CHANGES IN THE LEUKOCYTE COUNT AFTER PANCREATIC RESECTION BY PLASMA SCALPEL AND CRYODESTRUCTION

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The plasma scalpel effectively divides tissues and coagulates blood vessels, bile and pancreatic ducts, and the bronchi [2, 3, 5, 7, 10].

Tissue cryodestruction, to which an analgesic and antiinflammatory action is ascribed, is a new method in operative surgery. Application of cold increases the resistance of the parenchymatous organs to hypoxia and toxemia. In operations on the pancreas its secretory function is reduced and activity of the pancreatic enzymes is suppressed [1, 4]. It is considered that the prospects are good for the combined use of a plasma scalpel and tissue cryodestruction [2].

The use of these methods in experiments on animals, with a view to their future use in clinical practice, necessitates a comprehensive study of both local and general reactions of the body to these procedures. Great importance is attached to parameters of activity of the blood system, especially leukocytic reactions, during surgical intervention [8]. The aim of this investigation was to compare the blood leukocyte count during operations for resection of the pancreas in dogs, undertaken by means of a plasma scalpel, and also the combined operation in the form of preliminary cryodestruction followed by resection with a plasma scalpel.

EXPERIMENTAL METHOD

Experiments were carried out on 27 mongrel dogs weighing from 6 to 20 kg. The operations were performed under intrapleural hexobarbital anesthesia, in a dose of 0.8-1.0 mg/10 g body weight. The SUPR-M plasma apparatus was used. Its conditions of use were: diameter of the plasma-forming nozzle 1 mm, mode of operation of the apparatus – "sharpness." Rate of gas supply 0.4 kg/sec/cm. In the first series of experiments, after midline laparotomy, the uncinate process of the pancreas was resected in 16 dogs. The visible part of the plasma-jet was applied directly to the tissues of the organ at an angle of 60-70° to the resected surface. In the second series (11 dogs), the resection indicated above was carried out after freezing of the pancreas along the line of incision with a cryoapplicator for 1 min. Blood loss during the operation was minimal. It occurred only due to the lapatoromy and taking of blood samples for investigation. The wound was closed in layers: catgut sutures to the peritoneum and silk to the aponeurosis and skin. The operation was of a type readily tolerated. The animals were active on the day after the operation, drank water and ate food. The postoperative wound healed without complications. Blood for cytomorphologic investigation was taken from the femoral vein before the operation and 1, 3, 7, 14, 21, and 30 days and 2-3 months after the operation. The hemoglobin concentration, erythrocyte count, and hematocrit were determined in the blood samples. The total and differential leukocyte counts were determined. The necessary indices were calculated, including the leukocytic intoxication index (LII). The character of the leukocytic changes was judged on the basis of percentages and absolute values for individual types of leukocytes. The numerical results were subjected to statisti-

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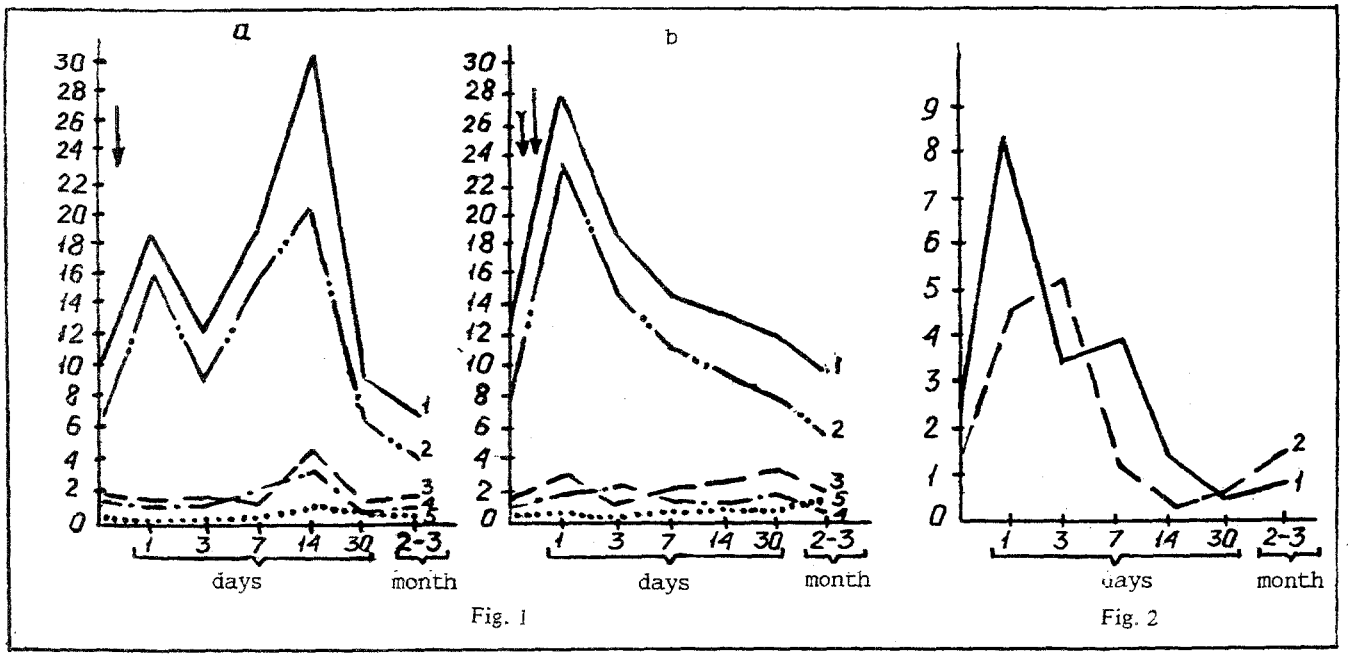

