Platelet adhesiveness, plasma free fatty acids, and serum triglycerides in kwashiorkor

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Khalil, M., Aref, M. K., Mahmoud, S., Abdel-Malek, A. T., Guirgis, F. K., Moghazy, M., and Abdel-Hay, M. M. (1974). *Archives of Disease in Childhood*, 49, 568. Platelet adhesiveness, plasma free fatty acids, and serum triglycerides in kwashiorkor. The concentrations of plasma free fatty acids and triglycerides were studied in 15 cases of kwashiorkor and in 14 normal controls in relation to the degree of platelet adhesiveness. A significant rise in the level of free fatty acids was found which correlated with a significant increase in platelet adhesiveness in these cases.

In 1959, McDonald and Edgill reported a decrease in platelet adhesiveness after 4 to 5 weeks of treatment with a fat-free diet in patients with ischaemic heart disease. Additional evidence of the effects of blood lipids on human platelets has been reported by Mustard and Murphy (1962), who found that a diet rich in fat caused an increase in platelet clumping with diminished platelet survival time. In kwashiorkor, disturbances in fat metabolism, with abnormal variation in the level of different lipid constituents, have been recognized by various workers (Schwartz and Dean, 1957; Lewis *et al.*, 1964; Awwaad *et al.*, 1967; Khalil *et al.*, 1973).

Sandstead *et al.* (1965) reported that petechial haemorrhages occur frequently in kwashiorkor. Though the mechanism of this haemostatic disturbance could be partially attributed to a nutritional vascular defect, possible derangement of platelet function in the presence of lipid disturbance was worthy of investigation. The present work accordingly deals with the study of the plasma levels of free fatty acids and triglycerides and their relation to platelet adhesiveness in kwashiorkor.

Material and methods

The study was made on 15 infants (7 males, 8 females) suffering from kwashiorkor, together with a matching normal control group of 14 apparently well-nourished infants. Their ages ranged from 8 to 22 months. The criteria for the diagnosis of kwashiorkor included growth

failure (weight between 60% and 80% of the expected weight for age), oedema, muscle wasting with retention of some subcutaneous fat, and psychomotor changes (Jelliffe, 1966). Other signs such as skin lesions, hair changes, and hepatomegaly were also commonly encountered.

The following laboratory investigations were carried out. Total serum proteins, albumin, and globulin levels (Varley, 1967); plasma free fatty acids (Duncombe, 1963); serum triglycerides (Van Handel and Zilversmit, 1957); platelet adhesiveness (glass beads, modified Hellem's method (Hellem and Stormorken, 1960)).

Results

Platelet adhesiveness in normal controls varied between 14 and 44% (mean $25.6 \pm 6.1\%$). In kwashiorkor the range was between 41 and 55% (mean $47.5 \pm 4.0\%$). The increase is significant ($P < 0.01$).

The values in Table I indicate that infants with kwashiorkor showed statistically significant variations from normal controls in the levels of plasma free fatty acids, serum triglycerides, and total serum proteins, as well as in the level of serum albumin and globulins. While there is a significant rise in the level of plasma free fatty acids in kwashiorkor, there is a significant reduction in the serum levels of triglycerides, total proteins, albumin, and globulins.

Table II shows that in cases of kwashiorkor there was a positive correlation between platelet adhesiveness and plasma free fatty acids. No such cor-

TABLE I

Levels of free fatty acids (FFA), triglycerides (TG), total proteins, albumin, and globulins in plasma of patients with kwashiorkor and of normal controls

	Normal controls (14 cases)					Kwashiorkor (15 cases)				
	FFA	TG	Serum proteins	Albumin	Globulins	FFA	TG	Serum proteins	Albumin	Globulins
	$\mu\text{Eq/l.}$	mg/100 ml	g/100 ml	g/100 ml	g/100 ml	$\mu\text{Eq/l.}$	mg/100 ml	g/100 ml	g/100 ml	g/100 ml
Mean	236.8	76.7	6.68	4.35	2.33	572.0*	44.7*	3.54*	2.03*	1.51*
Range	85-420	45-105	6.0-7.8	3.5-5.3	2.0-3.3	315-1000	30-72	2.5-4.9	1.2-2.9	0.9-2.2
SD	98.9	19.69	0.63	0.53	0.39	173.49	12.88	0.76	0.54	0.41
SE	26.4	6.95	0.168	0.140	0.104	44.8	4.55	0.19	0.14	0.106

*Significant difference ($P < 0.01$) between controls and kwashiorkor cases.

