Radionuclide examinations in hematology

Nuclear hematology focuses on the examination of peripheral blood elements, spleen and iron metabolism. Monitoring of vitamins (mostly B12) belongs to the examination GIT.

🔎 *For more information see Radionuclide examination of spleen.*

Measurement of body fluid volume

Using radionuclide methods it is possible to **measure the amount of fluids**. We can measure **volume of total extracellular fluid** or only **intravascular fluid**. These methods are not widely used in clinical practice, their importance lies in experimental use.

Total extracellular fluid (ECT) we find out using radiofarmaceutical, which **freely penetrate the capillary wall** into the environment, it is easily soluble in water and is not taken up by any organ. After administration of a radiopharmaceutical of known activity (A_0) and volume (V_0) it is neccessary to wait few hours for **dissolution** of the medication. Then blood is taken and according to the detected activity (A_e) the dilution and the total volume in which it was dissolved are calculated.

$$ECT = \frac{A_0 * V_0}{A_e}$$

Intravascular fluid is detected by drugs **that do not leak from the blood vessels into the interstitium**. This can be used for example marked. erytrocyte or albumin. Shorter time is required for even distribution in the vascular bed. Blood collection and calculations are the same as for total extracellular fluid.

Examination of erythrocytes

Measurement of erythrocyte mass volume

Erythrocyte mass volume is most often examined at krvácivých stavů, anemických pacientů, in severe burns and splenomegaly. The measurement principle is similar to the previous methods, the design and calculations differ.

The blood is taken from the patient (proximately 20 ml). Plasma and leukocytes are removed in the centrifuge. Hematocrit (H) (the remaining erythrocytes) are signed by radionuclide (often ^{51}Cr) and its value and radionuclide activity recorded (A_0). The hematocrit value must be multiplied by 0.98 (about 2% of the plasma remaining between erythrocytes). The labeled erythrocytes are administered to the patient.

The blood is taken in 15., 30. a 60. minute after administration of labeled erythrocytes. The activity is determined for each sample (A_v). The values are then inserted into the modified formula:

$$OEM = \frac{H * 0,98 * A_0}{A_v}$$

However, this value **does not match exactly** the whole body volume of erythrocytes. The hematocrit differs in different organs (for example spleen). There is also a difference between venous and arterial hematocrit.

Erythrocyte survival

To find out **erythrocyte viability** can be used two methods:

- erythrocyte monitoring **from precursors**;
- **significant heterogeneous population** of the erythrocytes.

Tracking from precursors consists in the use of a drug that binds to erythrocytes at a certain stage of maturation. After their disintegration, the labeled substance is eliminated from the body, so it should not be recaptured on red blood cells. Iron isotopes are most often used for labeling ^{52}Fe, ^{55}Fe, ^{59}Fe. We then monitor the loss of labeled erythrocytes and with it the loss of activity in the peripheral blood. The examination is not always perfect, because part of the iron ions of the radionuclide is again included in the formation of new erythrocytes. The examination time is also disadvantageous, ranging from weeks to months (normal erythrocyte viability is 120 days).

Labeling of a multi-population sample is a simpler and more commonly used method. Collected erythrocytes from peripheral blood are labeled with a radionuclide (^{51}Cr) and then returned to circulation. They occur in the sample**erythrocytes of different ages**, from freshly ripened to old. Therefore, we do not monitor the overall disappearance of the activity, as in the previous examination. Blood collection and activity measurements are

performed 24 hours and then three times a week for four weeks. A halving of the activity means that half of the labeled erythrocytes have been degraded, this time we call **half-life of chromium-labeled erythrocytes**. This should occur in a healthy person approximately **23–32 days** after administration of the labeled erythrocytes. Shortened time indicates **accelerated destruction of erythrocytes**.

Destruction site detection

The examination builds on the previous one. **We monitor the spleen, liver or other organs suspected of increased destruction by local scintigraphy** or by measuring activity. The activity over the precordium is used for comparison.

In places with higher activity, there is an increased breakdown of red blood cells and accumulation of radionuclides. The spleen and liver may show higher activity even under physiological conditions.

Examination of platelets

Survival and sites of platelet destruction

Labeled platelets (^{51}chromem nebo ^{111}indiem) are mostly from donors, as testing is indicated in patients with thrombopenia and other platelet disorders.

After administration of the labeled plates, blood is collected at 15, 60, 180 minutes and once a day for one week. To reduce the activity of the labeled platelets by half, they should milk in **7–10 days**. **Shortening** of this time indicates either increased destruction (artificial valves, splenomegaly) or increased consumption (thrombosis)

To find the site of increased destruction, we measure activity above the liver and spleen. If growing thrombi are suspected, we perform whole-body scintigraphy, which may reveal a possible increase in platelet uptake instead.

Examination of iron metabolism

Iron plays a key role in the construction of red blood cells. It is also involved in many metabolic pathways as a cofactor.

🔎 *For more information see Iron.*

Examination of iron metabolism is indicated in cases of or suspicion of various types of anemia, to monitor general end effective Erythropoiesis.

Plasmatic clearance

After administration of the radioactive isotope iron (usually ^{59}Fe) we take a blood sample at 5., 10., 20., 40., 60. minute and then every half an hour within 2 hours. We observe the change in activity by comparison with the sample from the 5th minute. The loss of radioactivity is comparable to the loss of iron from plasma. The important half (recess) is when the activity is halved.

Utilization of iron

We monitor the proportion of radioactive iron *embedded* in the erythrocyte.The measurement itself follows a few days after the administration of the radionuclide. The measured activity (A_v) of 1 ml of blood is multiplied by OEM (see above) and divided by the activity of the administered radionuclide (A_0).

$$utilizace = \frac{A_v * OEM}{A_0}$$

Uptake of organs

Following the administration of the iron radionuclide either **local measurement of activity by gavage** or **whole body scinthigraphy is performed**. We focus mainly on the **bone marrow**, but also on the organs of possible extramedullary hematopoiesis (liver, spleen).

Intestinal resorption

We give labeled iron orally and monitor the activity in the blood. Normmally about **20–30%** of labeled iron is absorbed. **Reduced** resorption indicates a failure of transport mechanisms or deficiency of vitamin C and HCl in gaster. **Increased** resorption indicates increased uptake during sideropenic anemia and after bleeding.

Odkazy

Související články

- Anémie

- Železo
- Trombocytopenie
- Červené krvinky

Použitá literatura

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Kategorie:Nukleární medicína Kategorie:Hematologie