Delta J. Sci. 12 (3) 1988, 1263-1278

THE ROLE OF MACROPHAGES IN THE MECHANISM OF LYMPHOCYTE TRAPPING

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Received: 3-12-1988

ABSTRACT

Lymphocytes trapping in the spleen may be initiated by macropages via a direct binding of the lymphocytes to their surfaces or it may be mediated by soluble products of macrophages, released in the circulation after phagocytosis. So this study was carried to clarify the role of macrophages in the mechanism of lymphocyte trapping.

Fourteen adult males of albino rats Rattus rattus (8 weeks old) were interavenously injected slowly with 0.3 ml of Pelican ink (16 mg/ml carbon). It was found that there is a positive correlation between the distribution pattern of carbon containing macrophages and the route of lymphocyte circulation in the spleen, which led us to suggest that lymphocyte trapping is due to direct lymphocyte-macrophages adherence.

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INTRODUCTION

In the recent years several investigators have shown that antigen can alter the pattern of lymphocyte recirculation (Zatz and Lance, 1971). This change in cell traphic has been called trapping (Frost and Lance, 1973). It has been reported by Frost and Lance (1973) that macrophages play a central role in the initiation of lymphocyte trapping in lymphoid organs following the administration of a variety of immunogenic and nonimmunogenic-compounds indicating that these show phagocytosis.

It is well established that lymphocytes enter the spleen in the arterial circulation which terminate as penicillary arterioles in the marginal zone after traversing the white pulp (Weiss, 1964 and Junqueira and Carneiro, 1983).

However, some lympocytes pass directly into the red pulp, whilist other enter the white pulp (periarteriolar lymphocyte sheath) (Mitchell, 1972). The same author described the marginal zone bridging channels which run between both the periarteriolar lymphatic sheath and the red pulp sinuses, and the peripheral white pulp and the red pulp sinuses, crossing the marginal zone in association with fine argentophilic fibres and suggested that transit

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was occurring in the direction from white pulp to red pulp rather than the revers.

However, the literature concerning the mechanism of trapping are deficient, so the aim of the present work is to study whether macrophages, often phagocytosis of colloidal carbon particles, could be responsible for the trapping through direct or indirect way through a correlation between the distribution pattern of carbon containing macrophages and the route of lymphocyte circulation in the spleen.

MATERIAL AND METHODS

Fourteen adult of males albino rats Rattus rattus (8 weeks old) were interavenously injected slowly with 0.3 ml of Pelican ink (16 mg/ml carbon) according to Kotani et al. (1985). The animals were sacrificed at times from 1 hour up to 7 days (1 h., six hs., 12 hs., 24 hs., 3 days, 5 days and 7 days]. The spleen from two rats at each time was fixed in Carnoy's fluid and embedded in paraffin wax. Serial 6 μ thick sections were stained with methyl green pyronin technique.

RESULTS

Two types of macrophages which ingested carbon were found in the marginal zone during the course of this study.

The first type (type 1) consisted of very large cells with big oval or rounded nuclei and contained large amount of carbon. The second type of cells (type 2) were much smaller and possessed far less carbon (Fig. 3).

Type 1 macrophages appeared in a great number in the marginal zone one hour after carbon injection (Fig. 1), and decreased markedly within 3 to 5 days (Fig. 8). Contrary to the rapid decrease of type 1 macrophages in the marginal zone these cells appeared in the red pulp immediatly outside the marginal zone (Fig. 2) and in the periphery of the white pulp (Fig. 4). This suggested the apparent migration of type 1 macrophages from the marginal zone towards the red pulp and white pulp. On the other hand, occasional type 2 macrophages were observed in the marginal zone one hour after carbon injection (Fig. 1) and increased markedly in a short time. Type 2 macrophages were scattered through the red pulp at one hour after carbon injection and subsequently were scattered through the white pulp. Both types of macrophages appeared in the periarterial lymphoid sheath surrounding the central artery. Although type 1 macrophages in the marginal zone decreased in number markedly within 3 to 5 days after carbon injection , many of them could be found untill the end of the experiment (7 days).

