

Histopathology and Dose Rates

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The three questions which we are at present focusing our attention on are: (1) where, in relation to the various histologic structure, Pu, Ra, and NstH are deposited in bone; (2) what cells are being irradiated and the magnitude of the irradiation dose; and (3) what are the local and systemic responses of the animal to the irradiation. Data presented is limited to two dogs sacrificed at 24 hours and one year following administration of 3 microcuries/kilogram of Pu.

Radioautographically Pu is principally deposited on the surface of trabecular bone structures just beneath the endostal layer. The average dosage rate received by the tissue within the range of the alpha particles in trabecular bone is 50 rep/day as calculated directly by gamma track counting radioautograms and by calculation from geometrical distribution data. The principal cells irradiated are the fibroblasts, osteoblasts, etc. of the endosteal layers. Osteoblasts are specifically irradiated by the intracellular incorporation of plutonium. About 1/5 of the bone marrow cells are within the range of the gamma particles in areas of trabecular bone. A much smaller fraction of the marrow is irradiated in the shafts. The dramatic depression of the circulating erythroid and myeloid elements appears to be secondary effects on the bone marrow and not simply direct irradiation.

The histopathologic changes present in the bone of the one year sacrificed animal were:

1. Peri-trabecular fibrosis
2. General ablation of bone marrow in areas of trabecular bone with islands of hyperplastic marrow.
3. Complete absence of osteoblastic and osteoclastic cells and activity since administration of Pu.
4. Pu mobilization into marrow spaces in "dead macrophages" containing aggregates of hemociderin.
5. Early resorption of bone without the presence of osteoclasts.

The extensive diffuse damage to connective tissue elements of bone which is present at one year in this high dosage level of plutonium is thought to cloud any more subtle changes such as those of a precarcinomatous condition, if present at all. Study of animals receiving smaller administered Pu²³⁹ and Ra²²⁶ doses over a greater interval of time should be more lucrative in studying the pathogenesis of gamma irradiation induced bone tumors

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