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Metabolic relations of serum lipids and lipoproteins in diabetic children

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Serum lipids and lipoproteins of 29 insulin dependent diabetic children have been determined and related to the metabolic status of the patients. The findings were compared to results obtained in 30 healthy children. The diabetic children showing unsatisfactory metabolic parameters had significantly higher total lipid and total triglyceride levels than did the healthy children ($p < 0.01$). All diabetic children, independently of their metabolic status, exhibited an increased low density lipoprotein cholesterol level ($p < 0.01$). On the other hand, high density lipoprotein cholesterol levels found in diabetics did not differ from normal values and showed no relationship with their metabolic status.

Prevention of vascular complications of diabetes must be started in childhood by attentive care directed to all details of the pathomechanism.

Atherosclerosis is one of the early complications of insulin dependent diabetes in childhood. The early onset may be related to the quality of metabolic control and to changes in plasma lipid and lipoprotein composition. It is obvious that the long-term prognosis of juvenile diabetes is determined by the degree of derangements in lipid metabolism; for this reason, investigation of plasma lipids and lipoproteins of diabetic children is of utmost importance [4].

Chase and Allen [2] observed increased serum total cholesterol, triglyceride and low-density lipoprotein (LDL) and decreased high density lipoprotein (HDL) levels even in well-controlled diabetics. Lopes-Virella et al. [6] found a significant positive correlation between haemoglobin A_{1c} and low density lipoprotein cholesterol (LDL-C) and an inverse relationship between haemoglobin A_{1c} and high density lipoprotein cholesterol (HDL-C) levels in diabetic children. No relationship between metabolic control and HDL-C levels were found by Sosenko et al [12], Madácsy et al [7] and Ratzmann et al [9] in juvenile diabetes. Eckel et al [3] described increased HDL-C levels in juvenile insulin dependent diabetes. More recently, Regöly-Mérei et al [10] investigated changes in lipoprotein fractions of diabetic children under organised camping conditions: they observed an increase of the HDL-C level as a result of more physical activity.

A positive correlation between haemoglobin A_{1c} and HDL-C levels was demonstrated by Klujber et al [5]. Soltész et al [11] found a relationship between HDL-C levels and

insulin doses but did not observe significant differences in other lipoprotein fractions between well- and poorly controlled diabetic children.

All this has prompted us to study the lipid and lipoprotein levels of diabetic patients in order to find eventual relationships between metabolic control and lipid metabolism.

Materials and Methods

Twenty-nine diabetic children, fourteen girls and fifteen boys, participated in the study. Their mean age was 10.6 $\pm$ 3.8 years, the range was 4 to 18 years. Mean duration of diabetes was 2.8 $\pm$ 2.7 years. The control group consisted of thirty children admitted for minor airway complaints. They were healthy at the time of the study; their mean age was 8.2 $\pm$ 3.9 years with a range of 8–14 years.

The diabetic children were divided into two groups. Group 1 comprised children with well- controlled diabetes: these patients had a haemoglobin A_{1c} level below 8% and during three months preceding the study they did not have a urinary glucose concentration exceeding 3% at any occasion of outpatient control.

Group 2 consisted of children with poorly controlled diabetes. They had a haemoglobin A_{1c} level higher than 8% and during the preceding three months period they repeatedly exhibited glucosuria exceeding 3%.

The blood samples were taken from fasting outpatients before injection of the morning dose of insulin. The samples were analysed for serum total lipid, total cholesterol, triglyceride, HDL-C, LDL-C and very low density lipoprotein cholesterol (VLDL-C), and haemoglobin A_{1c}.

Total lipid was determined by the phosphovanyllic acid method, all other lipids and lipoproteins and urinary glucose by Boehringer's enzyme test, and haemoglobin A_{1c} by a colour glycohaemoglobin test.

Results

Results are shown in Table I.

Serum total lipid and total triglyceride were elevated in both diabetic groups compared with the control group. Total cholesterol and VLDL-C were normal in both groups of diabetic children. The HDL-C value did not show any correlation with the quality of control of diabetes and it fell within the normal limits.

The LDL-C level was significantly higher in both diabetic groups than in the healthy controls.

Discussion

Nowadays the outlook of diabetic children is determined by the time of onset and the severity of vascular complications. Various forms of hyperlipoproteinaemia are risk factors in the development of atherosclerosis.

Hyperlipoproteinaemia developing in diabetes is caused by insulin deficiency since this hormone plays a key role in lipid balance. It enhances the conversion of glucose to fatty acids and stimulates lipoprotein lipase activity in the adipose tissue [13]. The latter enzyme facilitates lipoprotein catabolism, and this in turn leads to increased HDL-C levels [2].