DISCUSSION

There is a good agreement that intravenously injected antigen or immune complex are removed from the blood stream

in the marginal zone of the spleen by macrophages (Nossal et al., 1966 ; Hunter et al., 1969 and Nossal and Ada, 1971). The crucial finding of Frost and Lance (1974) was that substances such as colloidal carbon independant of their immunogenicity but depentant on phagocytosis after administration, cause lymphocyte trapping.

Lymphocyte trapping may be initiated by macrophages via a direct binding of the lymphocyte to their surface (Paraskevas et al., 1971) or it may be mediated by a soluble product of macrophages released in the circulation after phagocytosis as suggested by Van Rooijen and Roeterink, 1980.

The present study showed possible migration of carbon laden macrophages in a large scale from the marginal zone to the white pulp and to the red pulp. Migration of carbon laden macrophages appeared to move from the marginal zone to the deeper white pulp diffusely from the periphery of the white pulp or through the periarteriolar lymphoid sheath. The site of entry of these cells into the peri - arterial lymphoid sheath seemed to be the marginal zone bridging channels. So our results suggested a positive correlation between lymphocyte circulation in the spleen and macrophages. This suggesion was supported by (De Jesus et al., 1972 ; Brown et al., 1973 and Masahiko Kotani

et al., 1985) who thought that lymphocytes provid receptors for antigen-antibody complexes which are responsible for transport of macrophages in the spleen. They added that fixed macrophages type 1 plays the major role in the transport mechanism while the wandering macrophages type 2 plays a minor role.

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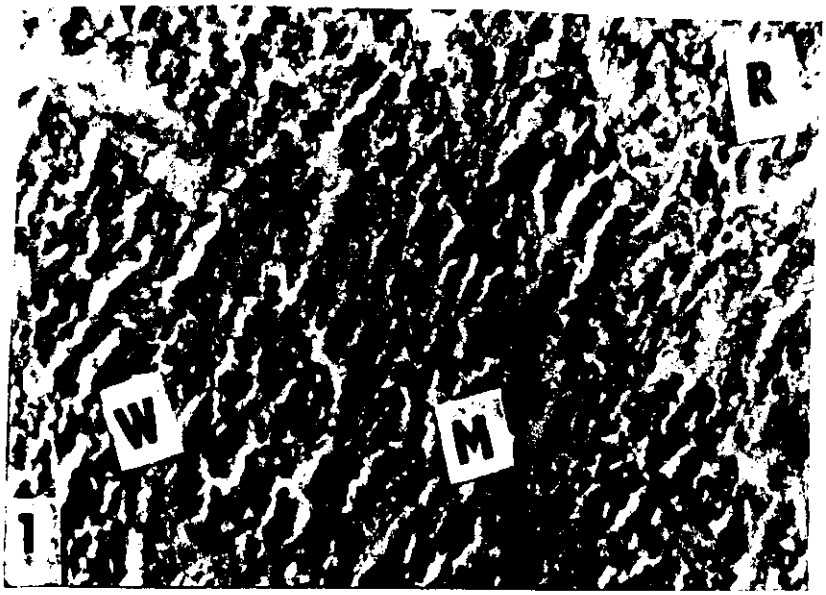
Fig. 1 : One hour after carbon injection. In the marginal zone (M) numerous carbon-laden macrophages (type 1) are seen, also smaller carbon laden macrophages are seen (type 2). None could be seen in the white pulp (W). Methyl green pyronin strain X 400.

Fig. 2 : One hour after carbon injection (type 2) macrophages are scattered through the red pulp (R). Methyl green pyronin X 160.

