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NONTRADITIONAL CONTRAST AGENTS FOR MEDIASTINAL LYMPHOGRAPHY USING SYNCHROTRON RADIATION

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The possibilities of SR usage in experimental medicine are considered. X-ray contrast agents which contain gold, silver, iron, platinum and rhodium were used to examine mediastinal lymph nodes of laboratory animals. The possibilities of X-ray contrast substance transport and the nature of their distribution in the internal structures of the lymph nodes were studied as well.

Despite the fact that a number of new methods of intrascopy (computer tomography, sonography, MR-imaging, etc.) have recently been advanced, X-ray contrast angio- and lymphography still remain necessary. In view of this, the development of new X-ray contrast agents (XCAs) still is an urgent problem.

Alongside with the creation and perfection of iodine water-soluble and oil-containing compounds for angio- and lymphography, magnetic compounds and liposome forms of XCA, and preparations of selective deposition in particular organs or systems, in the creation of new XCAs great attention is paid to the use of nontraditional chemical elements such as Ta, Hf, W, Cr and others [1]. This group of agents is for the most part injected intravenously to contrast the blood-vascular system of different organs, using radiation from X-ray tubes.

Nontraditional XCAs are currently applied to the examination of the lymphatic system rather insufficiently, in particular to indirect lymphography, although the latter can improve the diagnostics of the thorax, small pelvis and other organs where the transport of an XCA to the organ to be analysed is rather complicated or inefficient by other methods.

Our work is of experimental character and is devoted to the study of nontraditional XCAs for thorax lymphography, using X-ray fluorescence elemental analysis (XFEA) performed by means of synchrotron radiation generated by the storage ring VEPP-3 (INP, Novosibirsk). The high sensitivity of this technique and some other unique properties make it a convenient tool to determine low concentrations of an XCA and permit one to reveal its distribution in organs and tissues [2].

To contrast the lymphatic system of the mediastinum we have used agents containing rarely used or nontraditional chemical elements (gold, silver, iron, platinum, rhodium). The choice of these elements is due to their common properties to form colloidal solutions which are selectively absorbed by the roots of the lymphatic system in case of indirect lymphography. The agents were injected into the pleural cavity of Wistars, and 2, 4, 6 and 8 hours later the mediastinal lymphatic nodes were analysed using scanning SRXFA. The concentrations of Au and Pt were determined on the basis of the Fe, Rh and Ag L- and K-series in XFA spectra with a spatial resolution of 300 μm. The scanning was performed by shifting a sample by means of a two-coordinate mechanism (scanner) and the spectra were recorded and further processed for each of the points under examination. Such an analysis permits to obtain a map of the two-dimensional distribution of the particular element contained in the given XCA and distributed across the internal structures of a lymphatic node. The final stage of analysis was concerned with a morphological examination of the lymphatic system.

Our experiments have demonstrated the possibility of a steady contrasting of thoracic lymphatic nodes with colloidal solutions of the elements to be studied.

After computer-processing, the SRXFA data obtained were represented as curves which show the dynamics of XCA deposition. Analysis shows that the deposition of a contrast agent takes place at a particular rate. In the case of iron, rhodium and platinum solutions the rate is higher. For these elements, the peak concentration was observed 4 to 6 hours after injection. As for the gold- and silver-containing agents, a steady contrasting of the lymph nodes was observed too, but the dynamics of this process was different. The more efficient deposition of silver occurred for the first four hours, whilst for the gold-containing agent the same was observed six hours after the injection. For all our agents the common property was steadily high concentrations

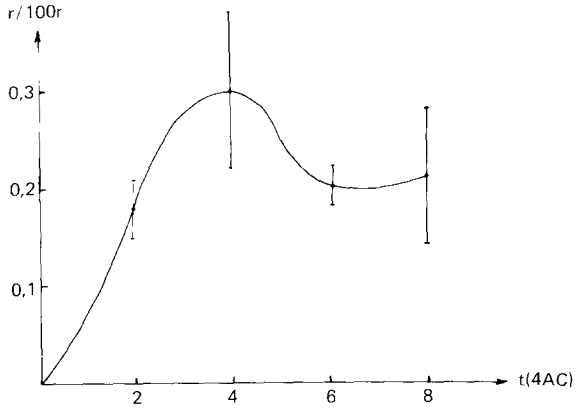

Fig 1. The diagram of Rh deposition dynamics in mediastinal lymph nodes.

4–6 hours after injection, which does not contradict our previous data [3]. The mean concentrations in lymphatic nodes were 1–2, 0.5–0.75, 0.2–0.35, 0.04–0.05 and 0.3–0.4 wt.% for Ag, Au, Rh, Fe and Pt, respectively. The diagram in fig. 1 illustrates the dynamics of Rh deposition in the lymph nodes of the mediastinum.

The results of the morphological analysis of lymphatic nodes have shown that the character of the XCA distribution in them is different and one can distinguish several variants of such a distribution in the lymphoid tissue of the nodes. The contrast substance was revealed either throughout the lymphatic node area or as fragments, or subcapsularly. As a consequence, the contrast substance is basically deposited in the sine system or in the cortical plateau of the lymphonode. As a rule there was no substance in lymphatic nodules and paracortex. In the cortical plateau of the lymphonode the XCA was distributed diffusively or locally. Proceeding from the morphological analysis of the XCA distribution in the lymph nodes, we may conclude that this is determined by the structurally functional condition of a particular lymphonode and just this determines its roentgenological structure.

Scanning analysis of the XCA distribution in the structure of mediastinal lymph nodes without pathology

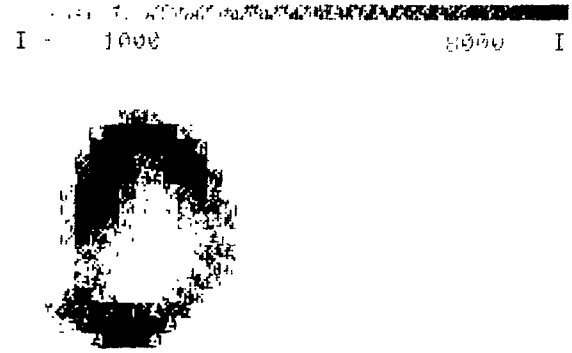

Fig. 2 The distribution of the X-ray contrast agent in the structure of a mediastinal lymph node without pathology.

(fig. 2) indicates that any of the XCA involved is arranged as a circle or a semi-ring in the node periphery, which is one of the variants of the XCA distribution for a normal case [4].

As the data available show, the colloidal solutions are steadily accumulated in the lymphatic system of the mediastinum and this allows to study experimentally the functional ability of the lymphatic system to transport various contrast agents and also to study the character of the XCA distribution in lymph nodes with and without pathology.

In conclusion we would like to note that the application of SRXFA to the solution of some applied problems in medicine, in particular to the creation of new XCAs, seems to be promising.

References

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