

DISTRIBUTION IN THE ORGANS AND TISSUES OF INTRAVENOUSLY ADMINISTERED RADIOACTIVE PHOSPHORUS IN INFECTIOUS PERITONITIS

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Peritonitis is one of the most serious diseases of the organs of the abdominal cavity. According to the data of different authors [4,16,19] the lethality in acute diffuse peritonitis is 4-10%.

According to the data of I. I. Deryabin [6] and K. S. Simonyan [17], all forms of metabolism are affected quickly and severely in peritonitis, which is probably a result of change in the permeability of the cell membranes. N. V. Okunev [14] notes that almost every nosological unit is based on some permeability disorder.

The many works carried out in N. N. Zaiko's laboratory [8] have given reason to conclude that the permeability of cell membranes is of great importance in protection of an organ from the action of toxins. K. F. Dogaeva [7] used the method of intravital microscopy to establish that the capillary walls of different organs and tissues are variably permeable by stains, the permeability depending primarily on both the structure of the capillary endothelium and the functional condition of the organ. The works of several authors [1,5,10,15,18] have demonstrated that the functional condition of almost every organ changes in peritonitis.

This study of the permeability of the vessels of the internal organs in infectious peritonitis was based on the above data.

METHOD

The work was performed on 20 rabbits and consisted of two series of experiments. In the first series, performed on ten animals, we studied the permeability of the capillaries in the internal organs under conditions of infectious peritonitis. In the second series, we studied capillary permeability in these same organs in ten healthy rabbits. This series served as the control.

Laparotomy was performed on the animals of the first series under local anesthesia (10-15 cc of a 0.5% Novocain solution subcutaneously administered) after preparation of the operative area. Then the stomach was perforated with a red-hot rod 0.3 cm in diameter. The cauterizing action of the rod created a zone of necrosis and a gaping perforation. Through the perforation, the gastric contents flowed out into the abdominal cavity. A 24 hour culture of virulent *Staphylococcus aureus* screened from purulent exudate obtained from sick people was then introduced into the gastric lumen through the perforation in a dose of one billion microbes. The subcutaneous administration of this microbe emulsion to a rabbit induced necrosis and purulent inflammation of the cellular tissue, while its intravenous administration caused death. The wound in the abdominal cavity was tightly sutured (by a method borrowed from I. I. Neimark [12]). In all the animals of this group, the development of peritonitis was indicated within 24 hr by the presence of exudate in the abdominal cavity, rise of body temperature and increased number of leukocytes in the peripheral blood.

We used the radioactive phosphorus isotope $P^{32}(Na_2HP^{32}O_4)$ to determine vascular permeability. Twenty-four hours after the operation described, radioactive phosphorus was injected into the marginal vein of the ear of the experimental and of the control (unoperated) animals in a dose of $22 \mu C$ per 1 kg weight. One hour after the phosphorus was administered, the animals were sacrificed by air embolism, and specimens were prepared from the internal organs to determine capillary permeability.

The following organs were examined: the parietal and visceral peritoneum, skin, lungs, diaphragm, heart, omentum, liver, spleen, kidney, adrenal gland and brain. A total of 140 specimens were prepared. The permeability of the capillaries in these organs was determined by I. A. Mukhamedzhanov's method [11]. Pastes prepared from each organ were applied in amounts of 200 mg to pieces of filter paper of equal weight and area. The pieces of paper with the tissue were dried somewhat, then examined for radioactivity on a type B counting apparatus with an MS-4 electronic counter. The number of impulses per min was computed after deduction of the background, and average figures were computed from three determinations. This method made it possible to judge the general capillary permeability [13].

