Restorative Capacity of Bone Marrow Transplantation in Gamma-irradiated Rats: A Study of the Bone Marrow, Spleen, Lungs and Blood

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List of Abbreviations

ALP	Alkaline phosphatase
BFUE	(Burst-forming unit erythroid)
BM	Bone marrow
BMT	Bone marrow transplantation
CAT	Catalase
CBC	Complete blood count
CD	Cluster of differentiation
CFU-S	Colony Forming Unit- Spleen
CPK	Creatinine phosphokinase
CSFs	Colony-stimulating factors
D0	(Dose level for gamma rays)
EDTA	Ethylenediaminetetraacetic acid
Fas	Death receptor or CD_{95}
FR	Free radical
GSH	Glutathione
GSHPx	Glutathione peroxidase
GVHD	Graft-versus-host disease
Gy	Gray
HCT	Haematocrit
HGB	Haemoglobin
HSCs	Haematopoietic stem cells
HSCT	Haematopoietic stem cell transplantation
IR	Ionizing radiation
IV	Intravenous
$L^{\cdot}$	Lipid radicals
LDH	Lactate dehydrogenase
LET	Linear energy transfer

List of Abbreviations (Cont.)

LOO.	Lipidperoxyl radical
LPO	Lipid peroxidation
LYM	Lymphocytes
M	Mitosis
MDA	Malondialdehyde
MHC	Major histocompatibility complex
NIR	Non-ionizing radiation
$O_2^{\cdot}$	Superoxide radical
$OH^{\cdot}$	Hydroxyl radical
PLT	Platelet
RBCs	Red blood cells
RNA	Ribonucleic acid
RNS	Reactive nitrogen species
ROS	Reactive oxygen species
SOD	Superoxide dismutase
TBA	Thiobarbituric acid
TBI	Total body irradiation
TCA	Trichloroacetic acid
WBCs	White blood cells

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Abstract

The current work was done on male albino rats *(Rattus norvegicus*) to investigate whether bone marrow (BM) transplantation could play a role in reducing the dangerous effects of γ-irradiation on the haematological parameters and the histological structure of the spleen, and lung tissues. The used animal groups included a control group, a BM-injected group, 3 and 5 Gy-irradiated groups, and 3 and 5 Gy-irradiated groups that were injected intravenously (IV) into the caudal vein of the recipient rat with bone marrow after 3 hr from irradiation. All the experimental animal groups were sacrificed after 5 weeks of the treatments. The haematological study included analyses of certain blood components (the count of the red and white blood cells, haemoglobin content "HGB", haematocrit value "HCT", blood platelets count "PLT"). The biochemical analyses included alkaline phosphatase (ALP), lactate dehydrogenase (LDH), malondialdehyde (MDA) and glutathione (GSH) in the blood and liver. The histopathological studies included the bone marrow, spleen and lungs.

The results showed that exposure to 3 Gy or 5 Gy γ-radiation induced significant decreases in certain blood components (WBCs, RBCs, HGB, HCT, PLT) and GSH level in both blood and liver, and significant increases in LDH and MDA levels in both blood and liver. Besides, radiation induced reduction in the bone marrow components and decrease in cell populations of the spleen tissue.

The lung tissue showed collapsed alveoli with thickened wall, congested blood vessels with irregular walls, thickened bronchiolar wall with incomplete epithelial lining and foci of haemorrhage and deposition of collagen fibres

around the congested pulmonary blood vessels, bronchioles, alveolar sacs and in between alveoli after 5 Gy γ-irradiation.

BM transplantation 3 hours after whole body 3 or 5 Gy gamma-irradiation restored HCT value, partially ameliorated the other blood components (WBCs, RBCs, HGB, PLT) and demonstrated a significant preservation of the bone marrow components, and scanty adipose cells' replacement. An increase in cellularity of the periarteriolar lymphocyte sheath of the white pulps was noticed in the spleen tissue. The microscopical observations showed normality of the structure of the lung sections.

In Conclusion, BM transplantation exerts curative effects on radiation exposure hazards occurring in certain haematological and biochemical parameters and in the histological structure of the studied body organs (the bone marrow, spleen and lungs).