PTCOG-AO2025-ABS-0098

Carbon Ion versus Photon-based Stereotactic Ablative Radiotherapy for Patients with Choroidal Melanoma

Jina Kim[*,1], Masaru Wakatsuki[2], Shuri Aoki[2], Jong Won Park[3], Nao Kobayashi[2], Ki Chang Keum[3], Hirokazu Makishima[2], Christopher Seungkyu Lee[4], Hitoshi Ishikawa[2], Kyung Hwan Kim[3]

[*,1] Radiation Oncology, Gangnam Severance Hospital, South Korea, [2] Radiation Oncology, QST Hospital, National Institutes for Quantum Science and Technology, Japan, [3] Radiation Oncology, Yonsei Cancer Center, South Korea, [4] Ophthalmology, Yonsei University College of Medicine, South Korea

Objectives

Treatment options for localized choroidal melanoma include either enucleation or eye-conserving approaches such as brachytherapy, proton beam therapy, stereotactic ablative radiotherapy (SABR), or carbon ion radiotherapy (CIRT). SABR allows delivery of high-dose radiation to the target area while minimizing the risk of complications, and the advantages of CIRT include its high linear energy transfer and its sharp penumbra, resulting in superior biological effects in radioresistant tumors including malignant melanoma. In this study, we aimed to compare the treatment outcomes of CIRT and photon-based SABR in patients with choroidal melanoma.

Methods

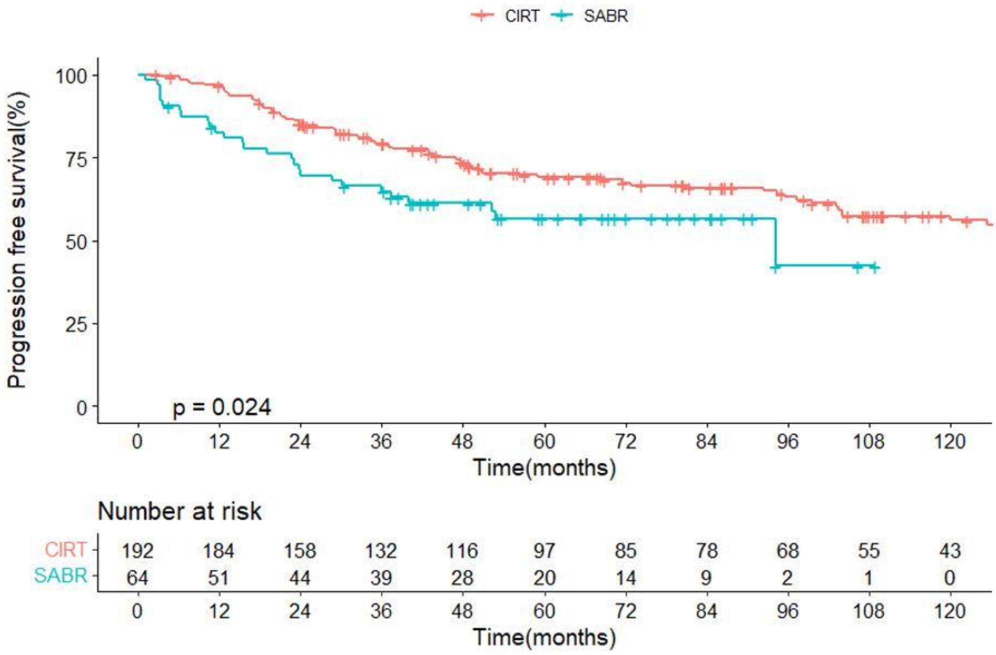
Medical records of patients diagnosed of localized choroidal melanoma who received CIRT or photon-based SABR at two institutions in Japan and South Korea between April 2001 and November 2021 were reviewed. Patients in the CIRT group received median 70 Gy of RT delivered in a median dosage of 14 Gy per fraction, and patients in the SABR group received median 60 Gy of RT delivered in a median dosage of 15 Gy per fraction. Propensity score matching (PSM) was performed to account for differences between the two groups. Primary endpoint was progression-free survival (PFS), and secondary endpoints included overall survival, cumulative incidence of local and distant failures, and enucelation.

