EVALUATION OF THE PITTING FUNCTION OF THE SPLEEN IN SPLENOMEGALY BEFORE AND AFTER SPLENECTOMY

THESIS

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BY

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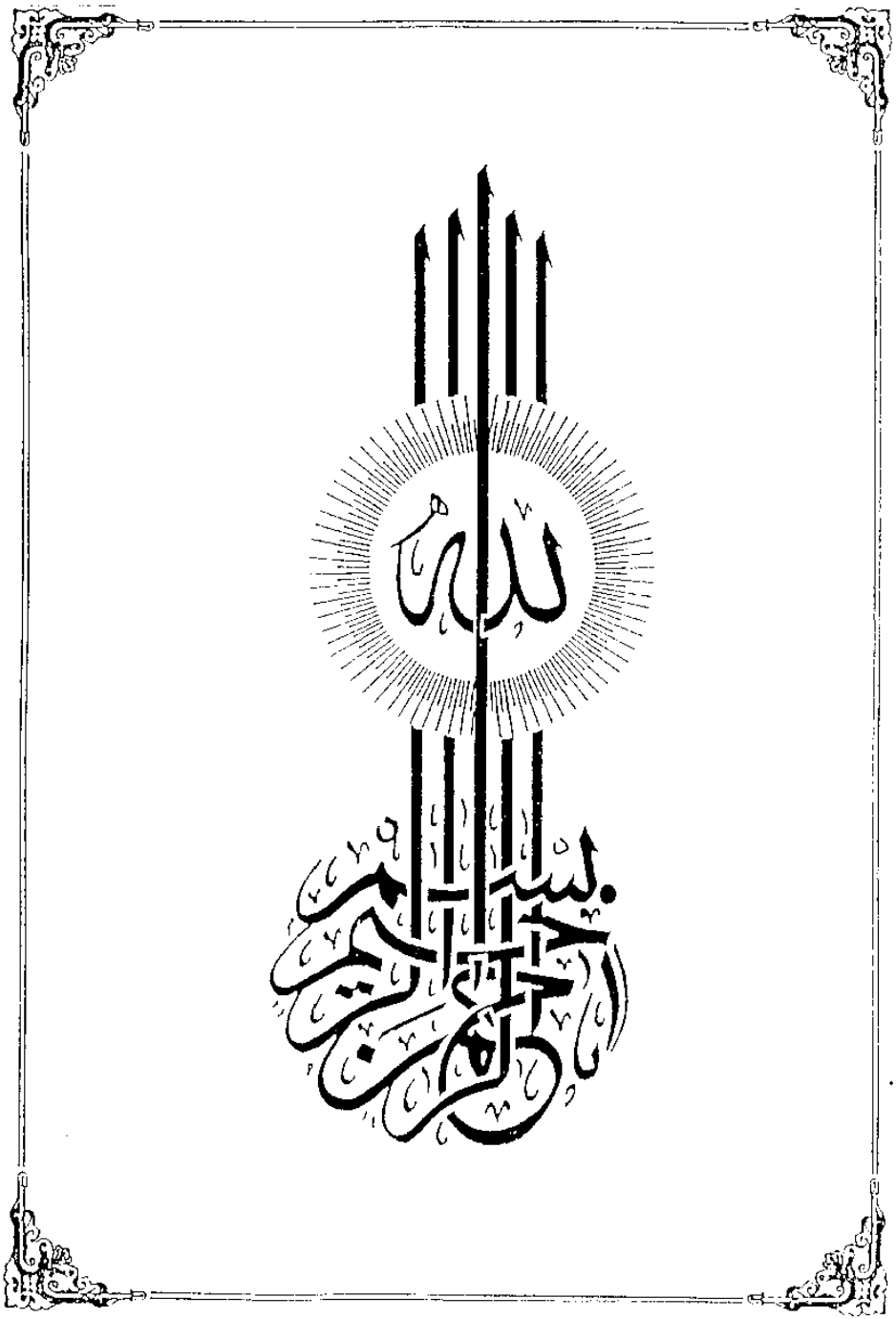
D E D I C A T E D T O

MY FATHER

MY MOTHER
&
MY HUSBAND



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Introduction

INTRODUCTION

The spleen is a line filter in the portal circulation. it removes particulate material of several kinds from the blood and gives to the blood some cells and proteins. It is an extremely vascular organ with several specialized vascular structures essential to its funciton.

