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Elution of ^{111}Indium from reticuloendothelial cells

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SUMMARY Measurement of isotope accumulation in an organ is often used to assess that organ's removal of blood cells labelled with the isotope. This technique is only valid if the isotope does not elute from the organ. Elution of ^{111}In from the liver and spleen has been investigated in 14 subjects following intravenous injection of heat-damaged erythrocytes labelled with ^{111}In. The elution rate from the spleen was found to be low, about 2% of the initial activity per day. The liver accumulated activity with respect to its initial uptake at a rate of about 5% per day. Bone marrow was not visualised except in two patients in whom it was identifiable in the initial scan.

The accumulation of isotope within an organ is often used as a measurement of uptake by that organ of blood cells previously labelled with the isotope. Examples of this are the accumulation of ^{51}Cr in the spleen and liver, detected by surface counting, after injection of ^{51}Cr-labelled erythrocytes, and the accumulation of ^{111}In in the same organs, following injection of ^{111}In-labelled platelets. The validity of this approach depends on the organ retaining the radioactivity after uptake of the cells. Thus, our conclusion in earlier papers[1 2] that the main organs responsible for removing effete ^{111}In-labelled platelets from the circulation are the spleen and the bone marrow rested on the assumption that ^{111}In taken up in these organs did not re-enter the circulation and become redistributed to other parts of the reticuloendothelial system. The elution of ^{51}Cr from the spleen has been found to be about 6% per day.[3] If the corresponding figure for ^{111}In was similar to this, then our assumption would not be justified. We undertook, therefore, a study to assess the elution rate of ^{111}In from the liver and spleen.

Material and methods

Eleven patients undergoing heat-damaged red cell clearance studies for assessment of activity of their rheumatic disorders[4] and three normal volunteers were used in this study. Two ml of washed erythrocytes were separated from heparinised whole blood and heated in a glass container at 49·5°C for 20 min. After washing, they were labelled with ^{111}In-oxine[5] or ^{111}In acetylacetone.[6] Labelling efficiency was consistently greater than 90%. After reinjection, blood samples were taken at intervals for up to 60 min for the calculation of clearance rate. After 24 h, gamma camera scanning of the chest and upper abdomen was performed and a blood sample taken. Scanning was repeated under identical conditions on at least one occasion between three and eight days after the first scan. The computer images were analysed for the total counts collected per unit time in regions over the spleen, liver and lumbar spine. The regions were recorded so that they could be recalled when the same patient was rescanned. The total counts in a region were corrected for background and isotope decay and expressed as a percentage of the 24 h (initial) value.

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Results

All the patients studied had normal clearance values[7] and normal-sized spleens. The circulating ^{111}In concentration was very low (less than 1% of the dose) at 24 h, and remained so throughout. It was essentially non-cell bound. Most of the administered activity localised in the spleen, with much less going to the liver (Fig. 1). The decay corrected activity levels in the spleen and liver, expressed as a percentage of the 24 h level, are shown in Fig. 2. Regression analysis gave a rate of loss of activity from the spleen of 2·0% of the 24 h activity per day with a 95% confidence interval of −4·2% to 0·16% per day, and a rate of accumulation in the liver of 5·4% of 24 h activity per day with 95% confidence limits of 11·0% and −0·5% per day. Only two patients displayed bone marrow signals at any stage large enough to observe changes; in these, the marrow to spleen ratios appeared to fall slightly. These two patients also showed high liver uptakes. During the course of the clearance study itself, much activity was visible in the lung fields. However,

