatment parameters by radiation dose group**

<table>
<thead>
<tr>
<th>Variable</th>
<th>&lt;72 Gy (n)</th>
<th>≥72 but &lt;82 Gy (n)</th>
<th>≥82 Gy (n)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical T stage</td>
<td></td>
<td></td>
<td></td>
<td>0.003</td>
</tr>
<tr>
<td>T1-T2</td>
<td>512 (93)</td>
<td>199 (93)</td>
<td>152 (100)</td>
<td></td>
</tr>
<tr>
<td>T3</td>
<td>40 (7)</td>
<td>16 (7)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>iPSA level (ng/mL)</td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>≤4</td>
<td>50 (9)</td>
<td>14 (7)</td>
<td>13 (8)</td>
<td></td>
</tr>
<tr>
<td>&gt;4 to ≤10</td>
<td>233 (42)</td>
<td>135 (63)</td>
<td>112 (74)</td>
<td></td>
</tr>
<tr>
<td>&gt;10 to ≤20</td>
<td>147 (27)</td>
<td>50 (23)</td>
<td>26 (17)</td>
<td></td>
</tr>
<tr>
<td>&gt;20</td>
<td>122 (22)</td>
<td>16 (7)</td>
<td>1 (1)</td>
<td></td>
</tr>
<tr>
<td>bGS</td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>2-6</td>
<td>350 (63)</td>
<td>149 (69)</td>
<td>122 (80)</td>
<td></td>
</tr>
<tr>
<td>7-10</td>
<td>202 (37)</td>
<td>66 (31)</td>
<td>30 (20)</td>
<td></td>
</tr>
<tr>
<td>Risk group</td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Low</td>
<td>161 (29)</td>
<td>96 (45)</td>
<td>99 (65)</td>
<td></td>
</tr>
<tr>
<td>Intermediate</td>
<td>134 (24)</td>
<td>51 (24)</td>
<td>43 (28)</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>237 (47)</td>
<td>68 (31)</td>
<td>10 (7)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>552 (100)</td>
<td>215 (100)</td>
<td>152 (100)</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: iPSA = pretreatment prostate-specific antigen; bGS = biopsy Gleason score.
Data presented as number of patients, with percentages in parentheses.

“dose escalation”

- dose agli OAR +
- dose al bersaglio
  = ↑ bNED
Dose escalation...why ???

INT. J. RADIATION ONCOLOGY BIOL. PHYS., VOL. 74, NO. 5, PP. 1405–1418, 2009

Fig. 10. Meta-regression analysis for biochemical control as a function of the radiotherapy total dose for all subgroups present in six trials. RTTD = radiotherapy total dose.
Prostata: 70.2 Gy in 26 frazioni da 2.7 Gy/fr
= dose biologicamente equivalente con frazionamento convenzionale di 2Gy/fr
(modello lineare quadratico alfa/beta 1.5 Gy)
= 84.4 Gy

Vescicole seminali: 59.8 Gy in 26 frazioni da 2.3 Gy/fr
= dose biologicamente equivalente con frazionamento convenzionale di 2Gy/fr
(modello lineare quadratico alfa/beta 1.5 Gy)
= 63 Gy
Prostata + vescicole seminali
VERO (IMRT-SIB)

Prostata: 70.2 Gy in 26 frazioni da 2.7 Gy/fr
Vescicole seminali: 59.8 Gy in 26 frazioni da 2.3 Gy/fr
Results: We treated 24 patients with a median follow-up of 24 months. Ten patients started with ADT resulting in a median ADT-FS of 38 months. The 2-year local control and clinical progression-free survival was 100% and 42%, respectively. Eleven and 3 patients, respectively, required a second and third salvage treatment for metachronous low-volume metastatic disease. No grade 3 toxicity was observed. Conclusion: Repeated salvage SBRT is feasible, well tolerated and defers palliative ADT with a median of 38 months in patients with limited bone or lymph node PCa metastases.
Linac-based Stereotactic Body Radiotherapy for Oligometastatic Patients With Single Abdominal Lymph Node Recurrent Cancer

Barbara A. Jereczek-Fossa, MD, PhD,*† Gaia Piperno, MD,* Sara Ronchi, MD,*† Gianpiero Catalana, MD,*‡ Cristiana Fodor, MSc,* Raffaella Cambria, MSc§ Piero Fossati Ing, MD,*†|| Federica Gherardi, MD,* Daniela Alterio, MD,* Dario Zerini, MD,* Cristina Garibaldi, MSc§ Guido Baroni, PhD,|| Ottavio De Cobelli, MD,†# and Roberto Orecchia, MD*†||
Reirradiazione loggia prostatica VERO (IMRT)

Caso clinico:
Recidiva ca prostata dopo chirurgia (2001)
RT salvataggio (2004) 70Gy
SBRT(24Gy) sul Inf iliaco est sx PET+ nel 2010
06/2012: RM pelvi + per ripresa di malattia, biopsia dell’anastomosi positiva

Dose: 25 Gy (5 Gy in 5 frazioni) a giorni alterni

<table>
<thead>
<tr>
<th>organo</th>
<th>Limite dose (1/3 valori constraints Timmerman SBRT ipofrazionata K prostata)</th>
<th>Valori piano di cura</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulbo penierno</td>
<td>Dmax &lt;8 Gy</td>
<td>4 Gy</td>
</tr>
<tr>
<td>Cavità peritoneale</td>
<td>Dmax &lt;20 Gy</td>
<td>0.6 Gy</td>
</tr>
<tr>
<td>Femori</td>
<td>D10cc &lt;6 Gy</td>
<td>5 Gy</td>
</tr>
<tr>
<td>Parete ant retto</td>
<td>Dmax &lt;9 Gy</td>
<td>15 Gy</td>
</tr>
<tr>
<td>Parete post retto</td>
<td>Dmax &lt;4 Gy</td>
<td>4 Gy</td>
</tr>
<tr>
<td>vesica</td>
<td>D10cc &lt; 10 Gy; Dmax &lt; 9 Gy</td>
<td>3 Gy; 14 Gy</td>
</tr>
</tbody>
</table>

Timmerman Sem in radiat oncology 2008, vol 18 n. 4
Isolated lymph node irradiation

Pre and post treatment
LUNG SBRT with VERO

- 1-3 no-coplanar conformal dynamic arcs
- 15-18Gy x 3 fractions
- Individualized margins

Images showing dose distribution and planning in lung SBRT treatment.
LUNG SBRT with VERO

Dose:
8-10 Gy x 4-5 fract
Steroid pre medication
Thank you for your attention