THE RATE OF FLOW OF THE LYMPH IN AN INFLAMMATORY FOCUS

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Numerous investigations have revealed the barrier properties of the inflammatory focus, leading to the retention of both high-molecular particles and low-molecular compounds in the focus. The delayed resorption of low-molecular compounds from the focus of inflammation is explained by a slowing of the rate of the lymph flow in inflammatory tissue [3, 4, 5] and by the formation of complexes through the interaction of these substances with the proteins of the exudate [6]. Fixation of particles and of high-molecular compounds in the inflammatory focus is explained by phagocytosis and by interference with the outflow of lymph by the formation of fibrin plugs [10] in the lymphatic capillaries and by spasm of the lymphatic vessels [11]. The condition of the flow of lymph within the inflammatory tissue cannot, however, be considered to be conclusively explained. In accordance with the known fact that the outflow of lymph from an inflamed limb is increased, for instance, it has been concluded that the retention of particles in the inflammatory focus is due to their adsorption on fibrin and not to the slowing of the flow of lymph [9].

In order to elucidate this problem, we carried out direct investigations of the rate of flow of the lymph in an inflammatory focus.

EXPERIMENTAL METHOD

Inflammation was induced by the application of 0.05 ml of xylol to a shaved area of the skin of the abdominal wall of rabbits.

The state of the lymph flow was judged by the rate of removal of serum protein, labeled with I^{131}, injected intradermally [1, 2, 7].

The serum proteins of the rabbits were labeled by the method of Francis, Mulligan and Wormall [11]. Labeled serum (0.02 ml) was injected into the skin of the abdomen of the rabbits before the application of xylol, immediately after application and again after 40 minutes. The skin over the site of injection of the serum was carefully washed 5-6 times by separate cotton-wool swabs soaked in water. The distance between the site of injection of the serum and the end-type radiation counter throughout the experiment was 2 cm. The radiation intensity was recorded every minute at intervals of one minute by means of a type B apparatus. The background radiation was measured before and after each experiment.

From the results obtained curves were drawn using a semilogarithmic system of coordinates (on the abscissa, time in minutes, on the ordinate, the logarithm of the number of impulses). The rate of removal of labeled protein from the skin and, consequently, the rate of flow of lymph in the skin were estimated from the time of removal of one half the labeled protein injected intradermally. The details of the method are described in our other paper [2].

EXPERIMENTAL RESULTS

The course of removal of the labeled serum proteins injected intradermally into 11 rabbits is shown in the table.

TABLE

Time of Removal of Half the Labeled Serum, Injected Intradermally, from Normal and Inflamed Skin in Rabbits (in minutes)

Rabbit No.	Weight of rabbit (in kg)	Before application of xylol to the skin	After application of xylol	
			Time of measurements (minutes)	
			0–40	40–100
1	1.83	80	82	153
2	1.67	94	105	96
3	2.10	89	67	123
4	2.30	90	103	108
5	1.81	90	47	105
6	1.45	94	60	92
7	1.75	84	56	141
8	1.63	89	62	99
9	1.81	86	48	100
10	2.15	81	55	107
11	1.85	89	—	171
M	1.85	87.8	68.5	117.6
σ±		4.6	21.2	26.1
m±		1.4	6.6	7.9

Analysis of the results shown in the table demonstrates that at the very beginning of development of inflammation (during the first 40 minutes after application of xylol to the skin) the rate of removal of serum proteins, injected intradermally, from the inflammatory focus was sharply increased ($P < 0.01$).

In the subsequent development of the inflammation (40-100 minutes after the application of xylol) the rate of removal of the labeled serum proteins from the inflammatory focus was slowed ($P < 0.01$).

An increase in the rate of removal of the labeled serum proteins from the inflamed tissue was observed only at the very beginning of development of the inflammatory process. This was evidence of an increase in the intensity of the lymph flow at this period of development of the inflammation and corresponded to the acceleration of the blood flow which we have described previously [3]. Soon the lymph flow, like the blood flow, was slowed. The proteins injected into the inflammatory focus began to be retained in the tissue. Side by side with the slowing of the blood and lymph flow in the inflammatory focus, at its periphery, the blood and lymph circulation were intensified. This accounted for the apparent discrepancy between the slowing of the lymph flow in the inflammatory focus and the increased outflow of lymph from the inflamed limb.

SUMMARY

Inflammation in rabbits was caused by xylol application to the skin of the abdomen (the hair being previously cut). The velocity of the lymph flow was determined by the rapidity of removal of the homologous I^{131} labeled serum, injected intradermally. The velocity of removal of labelled proteins is higher during the first 40 minutes following the application of xylol, and subsequently decreases. Thus, stagnation of the lymph develops in the focus of infection after a short period of accelerated velocity of the flow.

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