Cerebral Blood Flow in Insulin Dependant Diabetic Patients

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ABSTRACT

Background: *Haemorheologic abnormalities have been reported in diabetes mellitus. Many studies have reported an alteration in blood rheology and its impact on the cerebral blood flow and cerebrovascular reactivity.* ***Aim of the work:*** *To assess the role of TCD-Acetazolamide test in the measurement of cerebral blood flow velocity and cerebrovascular reactivity in type-1 D.M, and to evaluate the impact of different rheological parameters.* ***Subjects and Methods:*** *We studied 39 type-1 diabetic children and adolescents. They were subdivided equally into 3 groups; I A which included 13 diabetic patients with a disease duration less than 5 years; group IB patients with a disease duration ranging between 5 and 10 years and group IC patients with a disease duration more than 10 years. Thirteen healthy children and adolescents were selected as a control group. All patients and controls were subjected to TCD-Diamox examination to measure blood flow velocity of middle cerebral arteries and cerebrovascular reactivity. Also plasma viscosity, RBCs deformability, hematocrit; glycated hemoglobin% and lipid profile parameters were measured.* ***Results:*** *The mean value of mean flow velocities of middle cerebral arteries before Diamox injection and 15 minutes after its injection and mean value of cerebral vasoreactivity in type-1 diabetics with disease duration more than 5 years were significantly low compared to controls. RBCs deformability showed a significant positive correlation with mean value of mean flow velocities of middle cerebral arteries 15 minutes after Diamox injection and cerebral vasoreactivity; while fibrinogen level showed a significant inverse correlation.* ***Conclusion:*** *This study clearly demonstrated significant alterations in basal cerebral blood flow, cerebrovascular reactivity and haemorheological parameters in type-1 diabetics. The need to monitor these changes and to try to modify them early in the course of the disease is clearly validated and justified.* ***(Egypt J. Neurol. Psychiat. Neurosurg., 2005, 42(1): 235-245).***

INTRODUCTION

Diabetes Mellitus (DM) is one of the leading risk factors for cerebrovascular diseases and haemorheologic abnormalities which have been reported in it may play an important role in the pathogenesis of vascular complications[1].

The influence of altered haemorheology on the cerebral blood flow has been always suggested[2,3].

Transcranial doppler ultrasound (TCD) is used to study the cerebral circulation in human adults and newborns by determining changes in blood velocity[4]. Also, TCD is used and applied to evaluate the cerebral blood flow[5] and cerebrovascular reactivity using Acetazalamide (Diamox) IV in type- 1 D.M.[6].

The aim of this study is to assess the role of TCD- Acetazolamide test in the measurement of cerebral blood flow velocity and cerebrovascular reactivity in type-1 DM, and to evaluate the impact of different rheological parameters.

SUBJECTS AND METHODS

This study included 52 children and adolescents. They were classified into two groups:

Group I: Thirty nine type-1 diabetic children and adolescents attending the Diabetes Clinic, Children's Hospital, Ain Shams University. Patients in this group are subdivided into:

Group IA: thirteen patients having type-1 diabetes mellitus with duration less than five years.

Group IB: thirteen patients having type-1 D.M, with duration ranging between 5 and 10 years.

Group IC: thirteen patients having type-1 D.M for more than 10 years duration.

Group II: thirteen completely healthy children and adolescents.

All patients and controls were subjected to the following:

- Full history taking with more stress on duration of the disease, diabetic control, diabetic complications especially the cardiovascular complications, number of ketoacidosis attacks and neurological manifestations.
- Thorough clinical examination including assessment of anthropometeric measures: weight, height, and calculation of body mass index, cardiovascular and neurological examination including the fundus examination.
- Laboratory investigations including complete hemogram, mean glycated hemoglobin % (Hb AIc%), plasma viscosity, plasma fibrinogen level, red cell deformability and serum lipid profile.
- Transcranial doppler ultrasound – acetaxolomide test to study the blood flow velocity and vasoreactivity of the cerebral vessels by measuring blood flow velocity of the middle cerebral arteries (MCAs) before IV injection of acetaxolamide and 15 minutes after its injection in a dose calculated as 10 mg/kg for each subject[4].

Statistical analysis

Data were registered and analyzed using the statistical package SPSS. P values <0.05 were considered statistically significant. Descriptive statistics (e.g., mean, standard deviation, frequencies, and percentages) were calculated and analysis was performed using the student's t-test, Chi- square ($x^{2)}$ and correlation coefficient (r). Pearson's correlation was used when appropriate.

RESULTS

Demographic data (Table 1)

The present study was conducted on 52 children and adolescents. They were classified into the following groups.

Group I: 39 type I diabetic patients, they were subdivided into:

Group IA: 13 patients having type I DM with duration less than 5 years. Their ages ranged between 9 and 17 years with a mean age of 14.54±2.5 years. They were 7 males and 6 females.

Group IB: 13 patients having type I DM with duration ranging between 5 and 10 years. Their ages ranged between 11 and 18 years with a mean age of 14.53±2.25. They were 7 males and 6 females.

