Plasma and Red Cell Lipids in Sickle Cell Disease

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ABSTRACT

Lipids, in particular phospholipids, are essential components of membrane systems, and the measurement of phospholipids and cholesterol in plasma and tissues is helpful in diagnosis. Phospholipids represent about 60 to 70 percent of total red cell (RBC) lipids, while about 25 percent is free cholesterol. Lipids in RBC are present in a dynamic state of equilibrium, and the RBC have the capacity for rapid exchange of lipids with plasma in several ways. The present study examined the cholesterol and phospholipid levels of plasma and erythrocytes in male patients with sickle cell anemia and in healthy male individuals of comparable age. This was performed with a view to detecting possible differences that might be related to some of the RBC abnormalities which accompany the disease. The results show that plasma lipids are significantly reduced in patients with sickle cell anemia and that RBC cholesterol was higher in sickle cell patients than in normal subjects.

Introduction

The study of erythrocyte lipids in various diseases has generated enormous interest. Membrane changes have been described in conditions where there are defects in lipid metabolism. The cholesterol content of total red cell (RBC) is increased in liver disease and the phospholipid distribution is normal. Lipid distribution abnormalities have been reported in kwashiorkor, in thalassemia major, in acanthocytosis and in spur cell anemia.

To our knowledge, only one study has been reported concerning the levels of erythrocyte lipids in sickle cell anemia. Therefore, red cell lipids and plasma lipids in 20 patients with sickle cell disease and in healthy subjects of the same age group have been studied.

Materials and Methods

Twenty male patients with sickle cell disease (SS) and 20 healthy male subjects were studied. The ages of the patients and subjects ranged between 16 and 35 years. During this study, all the patients were in a state uncomplicated by clinical or hematologic crises. Blood was drawn after an overnight fast with disodium ethylenediamine tetraacetic acid (EDTA) (1 mg per ml of blood) as anticoagulant. All centrifugations and solutions were at 4°. The blood was centrifuged immedi-
Plasma Lipid Levels in Healthy Male Subjects and in Patients with Sickle Cell Disease (Mean ± S.D.)

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<th>Normals</th>
<th>Sickle Cell Patients</th>
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<tr>
<td></td>
<td>mg per dl</td>
<td>mg per dl</td>
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<tr>
<td>Total lipids</td>
<td>602 ± 80</td>
<td>497 ± 64</td>
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<tr>
<td>Phospholipids</td>
<td>201 ± 26</td>
<td>128 ± 30</td>
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<td>0.001</td>
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<tr>
<td>Total cholesterol</td>
<td>199 ± 32</td>
<td>114 ± 26</td>
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The results of the determinations of plasma lipid levels are presented in table I. Plasma total lipids, phospholipids and total cholesterol were significantly lower in patients with sickle cell disease compared to a group of normal subjects.

The results of the quantitative analysis of red cell lipids are reported in table II. Mean total lipids and cholesterol concentrations of the erythrocytes of the sickle cell patients were significantly higher than the concentrations found in normal subjects, when related to a unit volume of cells (mg per ml) p < 0.02. Analysis revealed that there was only a moderate and statistically insignificant increase in erythrocyte phospholipids in sickle cell patients when compared to a group of normal subjects.

Discussion

The results show that the mean plasma concentrations of lipids are lower in sickle cell patients than in normal subjects. This confirms previous studies which reported hypolipidemia in patients with sickle cell anemia. Low plasma lipid levels have also been reported in other types of anemias (iron deficiency, megaloblastic and hemolytic). The mechanism causing hypolipidemia in anemias is as yet unclear, although Hashmi and Afroz suggested that it might be due to the effects of low-oxygen carrying power of the blood on lipid absorption, transport and endogenous synthesis.

In this study, the concentrations of red cell total lipids, cholesterol and phospholipids in healthy subjects compared favourably with those reported by other investigators, in spite of differences in lipid extraction procedures. The mean concentrations of total lipids and cholesterol in the erythrocytes of patients with sickle cell disease were significantly higher than those of healthy subjects of comparable age. The red cell phospholipid concentrations of both groups were not significantly different. These findings, agree with some earlier reports.
It is known that there is a constant exchange of lipids between RBC and plasma, and some earlier studies have indicated that the process of exchange in the normal state is not energy dependent, but is related to the architecture of the cell.\textsuperscript{2,3} In a study of patients with hereditary spherocytosis, Cooper and Jandl\textsuperscript{4} noted that the changes in membrane lipid composition are due to some primary defect, probably the glycolytic energy system. It was also noted that the alterations of lipid concentrations are deleterious to the stability of the membrane and that the cells may change shape and hemolyse rapidly. The alteration of the lipid component of the red cell in sickle cell disease may, in fact, be secondary to a defect in the membrane, thus resulting in abnormal exchange of lipids with plasma.

It does not appear that there is any relationship between the hypolipidemia and the change in red cell lipids occurring in sickle cell patients. The results of some studies of erythrocyte lipids in various diseases suggest that they are influenced only in diseases in which specific enzymes are disturbed and that changes in plasma lipids alone do not appreciably alter red cell lipids in humans.\textsuperscript{14,15} The clinical importance of the slight but significant alterations in erythrocyte lipids observed in our sickle cell patients is yet unknown. Studies of erythrocytes phospholipid fractions during sickle cell crisis would be of considerable value since it has been shown that decreases in erythrocyte phosphatidylserine and phosphatidylethanolamine are an index of oxidation of erythrocyte lipids with a consequently greater predisposition towards hemolysis.\textsuperscript{12}

References


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