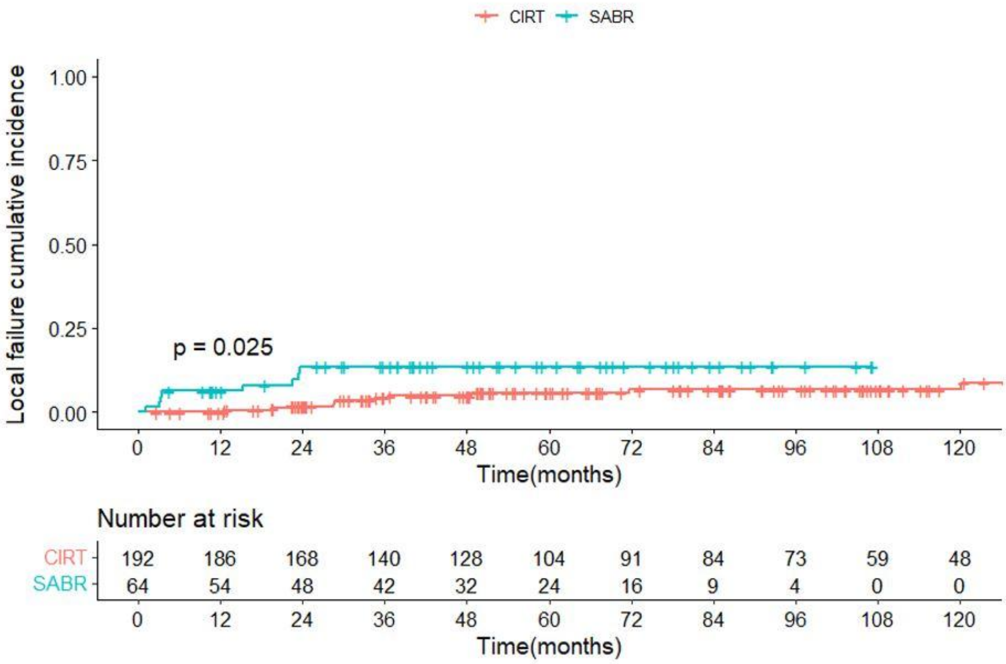
Results

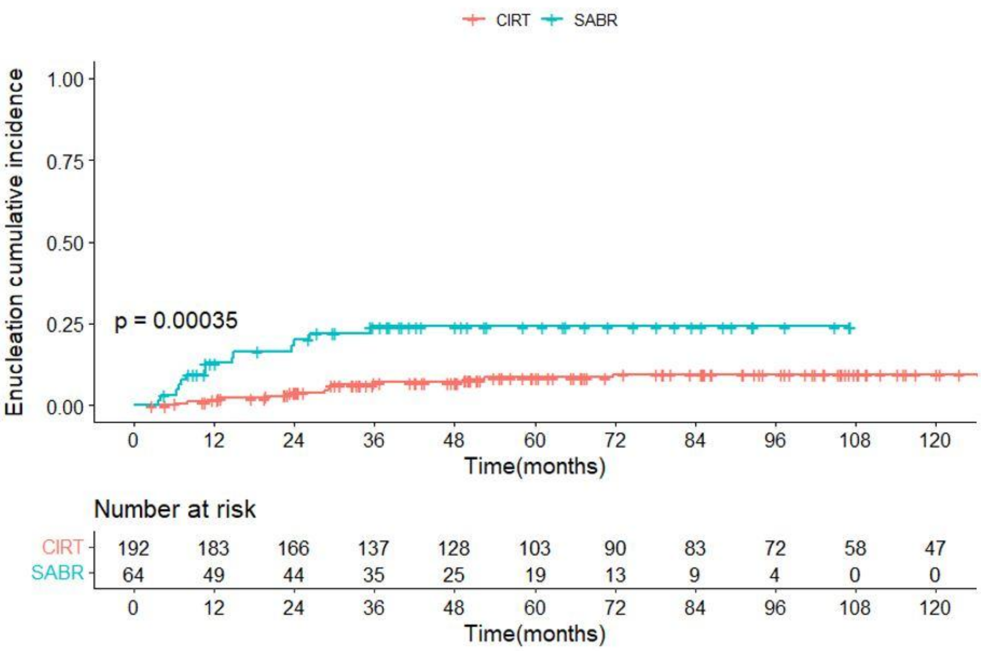
In all, 282 and 64 patients were included in the CIRT and SABR groups, and the median follow-up periods were 70.2 months and 51.9 months for the CIRT and SABR groups, respectively. After PSM, the 5-year PFS was significantly superior in the CIRT group to that in the SABR group (69.0% vs. 56.5%, $p=0.024$). The CIRT group also showed significantly reduced risks of local failure (5-year local failure rate 5.6% vs. 13.4%, $p=0.025$) and enucleation (5-year enucleation rate 8.5% vs. 24.2%, $p<0.001$). Multivariable analysis revealed that SABR, older age, and larger tumor diameter were associated with increased risk of progression. CIRT was also superior in terms of visual acuity preservation: the proportion of patients with visual acuity of ≥20/200 decreased from 64.7% initially to 23.7% at last follow-up in the CIRT group and from 64.1% to 6.3% in the SABR group ($p=0.0045$).

Conclusions

CIRT may offer advantages in terms of tumor control, eye preservation, and visual acuity preservation over SABR in patients with choroidal melanoma. Although CIRT is not accessible to all patients, this treatment option must be discussed with the patients with choroidal melanoma to achieve the best possible outcomes in tumor control and vision preservation.


CIRT
SABR
Progression free survival(%)
100
75
50
25
0
p = 0.024
0 12 24 36 48 60 72 84 96 108 120
Time(months)
Number at risk
CIRT 192 184 158 132 116 97 85 78 68 55 43
SABR 64 51 44 39 28 20 14 9 2 1 0
0 12 24 36 48 60 72 84 96 108 120
Time(months)


CIRT
SABR
Local failure cumulative incidence
1.00
0.75
0.50
0.25
0.00
p = 0.025
0 12 24 36 48 60 72 84 96 108 120
Time(months)
Number at risk
CIRT 192 186 168 140 128 104 91 84 73 59 48
SABR 64 54 48 42 32 24 16 9 4 0 0
0 12 24 36 48 60 72 84 96 108 120
Time(months)


CIRT
SABR
Enucleation cumulative incidence
1.00
0.75
0.50
0.25
0.00
p = 0.00035
0 12 24 36 48 60 72 84 96 108 120
Time(months)
Number at risk
CIRT 192 183 166 137 128 103 90 83 72 58 47
SABR 64 49 44 35 25 19 13 9 4 0 0
0 12 24 36 48 60 72 84 96 108 120
Time(months)