Fig. 3 : Higher magnification to show type 1 and type 2 macrophages. Methyl green pyronin X 1000.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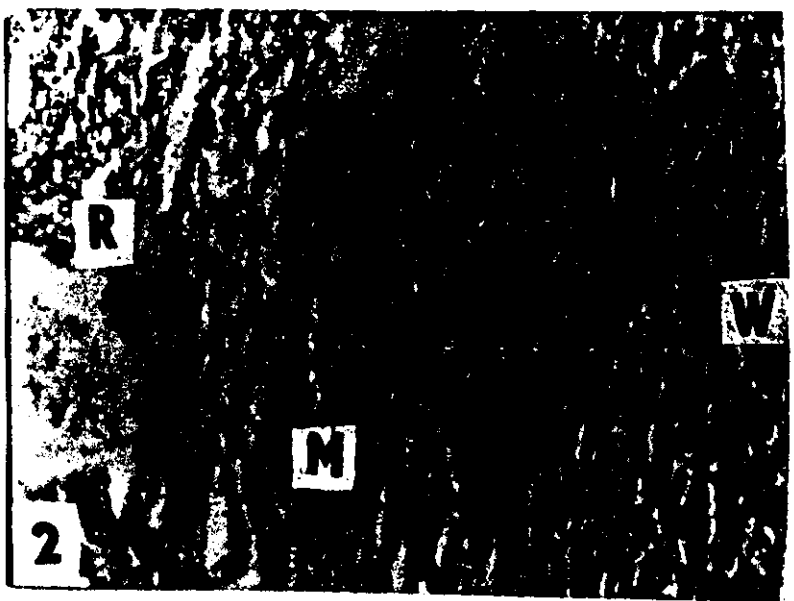
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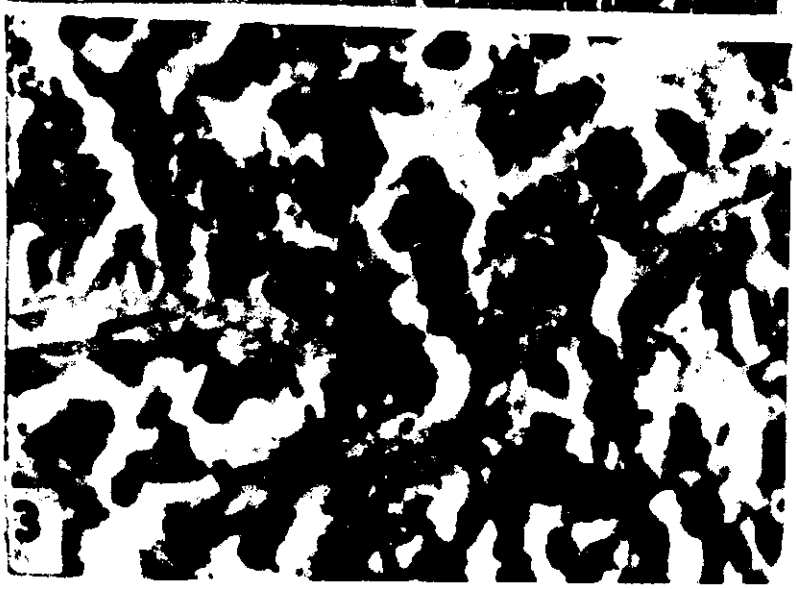
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Fig. 4 : Six hours after carbon injection. Type 2 macrophages are apparently migrating from the marginal zone into the periphery of the white pulp. Methyl green pyronin. X 160.

Fig. 5 : Twelve hours after carbon injection. Large number of type 2 macrophages are seen in the periarterial lymphoid sheath. Methyl green pyronin. X 400.

Fig. 6 : One day after carbon injection. Type 1 macrophages are apparently migrating from the marginal zone into the periarterial lymphoid sheath (A, artery) at the marginal zone bridging channel. Methyl green pyronin. X 400.

