Two-year clinical experience of the carbon-ion pencil-beam fast re-scanning for the treatment of hepatocellular carcinoma

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Purpose

- Since November 2016, our center has started hypofractionated carbon-ion radiotherapy (CIRT) for hepatocellular carcinoma1).
- A combination of carbon-ion pencil-beam fast re-scanning (CI-PBFR) and the gating with a respiratory sensor is employed in our center to accomplish highly precise CIRT.
- We verified the feasibility of this method by confirming the reproducibility of dose distributions using 4D-CT images which were taken at rail-on in-room CT scanner2).
- Herein, we report two-year clinical outcomes of CI-PBFR for the treatment of HCC in our center.

Methods

- Between November 2016 and December 2017
- 27 patients with HCC were treated in our institution.
- Total Dose: 60 Gy (RBE) in 4 fractions
- Overall survival rate (OS) and local control rate (LC) were estimated by Kaplan-Meier method.
- Adverse Events (AE) were evaluated according to Common Toxicity Criteria for AE version 4.

Results

Patient characteristics

Basic characteristics

| Age, years | 74 (63-92) |
| Sex | Male: 22 (82%), Female: 5 (18%) |
| PS | 0: 25 (92%), 1: 1 (4%), 2: 1 (4%) |
| Child-Pugh classification | A(5): 22 (82%), A(6): 2 (7%), B(7): 2 (7%) |
| Not applicable* | 1 (4%) |
| Underlying cause | HBV: 3 (11%), HCV: 10 (37%), Both: 0 (0%), Neither: 14 (52%) |

Tumor characteristics

| Size(cm) | 3.8 (1.0-11.2) |
| Tumors single | 27 (100%) |
| multiple | 0 (0%) |
| Prior treatment history | None: 18 (67%), One: 3 (11%), Two: 3 (11%), Three or more: 3 (11%) |

* warfarin was prescribed

OS and LC

1-yr OS: 92.1%

1-yr LC: 95.5%

Discussion & conclusion

- Our outcomes were in agreement with previous reports3). 1-year OS was 90-92%, 1-year LC was 92-95%.
- Adverse events were tolerable.: No grade 4 or more severe toxicity was observed.
- The combination of CI-PBFR and gating with a respiratory sensor is a promising high precision therapy with tolerability and effectiveness for HCC.

References

1) Minohara S, et al. Technical workflow of respiratory gated irradiation using carbon-ion fast-scanning beam in combination with external respiratory sensor. PTCOG57, May 21-28, 2018, Cincinnati, OH, USA
2) Kusano Y, et al. Dose verification using in-room 4D-CT images for respiratory moving target in carbon-ion pencil beam scanning method. World Congress on Medical Physics & Biomedical Engineering. June 3-8, 2018, Prague, Czech Republic