New biological indicators to evaluate and monitor radiation-induced damage: an accident case report.

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On March 11th, 2006, a radiation accident occurred in an industrial radiation facility, in the city of Fleurus (Belgium). An operator entered an irradiation room without noticing that the cobalt-60 source (activity of 3x104 TBq) was out of the security position. Few hours after the exposure, the victim had nausea and vomiting, but these clinical signs were confounded with a benign gastroenteritis. Eighteen days later, the patient consulted for persistent nausea and headache, transitory and refractory diarrhoea and hair loss. The occurrence of a radiation accident was then proposed as an explanation for these symptoms, and the patient was taken in charge by the medical staff of Percy hospital (Clamart, France). Cytogenetic dosimetry was used to define the radiation dose and heterogeneity received by the victim. This cytogenetic analysis indicated a mean radiation dose of 4.5 Gy, based upon dicentric chromosome frequency, reciprocal translocations and total translocations. However, the presence of 18.8% of cells without dicentric chromosomes suggested of an heterogeneous irradiation. This was confirmed by the physical dosimetry, which suggested an anterior-posterior gradient of dose. The patient was then followed by the mean of several new biological indicators of radiation-induced damages to specific organs and physiological systems. The blood Flt3 ligand concentration was used to evaluate and follow the hematopoietic syndrome. Initial measurement gave <2500 pg FL/ml of plasma, indicating a severe hematopoietic syndrome, with some evidence of a residual hematopoiesis. As soon as the patient received a cytokine treatment, a rapid and sustained hematopoietic recovery was observed. Citrulline concentration was used to evaluate damage to the mucosal epithelium of the small bowel. However, citrulline concentration was in the range of normal values, indicating the absence of significant damage to the mucosal epithelium. Several oxysterols were used to evaluate damages to the cardiovascular system and to the liver lipid metabolism. The decrease over time observed in 7α-hydroxycholesterol (7α-OH-Chol) concentration was indicative of a liver damage, as confirmed by decrease in AST and ALT concentrations and in Apolipoproteins A1 and B. The 27α-OH-Chol was strongly decreased over time, in parallel to an increase in CK-MB. This suggested radiation-induced damages to the cardiovascular system. Overall, our results show that these new biological indicators are useful for the initial evaluation of radiation-induced damages to specific organs and physiological systems, but also for the monitoring of pathophysiological evolution of the patient, in combination with existing scoring for radiation

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accident victims.