TABLE II

Correlation between platelet adhesiveness and both plasma free fatty acids and serum triglycerides in cases of kwashiorkor

	Platelet adhesiveness and plasma free fatty acids	Platelet adhesiveness and serum triglycerides
r	0.70	0.044
t	3.52	0.090
P	<0.005	>0.05

relation between platelet adhesiveness and serum triglycerides was shown.

Discussion

The factors which have been recognized to influence platelet adhesiveness include the blood lipids. Increased platelet adhesiveness after high saturated fatty acid meals in normals and in patients with diabetes mellitus and coronary heart disease were reported by Moolten, Jennings, and Solden (1963). An increase in platelet adhesiveness during alimentary lipaemia was also shown by Philp and Wright (1965). Warner, Hoak, and Conner (1967) found that plasma concentration of free fatty acids was high in patients with high frequency of thromboembolic complications.

In kwashiorkor disturbances in fat metabolism were recognized by various investigators. A decrease in total blood lipids was reported by Schwartz and Dean (1957) and Cravioto, Pena, and Burgos (1959). Lewis *et al.* (1964), Awwaad *et al.* (1967), and Khalil *et al.* (1973) reported a decrease in total serum cholesterol, and reduction in the level of both α -lipoproteins (Cravioto *et al.*, 1959) and β -lipoproteins (Khalil *et al.*, 1973) was also shown. In addition to the dietary deficiency of lipids,

disturbances in the protein transport system, the concomitant impairment of absorption and increased loss of fat in stools are considered the main factors underlying these disturbances of blood lipids.

In the present study the level of the plasma free fatty acids in kwashiorkor was significantly higher than in normal controls. This agrees with the results of Lewis *et al.* (1964) who found plasma free fatty acid levels significantly raised in severe cases of kwashiorkor. Sakr *et al.* (1971), in their study of serum lipids in protein-calorie malnutrition, found an increase in the serum saturated and a decrease in unsaturated fatty acids in cases of kwashiorkor. They attributed these changes to the inadequacy of essential fatty acids in diets of these cases, with selective mobilization of saturated fatty acids from depots and selective deposition of unsaturated fatty acids in the liver. In the present investigation we furthermore found a significant increase in platelet adhesiveness in cases of kwashiorkor compared with controls, which could be attributed to the reported significant rise in the level of plasma free fatty acids.

Warner *et al.* (1967) found that the incidence of thrombi was higher in patients with free fatty acid levels greater than 750 $\mu\text{Eq/l.}$ than in patients with lower levels. In the present study the mean value of the level of free fatty acids was 572 $\mu\text{Eq/l.}$ which may explain why thromboembolic manifestations are uncommon in cases of kwashiorkor in spite of the increased platelet adhesiveness in these cases.

In this study the level of plasma triglycerides was significantly reduced in cases of kwashiorkor. This agrees with the result of Lewis *et al.* (1964) who reported a significant reduction in plasma triglycerides in their kwashiorkor cases. The same mechanisms (deficiency of dietary fat and impaired fat absorption) which are involved in the reduction of cholesterol and phospholipids could be the underlying factors for hypotriglyceridaemia in these

malnourished infants. The effect of lipids on platelet adhesiveness is attributed mainly to the level of free fatty acids in the plasma which possibly produces morphological changes in the platelet membrane (Hoak *et al.*, 1972). Reduction of other lipid constituents, however, seems to have little effect.

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