Group IC: B patients having type I DM for more than 10 years duration. Their ages ranged between 15.5 and 19 years with a mean age of 17.88±1.19 years. They were 7 males and 6 females.

Group II: 13 completely healthy children and adolescents. Their ages ranged between 6.5 and 19 years with a mean age of 10.92±3.88. They were 7 males and 6 females.

Table (2) shows the laboratory data in group IA in comparison to control. Glycated Hb%, TC, HDL-C, LDL-C and T6 were significantly abnormal (P<0.001, P<0.01, P<0.001, P<0.001 and P<0.05 respectively). Hematocrit %, plasma viscosity, RBCs deformability and fibrinogen were not significantly different.

The mean value of MFVs of MCAs before Diamox injection (at rest) and 15 minutes after its injection showed no significant difference in patients in group IA compared to the control group (Table 3). Also, the mean value of vasoreactivity (%) showed no significant difference in to the two groups (Table 3).

Table (4) shows the laboratory data in group IB in comparison to control. All laboratory data were significantly abnormal, except hematocrit% and total cholesterol. The mean value of MFVs of MCAs before Diamox injection and 15 minutes after its injection was significantly low in patients (group IB) compared to the control (P<0.001). Also, the mean value of vasoreactivities % was significantly low (P<0.001) (Table 5). Similar results were also observed in the third group of patients in whom the duration of illness was more than 10 years, except total cholesterol (TC) was significantly high in this group (Tables 6 and 7).

When the results of different patient groups were compared to each other (Tables 8, 9, 10, 11, 12 and 13), it was found that TC and LDL- C were significantly high in group IC compared to their mean values in group IB and IA. The mean value of plasma viscosity and serum fibrinogen were significantly high in group IB and IC compared to their mean values in group IA. The mean value of RBCs deformability was significantly low in group IB and IC compared to its mean value in group IA. The mean value of MFVs of MCA 15 minutes after Diamox injection and mean value of vasoreactivity were significantly low in group IB and IC compared to their mean values in group IA.

Correlation studies, tables (14, 15 and 16) showed that the duration of diabetes mellitus had a significant positive correlation with HCT%, TC, LDL-C, plasma viscosity, fibrinogen level and a significant inverse correlation with RBCs deformability, MFVs of MCAs before Diamox injection, MFVs of MCAs 15 minutes after Diamox injection and vasoreactivity.

Plasma viscosity showed a significant inverse correlation with RBCs deformability, MFVs of MCAs at rest, MFVs of MSAs 15 minutes after Diamox injection and vasoreactivity, but it showed a significant positive correlation with fibrinogen. RBCs deformability showed a significant positive correlation with MFVs of MCAs at rest and 15 minutes after Diamox injection, but fibrinogen showed a significant inverse correlation.

Table 1. Demographic data.

Item	GIA (no. 13)	GIB (no. B)	GIC (no. 13)	GII (no. 13)
Age (mean ± SD in years	14.54 ± 2.5	14.53 ± 2.25	17.88 ± 1.19	10.92 ± 3.88
Sex (M/F)	7/6	7/6	7/6	7/6
Duration of the illness in years	< 5	5- 10	< 10	-

Table 2. Laboratory data in group IA.

Group / Variable	Group IA N=13 x ± SD	Controls N=13x ± SD	"t" test	"P" value
Hematocrit% (HCT%)	37.55± 3.62	39.35 ± 2.07	1.55	> 0.05*
Glycated Hb% (HbAIC%)	8.4 ± 0.93	7.5 ± 0.55	4.17	< 0.001***
TC mg/ dl	214.85 ± 46.85	171.69 ± 24.35	2.95	< 0.01***
HDL-C mg/dl	50.38 ± 8.88	66.07 ± 3.92	5.83	< 0.001***
LDL-C mg/dl	139.76 ± 46.10	87.69 ± 31.17	3.37	< 0.001***
TG mg/dl	123.31 ± 48.8	88 ± 27.88	2.26	< 0.05**
Plasma viscosity	1.17 ± 0.01	1.1380.09	0.85	> 0.05*
RBCs Deformability	2.10 ± 0.17	2.32 ± 0.46	1.61	> 0.05*
Fibrinogen gm/dl	2.08 ± 0.42	2.07 ± 0.27	0.072	> 0.05*

N= number x= mean SD= standard deviation TC= total cholesterol
TG= triglycerides HDL-C= high density lipoprotein- cholesterol RBCs=Red blood cells
LDL-C= low density lipoprotein- cholesterol *= non significant **= significant ***= Highly significant

Table 3. Cerebral Blood Flow in group IA.

Variable \ Group	Group IA N=13 X ± SD	Controls N=13 X ± SD	"t" test	"p" Value
MFVs of MCAs before Diamax Inection Cm/sec.	71.61 ± 11.31	76.46 ± 3.04	1.49	> 0.05*
MFVs of MCA after Diamax injection cm/sec	97.11 ± 14.53	103.07 ± 3.52	1.43	> 0.05*
Mean of resoreactivities	37.81 ± 5.33	34.58 ± 5.42	1.53	> 0.05*

N= number x= mean SD= standard deviation
MCAS = middle cerebral arteries * = non Significant

Table 4. Laboratory data in group IB.