The average normal surgically removed spleen with all blood drained out weighs about 80 g; blood flow through the normal spleen is about 300 ml per minute (Koyama, 1967). Thus the spleen makes up about 0.1 percent of the total body weight (80/70,000) but receives about 5 % of the cardiac out put (300/5,000). In 2,000 persons who suffered violent deaths the average post mortem splenic weight was about 135 gm (Krumbhar, 1939). The weight of apparently normal spleen, was as low as 100 g and as high as 250= g. The adult human spleen contains about 140 billion cells; some what less than half of which are capable of phagocytosis. Increased requirement for phagocytosis, as in hereditary spherocytosis, results in enlargement of the spleen, with the cell content increasing about eight fold (Jandl, 1965).

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The spleen has many functions, one of them is the pitting funciton, which is the ability of the spleen to remove various intra erythrocytic inclusions from the red cells without destroying the cell itself.

Several methods are used to detect this function especially its return after splenectomy (splenosis), but most of them are complicated or invasive as laparoscopy laparotomy or injection of 99 m technetium and scan the abdomen for uptake of this radionuclide by the splenic nodules.

To evaluate the pitting funciton we used a new, non invasive and semiquantitative technique for the presence of "Pocks", "Pits"or vacuoles on their surface using the interference phase contrast microscope. Persons with normal splenic function usually have less than 1% vacuclated red blood cells in their circulation. Whereas asplenic persons have 10 to 60% vacuolated cells and those with reduced splenic funciton (hypsplenia) have from 4 to 12%. When there is return of splenic function by the regenerated splenic tissue there is low percentge of vacuolated red blood cells.

Review of Literature

STRUCTURE OF THE SPLEEN

The vasculature :

The capsule of the human spleen contains some muscle fibres, so it can contract at the time of bleeding. The fibrous capsule of the spleen project trabeculae into the parenchyma, providing a scaffolding along which the arteries and veins penetrate from the hilus. Smaller arteries emerge from the trabeculae surrounded by a lymphatic sheath. Branches from these "central arteries" take of at almost right angles, consistent with a plasma skimming funciton. It is characteristic of the splenic circulation that the arteries emerging from the sheath do not terminate in capillaries connecting to veins. Anatomically, they are open-ended , indicating that blood is dumped into the splenic cords. The venous system collects the blood from these cords through splenic sinusoids into larger veins and thence to the hilus via the trabecular scaffold. " Skimmed" plasma returns to the circulation via lymphatics which also exist along the trabeculae. There has been controversy over whether the circulation through the red pulp is "open or closed". Does blood move from the arteries through closed channels into the sinuses or does it empty from the ends of arteries into the open mesh work of the cords and come into

vanous system through interstices of the walls of the sinuses? studies in vivo indicate the former. Swift currents of blood stream rapidly cross the cords, while a small amount moves sluggishly through the red pulp. (Williams, 1950 & McCuskey, 1972). Histologic studies however, have demonstrated few direct connections from the arterial to the venous system. (Weiss, 1972).

The cells that move slowly through the cords may take minutes to traverse these few millimeters, yet it is known that blood flows through the normal human spleen at a rate of 300 ml per min. At this rate not every cell could go through the cordal filter every time. There must be rapid shunts across the spleen.

The parenchyma :

The spleen is divided into 3 parts: the white pulp, the red pulp, and between red and white, the marginal zone. Each part has three components: vessels, reticular cells, and free cels within a reticular mesh work (Fig.).

The white pulp (Weiss, 1964) is seen grossly as points on the cut surfaces of the spleen and in histologic sections as small discs surrounded by the vaster martix of the pulp.

