CHANGES IN THE BARRIER FUNCTION OF INFLAMMATORY FOCI ON SENSITIZATION AND LOCAL COOLING

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In a previous work [5] we presented data on the changes which occur in tissue resorptive capacity on specific protein sensitization. It was shown that the absorption of horse serum tagged with radioactive iodine from tissue is more rapid in rabbits preliminarily sensitized with the same serum than in intact, unsensitized animals. Conversely, subsequent investigations revealed that general cooling of the body retards serum resorption, while local cooling has no material influence on the ability of tissue to resorb tagged proteins [2, 4].

TABLE 1. Resorption of Tagged Horse Serum from Intact and Inflammed Tonsillary Tissue in Sensitized and Unsensitized Rabbits

Group of rabbits	Rabbit No.	Date of Expt.	Half-resorption time (in min)	
			Intact tonsillary region	Inflamed tonsillary region
Sensitized	1	18/XII	35	60
	2	18/XII	50	75
	3	19/XII	40	40
	4	19/XII	25	45
	5	20/XII	35	55
	6	21/XII	30	55
	$M \pm m$		36,0±3,3	55,0±5,0
Unsensitized	7	22/XII	40	70
	8	22/XII	60	90
	9	22/XII	35	115
	10	25/XII	30	70
	11	25/XII	80	120
	12	26/XII	45	66
	$M \pm m$		48,3±7,5	88,5±10,0

All these data indicate that tissue resorptive activity may be altered when the reactivity of the organism changes.

This problem is of special importance in regard to inflammation, since it is well known that an inflammatory

TABLE 2. Resorption of Tagged Horse Serum from Inflammed Tonsils in Dogs

Dog No.	Nickname	Date of experiment	Half-resorption time (in min)	
			Right tonsil	Left tonsil
1	Galka	17/XI 1960	40	45
2	Talant	2/XII 1960	55	65
3	Georg	27/I 1961	45	45
4	Oblom	28/I 1961	60	55
5	Karo	10/II 1961	40	40

Note: Horizontal treatment method; M = 2 min, m = = ±2.5 min, t = 0.8, and the difference is unreliable.

process itself causes regular changes in tissue resorption, these, to a considerable extent, determining the barrier role of the inflammation. In this connection, it is clear that when inflammation is present the changes in tissue resorptive activity must be characterized by a number of peculiarities associated with the influence of factors such as cooling and specific sensitization.

This problem is of very great practical importance in regard to the tissues of the tonsils and adjacent regions, since changes in the resorptive activity of the oral tissues form the basis for the development of tonsillary and, especially, tonsilogenic lesions. Such lesions also develop under natural conditions, primarily in connection with sensitization and chilling.

This report presents the results of experiments performed on rabbits and dogs to elucidate the influence of specific sensitization and cooling on the ability of inflammatory foci to resorb protein substances.

EXPERIMENTAL METHOD

We used 12 rabbits and 11 dogs in our experiments. The resorptive capacity of the tissues of the tonsils (in the dogs) and the tonsillary region (in the rabbits) was evaluated from the rate at which horse-serum proteins tagged with radioactive iodine and injected into these tissues were absorbed. The proteins were tagged by the method of Liebster et al. [9], which we described in a previous work [5]. The rate at which the tagged proteins were resorbed was determined from the decrease in the radioactivity of the isotopes introduced into the tissue, using Kety's method [8] as modified by I. I. Islamov [1], which consists in evaluating the resorption rate of injected substances from the time required for their radioactivity to be halved.

The characteristics of the radioactive substances which we employed and other details of the experiment were described in a previous work [5].

The rabbits were sensitized with 6 intraperitoneal injections of horse serum at one-week intervals. Animals were usually selected for the experiments 3 weeks after the last sensitizing injection.

In the investigations on dogs one tonsil was cooled; the other, on the opposite side, was left intact and served as a control, since resorption was determined simultaneously in both tonsils.

The tonsils were cooled by superficial application of a test tube containing a mixture of ice and salt in such fashion that the temperature of the cooled tissue remained 2-3° below its initial level throughout the entire experiment.

In both the rabbits and the dogs inflammation was induced by injection of 0.1 ml of a turpentine emulsion into the appropriate tissue areas, this being followed by morphological examination.

In all the experiments study of the resorption rate began 5-10 min after the inflammation was induced.

