

Potassium concentrations in irradiated blood

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Blood components are irradiated to reduce the risk of graft versus host disease induced by transfusion in a wide range of immunocompromised patients. Irradiation has been claimed to be harmless to red cells and neutrophil function and to have little effect on platelet increments.¹⁻³ A case of fatal graft versus host disease induced by transfusion in a child prompted our paediatric oncologists to request irradiated blood for all children being treated for leukaemia and cancer in addition to patients receiving bone marrow transplants. Because two letters have reported raised potassium concentrations in irradiated blood^{4,5} we examined the plasma potassium concentration of blood irradiated at the Regional Transfusion Centre before expanding our service.

Methods and results

Twenty units of plasma reduced blood (volume 220-340 ml, erythrocyte volume fraction 0.55-0.77) taken three days previously from normal donors into citrate phosphate dextrose adenine anticoagulant were each divided under aseptic conditions into two equal parts. One part of each pair received 15 Gy irradiation in a gammacell (Vinten) irradiator. All samples were stored under identical conditions at 2-6°C. After mixing, aliquots were removed under aseptic conditions immediately after irradiation (day 0) and daily thereafter for 10 days to determine plasma potassium and sodium concentrations.

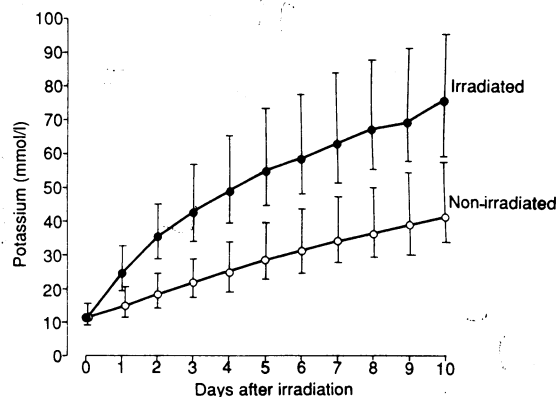
The figure shows the mean value and range of potassium concentrations. Plasma potassium concentrations in irradiated blood reached a mean of 49 (range 39-65) mmol/l after four days' storage and exceeded 90 mmol/l in one bag after only nine days. Plasma sodium concentrations fell concomitantly. The mean plasma potassium concentration of non-irradiated blood at expiry (35 days after collection) was 55 mmol/l.

Comment

Our results confirm previously documented rises in plasma potassium concentrations of irradiated blood. Potassium concentrations after irradiation of 15 Gy were similar to those reported after 20 Gy⁴ and 40 Gy.⁵ This increased leak of sodium and potassium from red cells suggests that irradiation may damage the sodium pump. Ultimately, increased rupture of red cells occurs, reflected in a gradual rise in plasma concentrations.⁴

Much of the argument has centred on neonates. Some workers recommend that irradiated blood intended for use in neonates or for intrauterine transfusion should not be stored.⁴ Others suggest

that washing red cells and resuspension in the donor's plasma might correct the problem.⁵ However, many patients with leukaemia, cancer, or other immunodeficiency and most undergoing marrow transplantation have permanent venous access lines, which often empty into the right atrium. Infusions with high potassium concentrations may be necessary in patients with hypokalaemia or those being fed parenterally, but doctors take a calculated risk. Unwitting use of blood with high potassium concentration may be more hazardous in patients with impaired renal function or hyperkalaemia, or both.



Mean and range of potassium concentrations in 20 samples of blood. Half of each sample received 15 Gy irradiation

Irradiation "on demand" poses important logistic problems for regional transfusion centres. Some may supply irradiated red cells for use at the discretion of hospital blood banks and clinicians. Since completing this study we irradiate blood collected just four days previously or less and recommended an expiry date of four days after irradiation because the mean plasma potassium concentration (49 mmol/l) then approaches that of non-irradiated, expired (35 days old) blood. Blood for intrauterine transfusion is used within 24 hours of irradiation. Unused blood may be recross-matched for other patients within four days after irradiation.

Clinicians and blood banks should be aware of the high potassium concentrations in irradiated blood. Policies for the safe use of irradiated red cell components should be drawn up by haematologists responsible for blood banks in association with the relevant clinicians and the centres responsible for irradiating blood.

Sodium and potassium concentrations were measured by the biochemistry department, Newcastle General Hospital.

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