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Dosimetric evaluation of ovaries and pelvic bones associated with clinical outcomes in patients receiving total body irradiation with ovarian shielding

Keiko Akahane[1], Katsuyuki Shirai[1,2], Masaru Wakatsuki[3], Masato Suzuki[1], Shogo Hatanaka[4], Yuta Takahashi[1], Masahiro Kawahara[1], Kazunari Ogawa[2], Satoru Takahashi[2], Noriko Oyama-Manabe[1], Masahiro Ashizawa[5], Shun-ichi Kimura[6], Shinichi Kako[6] and Yoshinobu Kanda[5,6]

[1]Department of Radiology, Jichi Medical University Saitama Medical Center, Saitama 330-8503, Japan
[2]Department of Radiology, Jichi Medical University, Tochigi 329-0498, Japan
[3]QST Hospital, National Institutes for Quantum and Radiological Science and Technology, Chiba 263-8555, Japan
[4]Department of Radiation Oncology, Saitama Medical Center, Saitama Medical University, Saitama 350-8550, Japan
[5]Division of Hematology, Department of Medicine, Jichi Medical University, Tochigi 350-8550, Japan
[6]Division of Hematology, Jichi Medical University Saitama Medical Center, Saitama 330-8503, Japan
*Correspondence. Department of Radiology, Jichi Medical University Saitama Medical Center, 1-847, Amanuma-cho, Omiya-ku, Saitama, 330-8503, Japan, E-mail: kshirai@jichi.ac.jp
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ABSTRACT

Total body irradiation (TBI) with ovarian shielding is expected to preserve fertility among hematopoietic stem cell transplant (HSCT) patients with myeloablative TBI-based regimens. However, the radiation dose to the ovaries that preserves ovarian function in TBI remains poorly understood. Furthermore, it is uncertain whether the dose to the shielded organs is associated with relapse risk. Here, we retrospectively evaluated the relationship between fertility and the dose to the ovaries, and between relapse risk and the dose to the pelvic bones. A total of 20 patients (median age, 23 years) with standard-risk hematologic diseases were included. Median follow-up duration was 31.9 months. The TBI prescribed dose was 12 Gy in six fractions for three days. Patients' ovaries were shielded with cylinder-type lead blocks. The dose–volume parameters ($D_{98\%}$ and D_{mean}) in the ovaries and the pelvic bones were extracted from the dose–volume histogram (DVH). The mean ovary D_{mean} for all patients was 2.4 Gy, and 18 patients recovered menstruation (90%). The mean ovary D_{mean} for patients with menstrual recovery and without recovery were 2.4 Gy and 2.4 Gy, respectively, with no significant difference (P = 0.998). Hematological relapse was observed in five patients. The mean pelvis D_{mean} and pelvis $D_{98\%}$ for relapse and non-relapse patients were 11.6 Gy and 11.7 Gy and 5.6 Gy and 5.3 Gy, respectively. Both parameters showed no significant difference (P = 0.827, 0.807). In conclusion, TBI with ovarian shielding reduced the radiation dose to the ovaries to 2.4 Gy, and preserved fertility without increasing the risk of relapse.

Keywords: relapse; ovarian shielding; fertility; total body irradiation (TBI)

INTRODUCTION

Hematopoietic stem cell transplantation (HSCT) is a well-established curative treatment widely used for various hematological diseases, including lymphoma, leukemia and multiple myeloma [1]. With the development of HSCT, these diseases have become more curable than previously. In combination with high-dose chemotherapy, total body irradiation (TBI) is an important part of the conditioning regimen for patients undergoing HSCT. TBI contributes to the eradication of malignant cells, and helps prevent graft rejection by the immune system among patients undergoing allogeneic HSCT. However, TBI and high-dose busulfan, which are often used for HSCT conditioning regimens, have been known as risk factors of ovarian failure [2–4]. Fertility preservation is a serious endeavor for patients who undergo HSCT because of the severe impact of infertility on the quality of