RESULTS

Radioactivity of Tissues of Various Organs in Control Rabbits (without Peritonitis) and Animals with Peritonitis. Number of Impulses (in %) Are Averages of Ten Determinations

| Experimental organ | Control rabbits | | Rabbits with peritonitis | | Average difference (%) |
|---------------------|-----------------|---|--------------------------|---|------------------------|
| | Impulses | Mean square deviation and average error | Impulses | Mean square deviation and average error | |
| Brain | 100 | $\sigma \pm 4.00$ $m \pm 1.02$ | 140 | $\sigma \pm 3.74$ $m \pm 1.01$ | +40 |
| Skin | 160 | $\sigma \pm 4.80$ $m \pm 1.05$ | 200 | $\sigma \pm 5.29$ $m \pm 1.07$ | +40 |
| Lung | 200 | $\sigma \pm 5.29$ $m \pm 1.06$ | 220 | $\sigma \pm 5.74$ $m \pm 1.08$ | +20 |
| Heart | 200 | $\sigma \pm 5.92$ $m \pm 1.08$ | 220 | $\sigma \pm 4.80$ $m \pm 1.05$ | +20 |
| Liver | 200 | $\sigma \pm 4.80$ $m \pm 1.05$ | 300 | $\sigma \pm 5.83$ $m \pm 1.08$ | +100 |
| Spleen | 200 | $\sigma \pm 3.00$ $m \pm 0.94$ | 220 | $\sigma \pm 5.57$ $m \pm 1.07$ | +20 |
| Omentum | 140 | $\sigma \pm 3.61$ $m \pm 1.01$ | 160 | $\sigma \pm 2.83$ $m \pm 0.89$ | +20 |
| Visceral peritoneum | 200 | $\sigma \pm 7.48$ $m \pm 2.03$ | 280 | $\sigma \pm 5.10$ $m \pm 1.06$ | +80 |
| Parietal peritoneum | 140 | $\sigma \pm 4.90$ $m \pm 1.05$ | 220 | $\sigma \pm 5.00$ $m \pm 1.05$ | +80 |
| Diaphragm | 140 | $\sigma \pm 5.10$ $m \pm 1.06$ | 240 | $\sigma \pm 5.83$ $m \pm 1.08$ | +100 |
| Kidney | 160 | $\sigma \pm 3.87$ $m \pm 1.02$ | 240 | $\sigma \pm 4.58$ $m \pm 1.04$ | +80 |
| Adrenal gland | 180 | $\sigma \pm 4.80$ $m \pm 1.05$ | 200 | $\sigma \pm 5.48$ $m \pm 1.07$ | +20 |

The results obtained are given in the table.

It is evident from the data presented in the table that, as Starling has indicated [21], capillary permeability is not stable in healthy animals. The variations in permeability which occur under normal physiologic conditions are evidently connected with the course of the metabolic processes.

The results obtained indicate that the vessels of all the internal organs of the rabbits with peritonitis showed considerably greater permeability than those of the control animals. In such organs as the lungs, heart, spleen, omentum, and adrenal gland the vessels' permeability was 20% higher, and in the skin and brain vessels 40% higher, while the vessels of the parietal and visceral peritoneum were 80% more permeable than those of the controls. The number of impulses found in the liver and diaphragm specimens showed a 100% increase in permeability as compared with the controls.

The data we obtained, therefore, indicate that the properties of the whole capillary network are disturbed in peritonitis, apparently as a result of metabolic disturbance and the accumulation of toxic products which act on the vascular walls. The increased permeability of the vessels of the internal organs creates favorable conditions for the absorption of the pathologic metabolic products which form in great quantity under conditions of an inflammatory process as extensive as peritonitis [2, 3, 9, 20]. On the basis of these data, it is easy to explain the symptoms of meningoencephalitis observed by Kh. G. Gafurov [5] in animals with experimental purulent peritonitis.

SUMMARY

Changes in the capillary permeability of internal organs, skin and brain occurring during infectious acute peritonitis were studied with the aid of radioactive isotopes. The results obtained have demonstrated an increased capillary permeability in all the internal organs, skin and brain. The greatest rise of capillary permeability was noted in the organs directly adjacent to the inflammation focus, or in those participating in the neutralization and excretion of toxic substances from the body.

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of this issue.