Our findings showed that the HDL-C levels are not higher in diabetic children than in healthy controls nor are they dependent of the quality of control of diabetes. On the other hand, serum total lipid and total triglycerides were higher in children

TABLE I

Serum lipid and lipoprotein values (mean + S.D.) of diabetic children and healthy controls

	Healthy controls (30)	Diabetic children	
		Group 1 (16)	Group 2 (13)
Haemoglobin A_{1c}, per cent	0.83 ± 0.73	7.66 ± 0.55	11.3 ± 0.73
Total lipid, g/l	6.12 ± 1.54	6.53 ± 1.82 N.S.	6.63 ± 1.47 $P < 0.01$
Total cholesterol, mmol/l	4.34 ± 0.66	4.52 ± 0.75 N.S.	4.59 ± 0.74 N.S.
Total glyceride, mmol/l	1.35 ± 0.15	1.40 ± 0.31 N.S.	2.15 ± 0.55 $P < 0.01$
VLDL-C, mmol/l	3.25 ± 0.45	3.33 ± 0.75 N.S.	3.46 ± 1.02 N.S.
LDL-C, mmol/l	2.04 ± 0.68	2.98 ± 0.35 $P < 0.01$	3.13 ± 1.00 $P < 0.01$
HDL-C, mmol/l	1.09 ± 0.50	1.07 ± 0.41 N.S.	1.11 ± 0.40 N.S.

No. of cases in parentheses

with poor metabolic control than in diabetic children under good control.

Our observation concerning increased LDL-C levels in both diabetic groups is in accordance with the findings of other authors [2].

Our finding of normal HDL-C levels in diabetics may be attributed to the fact that the study was performed in outpatients who had possibilities for physical activity. Physical exercise is known to increase HDL-C levels. In addition, our patients had been treated with insulin for years. Insulin itself stimulates lipoprotein lipase activity and, by that, also leads to an increase of the HDL-C level [8, 13].

The present findings corroborate the necessity of a complex care of diabetes, comprising the control of glucose and fat metabolism and organising home facilities for regular physical exercise. None of our diabetic patients are exempted from school gymnastics and many of them regularly play some ball-games.

Prevention of diabetic angiopathy has to be started in childhood by complex care directed at all factors of diabetic complications.

REFERENCES

1. Barta L: Über die Bedeutung der Blutlipide beim Diabetes mellitus im Kindesalter. Endokrinologie 53:261, 1968
2. Chase HP, Allen MV: Juvenile diabetic plasma lipids and lipoprotein levels. Am J Dis Child 130:1112, 1976
3. Eckel H, Albers JJ, Chenung MC, Wahl PW, Lindgren FT, Bierman EL: High density lipoprotein composition in insulin-dependent diabetes mellitus. Diabetes 30:132, 1981
4. Erxleben B, Spahn U, Kauf E, Petrich E, Knaut C, Winter K: Zur Hyper-

lipidaemie bei juvenilem Diabetes mellitus. Kinderarztl Prax 8:407, 1980
5. Klujber L, Molnár D, Kardos M, János V, Soltész Gy, Mestyán J: Metabolic control, glycosylated haemoglobin and high density lipoprotein cholesterol in diabetic children. Eur J Pediatr 132:289, 1979
6. Lopes-Virella MF, Wohltman HJ, Loadholt CB, Buse MG: Plasma lipids and lipoproteins in young insulin-dependent patients. Relationship with control. Diabetologia 21:216, 1981
7. Madácsy L, Peja M, Bognár M, Kassay L: Metabolic control and lipoprotein metabolism in diabetic children. Pediatr Res 15:1198, 1981
8. Ratkis T, Boyden TW, Pamenter RW, Stanforth P, Wilmore J: High density lipoprotein cholesterol and body composition of female runners. Metabolism 10:994, 1981
9. Ratzmann KP, Witt S, Hidmann W, Schutz V: Zur klinischen Bedeutung des HDL-Cholesterols bei Patienten mit gestörter Glykosetoleranz und Typ I Diabetes mellitus. Dtsch Gesundh-Wes 36:1682, 1981
10. Mérei-Regöly A, Barta L, Molnár M, Tichy M, Pena M: Besserung des Zustandes der diabetischen Kinder unter der Wirkung des Sommercampings. Wien Med Wochenschr 131 Suppl 67:21, 1981
11. Soltész Gy, Molnár D, Kardos K, Klujber L: Insulin therapy, metabolic control and plasma lipoprotein levels in diabetic children. Pediatr Res 15:1192, 1981
12. Sosenko JM, Breslow JL, Mietinen OS, Gabbay KH: Hyperglycemia and plasma lipid levels. N Engl J Med 302:650, 1980
13. Taskinen MR, Nikkila EA, Gordin RNA: Lipoprotein lipase activity in adipose tissue in skeletal muscle of human diabetics during insulin deprivation and restoration. Scand J Clin Lab Invest 41:263, 1981

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