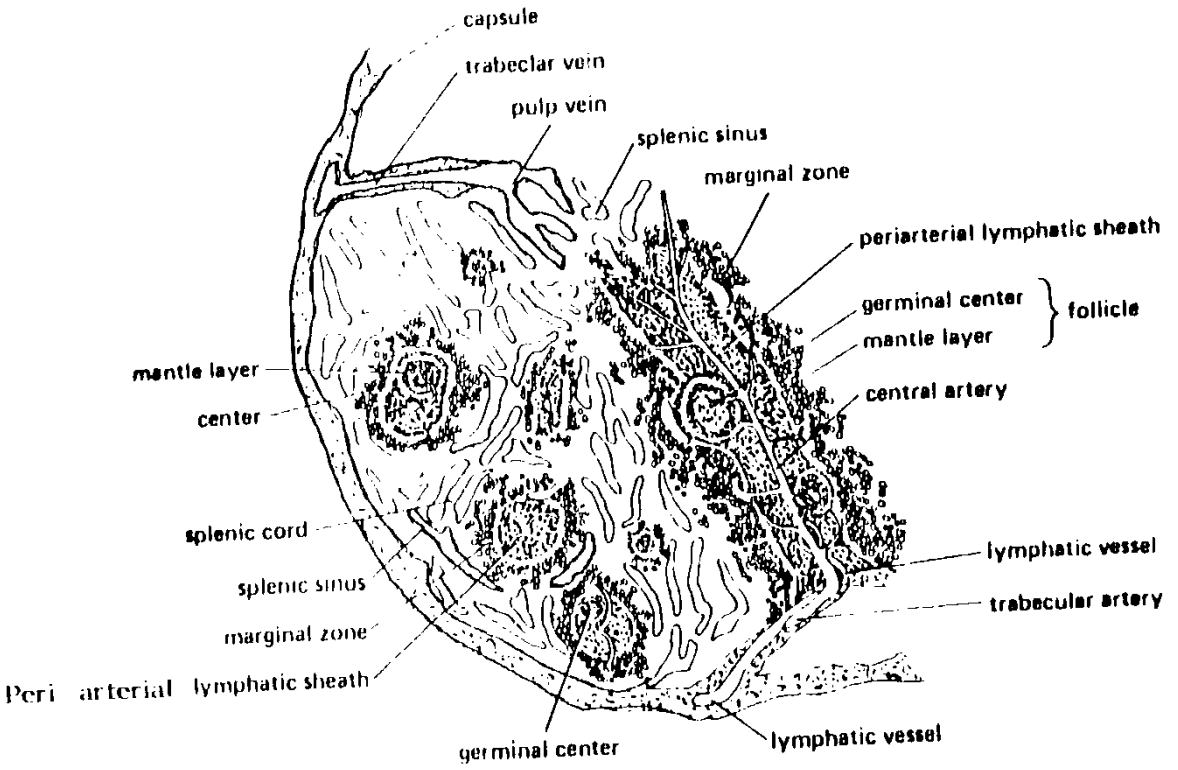

Fig. (1): The structure of the spleen. white pulp is composed of periarterial lymphatic sheath and the germinal centers. Red pulp is the area of splenic cords and sinuses. Quoated from William's text book of hematology.

In three dimensions the white pulp is a cylindrical periarterial lymphatic sheath surrounding the central artery. Eccentric within the sheath are germinal centers encased by a shell of small lymphocytes, the mantle layer. The vessels are branches of the central artery which take off at right angles. Some terminate within the white pulp, some in the marginal zone, and others, often the larger ones, in the red pulp. Plasma skimming probably minimizes the number of red cells released into the white pulp , while larger terminal arterioles carry a concentrated mix of red cells into the red pulp. The reticular mesh work of the white pulp forms the structural fabric. At the periphery of the sheath it forms a fine radial net, but the interior is an intricate, almost random, interlacing. The fibers of the periarterial sheath have a particular affinity for the T lymphocytes that comprise the lymphocytic component of the sheath, entrapping and retaining them as they arrive via the circulating blood (Weiss, 1964). The reticular structure also supports the germinal centers with a shell of fibrils.

Free cells in the white pulp are predominantly small lymphocytes. There are few granulocytes and plasma cells even fewer red cells. Macrophages are present

in all parts of the spleen. In the germinal centers large and medium size lymphocytes are present, together with many macrophages. The mantle of the germinal center consists almost entirely of small lymphocytes.

The marginal zone (Weiss, 1963) is peripheral to the radial layers of reticulum that bound the periarterial sheath. Vessels are end arterioles arising from the central artery. The reticulum of the marginal zone is dense. The net work receives many if not most of the terminal arterioles. The free cells are blood cells emerging from the arterial endings, a fair number of macrophages, and many medium size lymphocytes. The cells are not so tightly packed as in the white pulp. Although the marginal zone is clearly demarcated from the periarterial sheath, its outer margin blends imperceptibly with the red pulp, so that some sinusoids of the red pulp come quite close to the periphery of the sheath.

The red pulp (Chen, 1972) are primarily arteries derived from the central artery and the venous sinuses. The arteries arise from the central artery, branching to penetrate the lymphatic sheath or extending beyond the termination of that periarterial cylinder. Some of these branches end in the marginal zone, others cross