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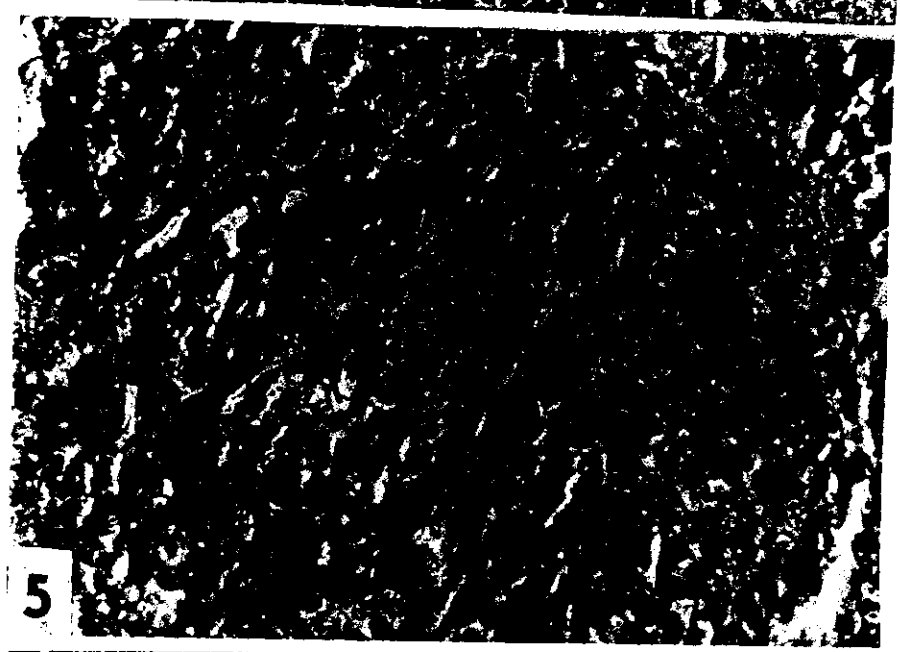

