uptake of $^{111}$In-Cl represent erythropoiesis.

After intravenous administration of $^{111}$In-Cl, $^{59}$Fe-citrate and $^{99m}$Tc sulfur colloid to three groups of rats, i.e., the control, phenyl-hydrazine treated and irradiated ones, the distribution of these three radionuclides in the femur, the spleen and the liver was examined. There was significant increase in the intrasplenic uptake of radioiron and also of radioindium, although in the lesser degree, in the phenyl-hydrazine treated rats, where remarkable enlargement and extra-medullary hematopoiesis were recognized. On the other hand, technetium colloid uptake was rather reduced. In the irradiated rats the spleens were atrophic and uptake of these three radionuclides was invariably decreased.

In forty cases having various degree of erythropoiesis, the following studies were clinically carried out.

Plasma disappearance of $^{111}$In-Cl was remarkably slower, with half-time of 5 to 8 hours, than that of radioiron. This rate was significantly correlated with red cell iron turnover rate, not necessarily with plasma iron turnover rate, in 23 examined cases. Red cell iron incorporation rate of radioindium was only from 0.6 to 12 percent, extremely low value in contrast to radioiron.

Radioindium uptake in the local marrow was examined for 7 days in the selected 5 parts, i.e., the frontal skull, upper sternum, sacrum, proximal and distal femur. The uptake rate was faster and the amount was greater in erythroid-hyperplastic stage than in normalized stage after the treatment in hemolytic anemias and also in polycythemia veras. Whole body linear scanning enabled us to calibrate extra-hepatosplenic, i.e., bone marrow uptake ratio to administration dosis. The change in this ratio with radioindium was in good accordance with erythropoietic change in those cases, while that with technetium was sometimes paradoxical.

In reference to erythropoietic activity determined by red cell iron turnover rate, delineation ability of the active marrow by radioindium was examined by scintiphography and compared to that by technetium colloid. The marrow of erythroid hyperplasia was delineated with the indium as clearly as with the technetium. On the other hand, the functioning marrow in its hypoplastic state was just poorly delineated with the indium but was not necessarily so with the technetium.

These results led us to the following conclusions. In vivo behavior of indium chloride was not identical with iron. Erythropoietic activity was reflected by the marrow uptake of the radioindium only partially but more than that of technetium colloid. Therefore, indium chloride is considered to be a suitable agent for marrow imaging, if general erythropoietic activity is the subject of examination at present.

Studies on Bone Marrow Lymphocytes. II. Cell Surface Immunoglobulin As Studied by Direct and Indirect Radioautography

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The density of surface immunoglobulin on small lymphocytes of bone marrow and spleen has been evaluated radioautographically by the direct and indirect methods.

Cell suspensions from C57BL mice were exposed to I$^{125}$-labeled rabbit anti-mouse immunoglobulin in a wide range of concentration for 30 min at 0°C (direct method). In the indirect method, cells were reacted for 30 min at 0°C with graded dilutions of unlabeled rabbit anti-mouse immunoglobulin followed by further reaction with a sheep anti-rabbit immunoglobulin labeled with I$^{125}$. After washings, lymphocyte labeling was quantitated by radioautography. With increasing concentrations of anti-mouse immunoglobulin, the percentage of immunoglobulin-bearing cells in the spleen reached a plateau level (45–50%) in both methods. The lowest concentration of anti-mouse immunoglobulin at which the plateau was attained was 1/10 and 1/500 in the direct and indirect
methods, respectively. Bone marrow lymphocytes reached a plateau labeling of 30% at 1/100 dilution of anti-mouse immunoglobulin in the indirect method, while showing a linear increment in percentage labeling up to 30–35% throughout the I¹²⁵-anti-mouse immunoglobulin range in the direct method. Approximately two thirds of bone marrow lymphocytes remained unlabeled in both methods. The intensity of labeling was lower in the marrow lymphocytes than in the spleen cells in both methods under equivalent conditions.

The majority of labeled cells showed a diffuse labeling in the direct method. In contrast, the predominant pattern of labeling was cap formation in the indirect method. Background grains were lower in the indirect than in the direct method.

The results demonstrate that the indirect method is 50–100 times more sensitive than the direct method and appears more suitable for studying the surface properties of bone marrow lymphocytes which have lower densities of surface immunoglobulin than the peripheral B cells.

Evaluation of the Tc-99m labeled RBC in the hematological quantitative measurements

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We made an attempt to evaluate the accuracy, availability and overcoming the rich label efficiency of Tc-99m RBC.

Our labeled procedure has essentially been that of Eckelman and Atkins.

The labeling yields of Tc-99m RBC without reducing step averaged II, 0% with whole blood samples in which efficiency of plasma removal before labeling was 16.3% and twice-washed samples averaged 24.2%. The labeling yields of Tc-99m RBC with normal procedure averaged 55.9% with whole blood samples in which efficiency of plasma removal before labeling was 74.3% and twice-washed samples averaged 73.7%.

In vivo studies, over 96.1% of the radioactivity was found to be bound to red cell fraction and this distribution in the circulating blood no measurable change throughout the study. In 10 patients, comparison with Cr-51 in a double tagging experiment showed excellent correlation. Namely apparent red cell volume were calculated at the various intervals. The 15 min ratio of Tc-99m RBC volume to Cr-51 RBC volume was used as a measure of the stability of Tc-99m TGC. The ratio of Tc-99m RBC volume to Cr-51 RBC volume was 1.04 at 15 min, 1.02 at 30 min, 1.06 at 60 min and 1.14 at 3 hours. The ratio of Tc-99m RBC 3 hours to 15 min was 1.22. The ratio of Cr-51 RBC 3 hours to 15 min was 1.08. These results indicated that free Tc-99m is released from Tc-99m TBC with increasing time, especially over 3 hours after reinjection.

In conclusion, the results of studies on a limited number of experiments indicated that Tc99m RBC should be used to the various peripheral hematological measurements in a short period.

Studies on mean red cell life span (MRCLS) with DF³²P in the patients with aplastic anemia
—in view of ferrokinetics—

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Disopropylfluorophosphate-³²P (DF³²P) has been introduced as a clinically available radiopharmaceutical for measuring mean red cell life span (MRCLS). However, it is not widely used yet.