EXPERIMENTAL RESULTS

In the 1st series of experiments we studied the influence of sensitization on the resorption of proteins tagged with radioactive iodine from normal and inflammed tissue in rabbits. For this purpose, six animals were preliminarily sensitized with horse serum; six unsensitized animals served as the control. Inflammation was induced in the tonsillarly region of one side in the rabbits of both groups; tagged serum was then injected into the tissues of both sides and the dynamics of resorption were determined simultaneously for both sides. We were thus able to compare the resorptive activity of normal and inflamed tissue after specific sensitization and with no sensitization.

Our investigations showed (Table 1) that the inflammatory process caused a retardation of the resorption of tagged proteins, a phenomenon reflected in the fixative role of the inflammatory focus. This retardation was quite marked in both the sensitized and unsensitized animals. In the former case its mean value was 19.0±7.8 min, while in the latter it was 40.2 ± 12.2 min (the difference was reliable in both cases: $P<0.05>0.01$).

TABLE 3. Resorption of Tagged Horse Serum from Inflamed Dog Tonsils on Local Cooling

Dog. No.	Nickname	Date of expt. (1961)	Half-resorption time (in min)	
			Cooled tonsil	Uncooled tonsil
1	Mu-Mu	1/II	135	105
2	Shaiba	26/I	120	105
3	Zoika	28/I	80	35
4	Struchok	2/II	105	38
5	Minutka	3/II	80	65
6	Sova	27/II	85	37

Note: Horizontal treatment method; M = 35 min, m = = ±11, t = 3.5, P<0.02> 0.01.

The comparative data on the resorption rates in the sensitized and unsensitized animals indicate that sensitization accelerates protein resorption from both normal and inflamed tissue. This becomes quite clear when we compare the data on the time required to remove half the protein from the inflammatory focus in rabbits Nos. 1-6 and 7-12.

More specifically, while the time required for the radioactivity of the proteins injected into the inflammatory focus to decrease by a factor of two was 55±5 min for the sensitized rabbits, it was 88.5±10 min for the unsensitized rabbits. The difference in the resorptive activities of the inflammatory foci in the sensitized and unsensitized animals was thus 33.5±1.1 min (a reliable difference: P<0.05 > 0.02).

The data obtained indicate that specific sensitization is a factor which attentuates the barrier properties of an inflammation and accelerates resorption of protein substances from the inflammatory focus. Sensitization has the same effect on inflamed and intact tissue in this respect.

In the next series of experiments, which was conducted on dogs, we studied the influence of cooling of the tonsillary tissue on its protein resorption. Since the inflammation was induced on both sides and one tonsil was later cooled, we first conducted a series of experiments on 5 dogs, in which we studied the extent to protein absorption was retarded when inflammation was induced on both sides under identical conditions. It was found (Table 2) that the difference in the time required for half the protein injected to be absorbed from the left and right tonsils did not exceed 1 min, averaging 2 min. Taking this into account, we were able to proceed with an investigation of the influence of cooling on the resorption of proteins from inflamed tissue, i.e., an investigation of the influence of cooling on the barrier function of inflammatory foci.

Our research showed (Table 3) that cooling retards absorption of protein substances from inflammatory foci. More specifically, the mean time required for resorption of half the protein from the inflammatory focus in the cooled tonsils was 35 ± 10 min greater than that for the inflamed uncooled tonsils (this difference was reliable: P<0.02> 0.01).

The data obtained enable us to conclude that cooling intensified the fixative action of inflammation.

As is well known, formation of the barrier which prevents penetration of proteins from an inflammatory focus into the surrounding tissue may result from occlusion of the lymph passages by fibrin [10, 11], the activity of cellular elements [3, 7, 10, 12], a change in the sorptive properties of connective-tissue elements [3, 6], formation of large protein complexes, etc. It is difficult to say which of these mechanisms cooling may affect, but it must be assumed that the phenomenon described above is based on a spasm of the lymph capillaries. This spasm is apparently an additional factor which intensifies protein fixation in the inflammatory focus and thus intensifies the focal barrier properties.

The data cited also merit attention in connection with the fact that, as our previous work demonstrated, similar local cooling of uninflamed tonsillary tissue is not accompanied by any marked or regular retardation of protein absorption. We may consequently speak only of the characteristics of the reaction of the lymph capillaries to cooling when inflammation apparently leads to functional changes in the tissue lymph system, which cause it to have an increased sensitivity to the action of a number of environmental factors.

SUMMARY

In experiments on dogs and rabbits it was demonstrated that specific sensitization reduced the barrier properties of the infection focus to the radioiodine labeled proteins. And conversely, local chilling delayed resorption of the local proteins from the inflammation focus, i.e., enhanced the barrier properties of the latter.

Pathophysiological significance and the mechanism of the described phenomenon are discussed.

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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.