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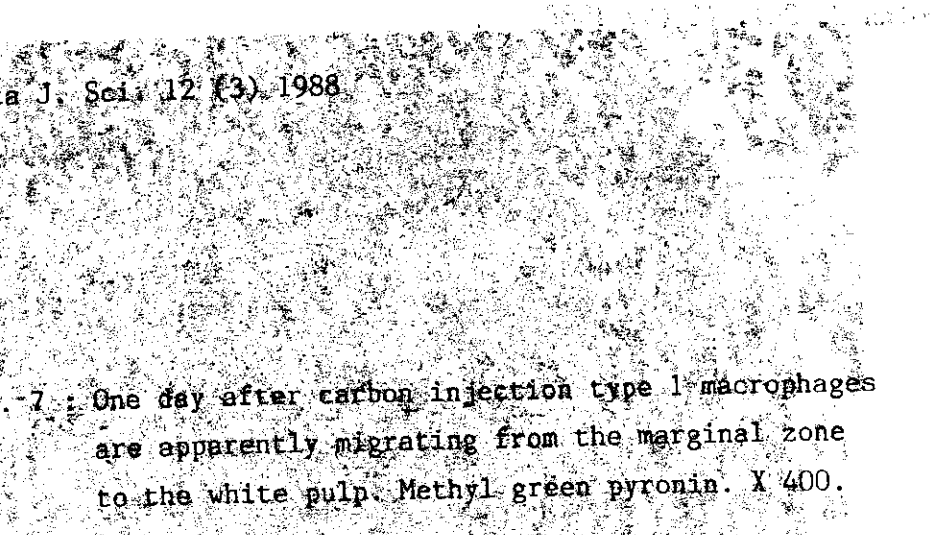
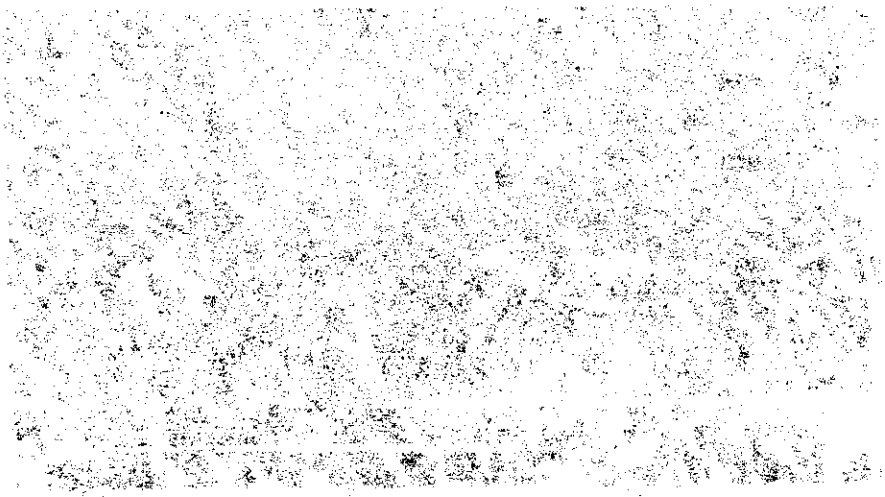
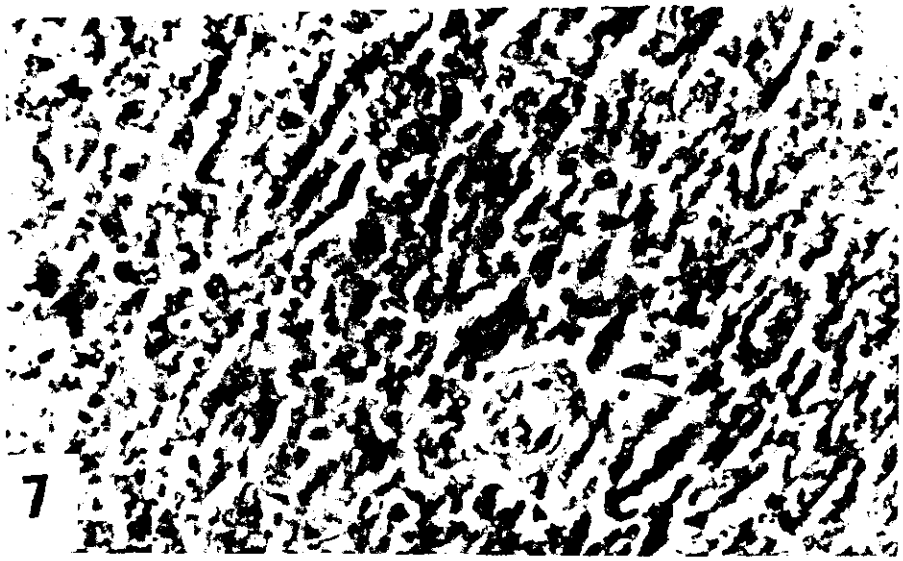


Fig. 7 : One day after carbon injection type 1 macrophages are apparently migrating from the marginal zone to the white pulp. Methyl green pyronin. X 400.

Fig. 8 : Three days after carbon injection. Carbon laden macrophages are markedly decreased in marginal zone (M) while they are present in red pulp (R) Methyl green pyronin. X 400.

Fig. 9 : Five days after carbon injection. Carbon laden macrophages both type are still accumulate in red pulp. Methyl green pyronin. X 400.