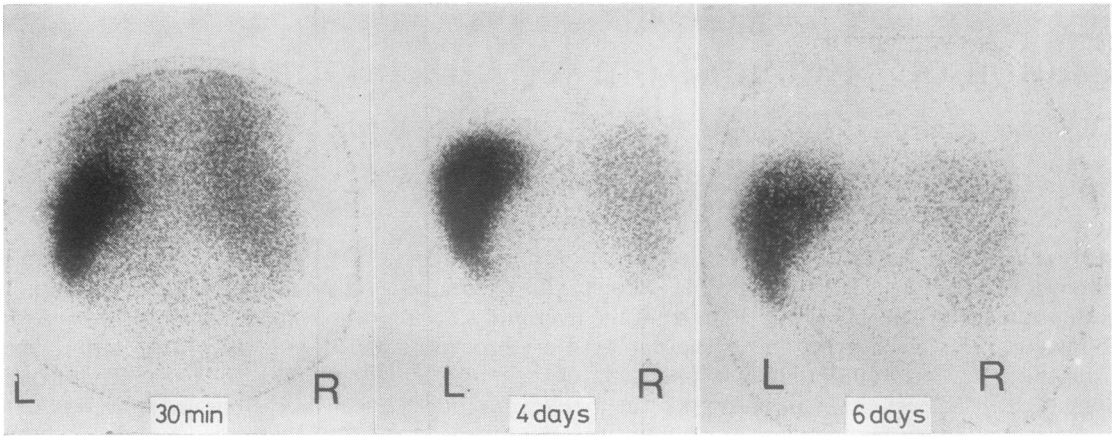

Fig. 1 *Posterior gamma camera scans taken at 30 min, 4 and 6 days after injection of ^{111}In labelled heat-damaged erythrocytes. At 30 min, activity is present in lung fields, liver (R) and spleen (L), but none in bone marrow. In later scans, spleen and liver activity persists whereas the lung fields become clear. Bone marrow remains invisible.*

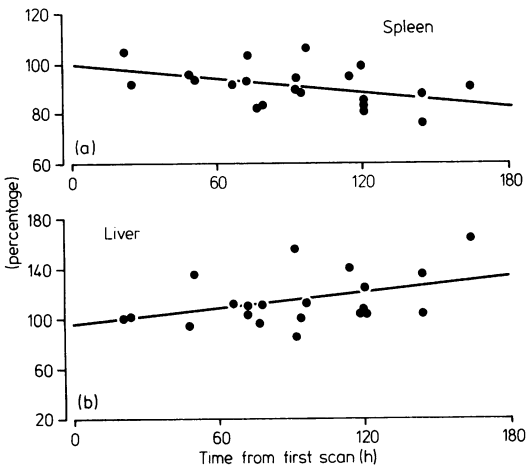

Fig. 2 *Changes in (a) splenic and (b) hepatic ^{111}In, after injection of heat-damaged erythrocytes labelled with ^{111}In. Decay corrected count rates are expressed as the percentage of the value at 24 h. The continuous line is the line of regression. (Pooled data from 14 patients.)*

at 24 h, lung activity had entirely disappeared (Fig. 1).

Discussion

We conclude from this study that red cell-bound ^{111}In taken up by the spleen shows a slow rate of elution over a period of eight days. Because ^{111}In losses via urine and faeces are very low[8] and because injected free ^{111}In localises selectively in spleen, bone marrow and particularly liver,[9] redistribution would have been expected to produce a bone marrow image, a falling spleen count and a rising liver count. Such redistribution occurred slowly. Although bone marrow was clearly visualised in two patients, the decay corrected counts did not change appreciably with time, nor did their ratio with the spleen counts. The effect of lung uptake on ^{111}In redistribution need only be considered over the first 24 h, since after this time lung activity had disappeared and did not reaccumulate. This study, therefore, supports the claim that increasing marrow radioactivity after injection of ^{111}In labelled platelets does indeed reflect uptake by the marrow of effete platelets. The stability of intracellular ^{111}In should make this a useful isotope for other, similar, haematological investigations, such as the quantification of red cell destruction in severe haemolytic anaemias in which red cell life span is compatible with the half life of ^{111}In. An interpretation of bone marrow uptake of heat-damaged red cells, when it occurs, cannot be made from this limited data, but because of its possible association with heavy liver uptake, may be a reflection of excessive damage.

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