

## Susceptibility to Total Body Irradiation

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August 1946 'Little Boy' a U<sup>235</sup> nuclear bomb was detonated over Hiroshima and 'Fat Man' a Pu<sup>238</sup> bomb over Nagasaki. Thousands of Japanese died almost instantaneously from the explosive force, heat, winds, collapse of buildings caused by the bombs. Fifteen % of the survivors died weeks later from complications of Total Body Irradiation (TBI). The Manhattan project explored TBI toxicity in experimental animals, exposed to gamma irradiation, but not to neutron TBI. Fifty % lethality after TBI occurs in 3 waves:

1. within hours after >100Gy TBI due to necrosis in the brainstem. ('CNS' syndrome)
2. within 3-5 days after 8-12 Gy TBI due to fluid loss from the GI tract ('GI' syndrome)
3. within 6-12 days after 3.7 -7 Gy TBI due to Bone Marrow aplasia ('BM' syndrome)

Neutron TBI cause more GI toxicity than gamma TBI. Three of Manhattan project physicists accidentally exposed themselves to a TBI dose between 12- 100Gy. They died in less than 3 days from low blood pressure due to irreversible Vascular Leak (VL)

4. The VL syndrome was not observed in experimental animals.

The VL and CNS syndrome cannot be reversed. The GI syndrome can be ameliorated by intensive care with fluid replacement, antibiotics and transfusion of blood products, irradiated with 20Gy. The BM syndrome can be corrected with the intravenous infusion of bone marrow cells from a healthy donor. BM donor lymphocytes will cause Graft versus Host disease (GvHD) in the recipient. The severity of GvHD is determined by 4 factors

1. The number of BM donor lymphocytes administered per kg of the recipient
2. Immunosuppressive treatment of the recipient post transplantation
3. HLA differences between BM donor and recipient
4. The microflora in the GI tract of the recipient

The devastation/chaos caused by nuclear warfare excludes the use of BM transplantation for the treatment of surviving citizens. The incidence of radiation accidents with nuclear reactors can be decreased by new, safer, breeder reactors, which also decrease the half-life and volume of nuclear waste. Radiation accidents have helped to optimize autologous and allogeneic human BM transplantation.

**Keywords:** nuclear energy, improved nuclear energy reactors, prevention of GvHD