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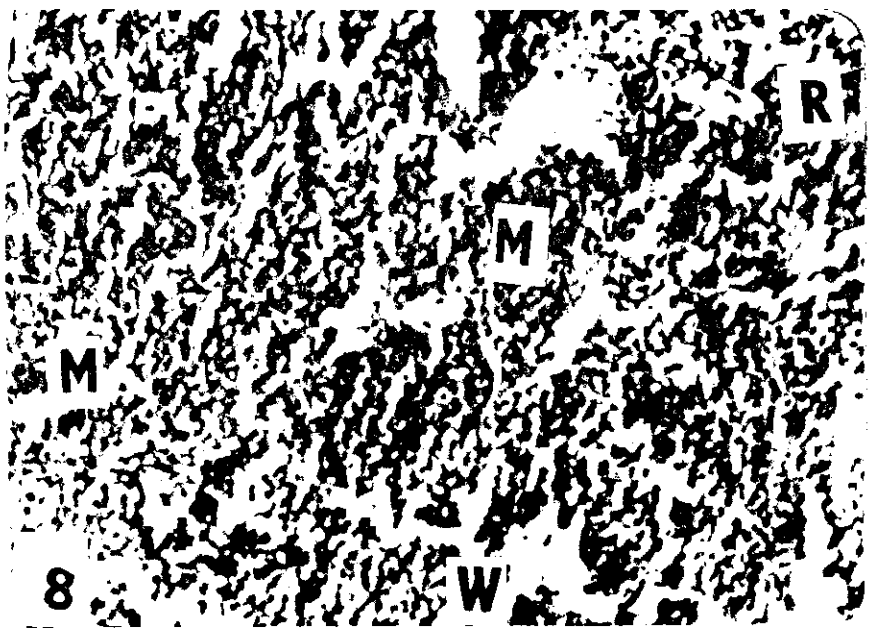
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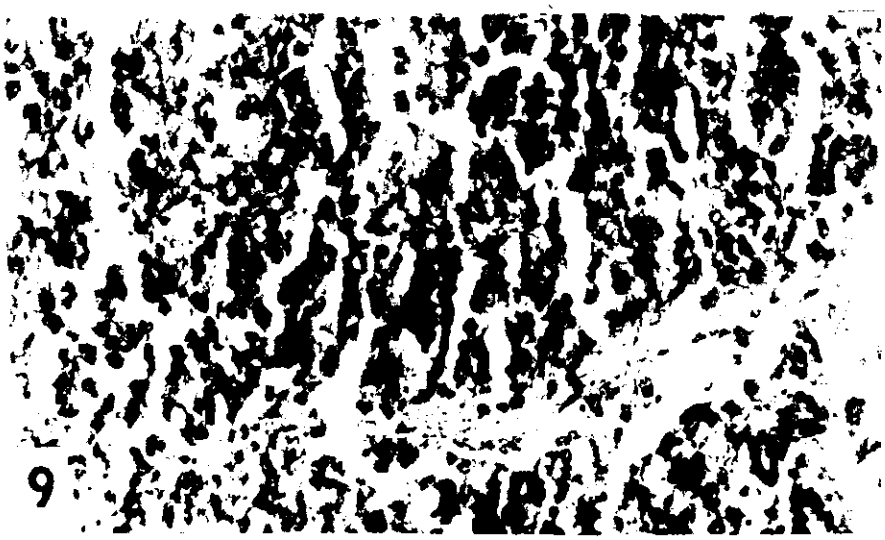
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دور الخلايا البلعميـــة (الاكـــولة) فى آليـــة اقتناص الخلايا الليمفـــاوية (فى الطحـــال)

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تناول هذا البحث دراســـة دور الخلايا الاكولة فى عمليـــة تنبيـــه وبدء اقتناص الخلايا الليمفاوية فى الطحال عقب دخول بعض المركبات المناعية أو الغير مناعيـــة الجســـم.

وقد استعمل فى هذا البحث عدد ٢٤ من الفئران البيضـــاء حقنت وريديا بمحلول الكربون وجهزت العينات من الطحال كما هو موضح بالداخل. وقد اتضح من الفحص والدراســـة ما يلى:ـ

أن دور الخلايا الاكولة فى عمليـــة اقتناص الطحال للخلايا الليمفاوية دور مباشر حيث أن انتشـــار وتوزيع الخلايا الاكولة الملتهمـــة لحبيبات الكربون كان مطابقا لدورة الخلايا الليمفاويه فى الطحال مما جعلنا نفكر فى وجود أعضاء حسية على ســـطح الخلايا الليمفاوية تقوم بحمل الخلايا الاكولة أثناء عملية الاقتنـــاص.