

ACUTE EFFECTS OF EXTERNAL RADIATION

Eugene L. Saenger, M.D.

External radiation exposure produces the greatest number of overt nonstochastic injuries. Although this type of injury is of greatest interest to the clinician, radiation accidents are so rare that most physicians and public health authorities never encounter exposed patients. Fortunately the ionizing radiation dose and its distribution in the body can be measured with great accuracy and precision. Thus, the following statements are interpretable far more easily for radiation injury than for chemical, heat, light, blast, and burn injuries.

Several radiobiological principles are important to the understanding of the clinical and laboratory findings: The greater the percentage of the body exposed, the greater the effect. Accidental radiation exposure usually is irregularly distributed, which may moderate the clinical course. Shielding of a relatively small portion of the body (eg, the spleen) will give significant degrees of protection; the shielding of an extremity will help to protect bone marrow.

Other important factors determining the effects of exposure are the total dose and the dose rate. Dose is that amount of radiation or drug delivered. Inasmuch as response is proportional to dose, the larger the dose, the greater the response or the more rapid the onset of symptoms. Dose rate is somewhat more difficult to relate to the injury. A dose that might be lethal if delivered within minutes or hours is tolerable when delivered over days or weeks. In most external radiation injuries, exposures are acute; however, if exposure occurs over days or weeks, the effects often are initially attributed to causes other than radiation. Fractionated doses used in radiation therapy often produce minimal clinical changes until the total dose reaches 30 to 60 Gy (3,000 to 6,000 rad). Thus, the lower the dose rate, the greater the degree of recovery and the less the effect.

For the purpose of emergency planning, the LD_{50/60} (the estimated median radiation dose leading to death in 60 days) is a useful guide in determining the need for supportive or aggressive therapy. If only first aid or minimal supportive therapy is available, the LD_{50/60} is 2.5 to 3.5 Gy (250 to 350 rad); when hospital care and more supportive therapy (antibiotics, blood derivatives, reverse isolation) are available, the LD_{50/60} is about 4.5 Gy (450 rad). With provision for intensive treatment, the LD_{50/60} can be 6 Gy (600 rad) or more.¹

Professor of Radiology and Director, E.L. Saenger Radioisotope Laboratory, University of Cincinnati Medical Center, Cincinnati, Ohio.