Hematopoietic stem cell grafts from unrelated donors are commonly transported by aircraft. They must not be subjected to x-rays during security checks, which may cause inconvenient discussions between the courier and the airport security staff. We exposed hematopoietic stem cells from mobilized peripheral blood to a widely used x-ray hand-luggage control system. Cell viability as well as growth in vitro of mature progenitor cells (colony-forming cells), primitive progenitor cells (long-term culture-initiating cells), and lymphocytes were not altered even after 10 passages through the hand-luggage control system. Thus, repeated exposure to the low radiation dose of hand-luggage control systems (1.5 ± 0.6 μSv per exposure) seems to be harmless for hematopoietic stem cells, which should simplify the international transport of stem cell grafts. (Blood. 2002;99:4632-4633)

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Results and discussion

After up to 10 radiographical passes, neither cell viability nor the number of hematopoietic progenitor cells was affected (Table 1). The expandability of MNCs (no x-ray: 259 ± 108-fold, 5 passages: 285 ± 132-fold), of CFCs (no x-ray: 446 ± 223-fold, 5 passages: 495 ± 251-fold), of NK cells (no x-ray: 2.4 ± 0.3-fold, 1 passage: 2.4 ± 0.4-fold, 5 passages: 2.3 ± 0.3-fold, 10 passages: 2.4 ± 0.4-fold), and of T lymphocytes (no x-ray: 1.9 ± 0.2-fold, 1 passage: 1.9 ± 0.1-fold, 5 passages: 1.9 ± 0.2-fold, 10 passages: 1.8 ± 0.2-fold) was unaltered. Also, HLA-unrestricted (NK cell) cytotoxicity against the erythroleukemia cell line K562 (effector to target ratio 5:1 and 25:1) was comparable to that of the controls (Table 1). Endothelial cells could be generated from the irradiated samples (data not shown), indicating the preservation of progenitor cells with hematopoietic and hematopoietic differentiation capacity. These data suggest that the radiation emitted from hand-luggage security-check devices exerts no harmful effect on the cellular content of hematopoietic stem cell grafts.

The exposure of airplane personnel to radiation from extraterrestrial sources is 3 to 6 mSv/y, compared with 1 mSv at ground (a sievert [Sv] is a measure of the total radioactive dose, factoring in the patient’s exposure to radiation from different sources). Figure 1 shows the radiation dose in a hand-luggage control (0.0015 mSv), compared to other radiation sources such as chest radiography (0.05 mSv) and abdominal computer tomography (>1.0 mSv).

Figure 1. Amounts of radiation from various sources. Figure shows radiation emitted from x-ray-hand luggage controls compared to other radiation sources in mSv (milli Sievert).
each type of radiation and its energy), and this may increase the incidence of malignant diseases. The risk of developing acute leukemia is 5.1-fold in those flying more than 5000 hours.6 Pilots (and accordingly, their bone marrow) are exposed to a radiation dose of 60 μSv during a 10-hour flight, a dose that is roughly equivalent to 40 hand-luggage controls. Assuming 5 connecting flights, the radiation dose applied to hematopoietic stem cell grafts is 67.5 μSv in 5 security checks plus 60 μSv during a 10-hour overseas flight. This is approximately 1.3% of the dose acquired by pilots every year.

Only vigorously instructed personnel are authorized to obtain, handle (ie, couriers), and deliver hematopoietic stem cell transplants to human beings. Couriers are instructed by international guidelines to refuse the checking of stem cell transplants by means of x-ray–assisted devices. Thus, unsatisfying discussions are frequently entailed, ultimately resulting in the visual and tactual inspection of the graft by security staff who are unskilled to handle vital human organs. On the other hand, thick-walled containers containing human organs may be targets for bootlegging illegal goods or weapons. Our data suggest that the radiation emitted from x-ray hand-luggage control systems at airports does not harm the cellular components of peripheral blood stem cell grafts. Thus, a customary examination using x-ray devices should facilitate the delivery of stem cell grafts and minimize the risk for the graft, for the people obliged to check this, as well as for the passengers joining the flights.

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References

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