Fig. 1. Leukocyte counts in 1st (a) and 2nd (b) series of experiments: 1) total leukocyte count, 2) neutrophils, 3) lymphocytes, 4) monocytes, 5) eosinophils. Arrows: → – plasma scalpel; ⇢ – cryodestruction.

Fig. 2. Leukocytic intoxication index: 1) after resection of pancreas with plasma scalpel; 2) after combined operation.

cal analysis. Changes at the $p \leq 0.05$ level were considered to be significant. Because of the very small blood loss the hemoglobin concentration and erythrocyte count and the hematocrit index did not undergo any significant changes. There was only a tendency toward a transient erythrocytopenia and oligochromemia on the 3rd-7th days after the operation.

Conversely, changes in the leukocyte spectrum of the blood in the two series of experiments were sufficiently regular. In the first series (Fig. 1a), for instance, neutrophilic leukocytosis developed 1 day after the operation, with a shift of the stab cells to the left. The total leukocyte count rose on average from 11.2 ± 2.5 to $18.3 \pm 2.3 \cdot 10^9$/liter ($p < 0.05$). It will be clear from Fig. 1 that the leukocytosis developed on account of an absolute increase in the number of neutrophils, whereas the concentrations of other types of leukocytes fell significantly. On the 3rd day the intensity of this reaction was a little reduced, but 2 weeks after the operation a new peak of leukocytosis occurred, due not only to neutrophils, but also to an absolute increase in the numbers of lymphocytes and monocytes. The total leukocyte count reached $29.7 \pm 3.6 \cdot 10^9$/liter ($p < 0.05$). The absolute number of eosinophils in the blood was increased under these circumstances by 2.1 times, the number of monocytes by 2.45 times, and of lymphocytes by 2.92 times ($p < 0.05$, $p < 0.02$, $p < 0.05$ respectively). Basophils varied within the range $(0.01\text{-}0.02) \cdot 10^9$/liter. At the height of the leukocytosis, like the eosinophils, they were hardly detectable in the peripheral blood. Normalization of the blood leukocyte spectrum took place toward the end of the first month after the operation.

In the second series of experiments after the operation with cryodestruction and the use of the plasma scalpel the leukocytic response was significantly changed. It will be clear from Fig. 1b that during the first day the animals developed a comparatively higher leukocytosis. On average the total leukocyte count rose from 9.0 ± 1.3 to $27.5 \pm 1.6 \cdot 10^9$/liter ($p < 0.05$), mainly on account of neutrophils, the number of which increased under these circumstances by $16.6 \cdot 10^9$ cells/liter. Quantitative fluctuations of the remaining types of leukocytes showed no significant regular pattern.

Starting with the 3rd day the total leukocyte count fell rapidly to its initial level. In this series of experiments the second wave of "mixed" leukocytosis was absent and absolute lymphomonocytosis did not arise.

The LII is a parameter calculated from the data of the leukocyte counts and, in the opinion of some research workers, it reflects the dynamics of the inflammatory process, and the degree of toxic damage [6, 9]. As Fig. 2 shows, 1 day after the combined operation LII was much less than in the first series of experiments, evidence of less severe toxic and inflammatory manifestations in response to this procedure. Normalization of the index took place in this case a week earlier than in the first series of experiments.

The characteristics of the leukocytic reaction to the combined operation have a complex genesis. Very probably due to the deep cooling of the resected part the level of resorption and intoxication falls, and perhaps so also does the level of reception, including nociceptive, and this is reflected in the dynamics of the leukocytic reaction.

Resection of the pancreas by means of a plasma scalpel is thus accompanied by biphasic changes in the leukocyte count, in the form of two consecutive waves of neutrophilia, involving the other types of leukocytes in the second phase. On the whole this reaction is evidence of awakening of activity of the "leukon" in response to the operation. Some particular features of the leukocytic reaction to a combination of cryodestruction and the plasma scalpel also were discovered, and these will be of interest for clinicians and experimental research workers. The truncated character of the leukocytic response and the comparatively lower values of LII, etc., point to a weaker degree of inflammatory manifestations in the cases when cryodestruction was used.

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