Variable \ Group	Group IB N=13 X ± SD	Controls N=13 X ± SD	"t" test	"p" Value
Hematocrit % (HCT%)	38.89 ± 2.72	39.35 ± 2.07	0.68	> 0.05*
Glycated Hb %	8.66 ± 1.04	7.15 ± 0.55	4.62	< 0.01***
TC Mg/dl	198.38 ± 71.39	171.69 ± 24.35	1.28	> 0.05*
HDL-C Mg/dl	46.76 ± 5.65	66.07 ± 3.92	10.11	< 0.01***
LDL-C Mg/dl	126.39 ± 68.46	87.69 ± 31.17	185	< 0.05**
TG Mg/dl	132.15 ± 39.76	88 ± 27.88	2.61	< 0.01***
Plasma viscosity	1.6 ± 0.12	1.138 ± 0.09	11.10	< 0.019***
RBCs Deformability	1.44 ± 0.17	2.32 ± 0.46	6.44	< 0.01***
Fibrinogen Gm/dl	3.07 ± 0.17	2.32 ± 0.46	5.23	< 0.001***

N= number x= mean SD= standard deviation TC= total cholesterol
TG= triglycerides HDL-C= high density lipoprotein- cholesterol RBCs=Red blood cells
LDL-C= low density lipoprotein- cholesterol *= non significant **= significant ***= Highly significant

Table 5. Cerebral Blood Flow in group IB.

Variable \ Group	Group IB N=13 X ± SD	Controls N=13 X ± SD	"t" test	"p" Value
MFVs of MCAs before Diamox Injection Cm/sec.	65.42 ± 9.98	76.46 ± 3.04	3.81	< 0.001***
MFVs of MCA after Diamox injection cm/sec	80.42 ± 12.90	103.07 ± 3.52	6.108	< 0.001***
Mean of Vaso - resoreactivities %	22.88 ± 5.09	34.58 ± 5.42	5.67	< 0.001***

N= number x= mean SD= standard deviation
MFVs= Mean flow velocities ***= Highly significant MCAS = middle cerebral arteries

Table 6. Laboratory data in group IC.

Group / Variable	Group IC N=13 $\bar{X}$ ± SD	Controls N=13 $\bar{X}$ ± SD	"t" test	"p" Value
Hematoccit % (HCT%)	39.48 ± 2.71	39.35 ± 2.07	0.05	> 0.05*
Glycated Hb %	9.05 ± 0.58	27.15 ± 0.55	8.27	< 0.001***
TC Mg/dl	249.61 ± 59.22	171.69 ± 24.35	4.39	< 0.001***
HDL-C Mg/dl	47.38 ± 3.04	66.07 ± 3.92	13.57	< 0.001***
LDL-C Mg/dl	172.53 ± 54.96	78.69 ± 31.17	4.48	< 0.001***
TG Mg/dl	147.46 ± 59.87	88 ± 27.88	3.25	< 0.01***
Plasma viscosity	1.89 ± 0.23	10.138 ± 0.09	10.97	< 0.001***
RBCs Formability	1.35 ± 0.11	2.32 ± 0.46	7.35	< 0.001***
Fibrinogen Gm/dl	4.15 ± 1.08	2.07 ± 0.27	6.76	< 0.001***

N = number x= mean SD = standard deviation TC = total cholesterol TG = triglycerides
HDL-C= high density lipoprotein- cholesterol RBCs =Red blood cells
LDL-C = low density lipoprotein- cholesterol *= non significant ** = significant *** = Highly significant

Table 7. Cerebral Blood Flow in group IC.

Group / Variable	Group IB N=13 $\bar{X}$ ± SD	Controls N=13 $\bar{X}$ ± SD	"t" test	"p" Value
MFVs of MCAs before Diamox Injection Cm/sec.	64.46 ± 10.51	76.46 ± 3.04	3.95	< 0.001***
MFVs of MCA after Diamox injection cm/sec	73.30 ± 12.07	103.07 ± 3.52	8.53	< 0.001***
Mean of Vaso - resoreactivities %	13.44 ± 8.84	34.58 ± 5.42	7.36	< 0.001***

N= number x= mean SD= standard deviation
MFVs= Mean flow velocities ***= Highly significant MCAS = middle cerebral arteries

Table 8. Rheological data in Group IA Group IB.

Group / Variable	Group IA N=13 $\bar{X}$ ± SD	Group IB N=13 $\bar{X}$ ± SD	"t" test	"p" Value
Plasma viscosity	1.17 ± 0.10	1.60 ± 0.12	9.92	< 0.001***
RBCs formability	2.10 ± 0.17	1.44 ± 0.17	10.19	< 0.001***
Fibrinogen Gm/dl	2.08 ± 0.42	3.07 ± 0.63	4.64	< 0.001***

N= number x= mean SD= standard deviation ***= Highly significant

Table 9. Cerebral Blood flow in Group IA Group IB.

Variable / Group	Group IA N=13 $\bar{X}$ ± SD	Group IB N=13 $\bar{X}$ ± SD	"t" test	"p" Value
MFVs of MCAs before Diamox Injection Cm/sec.	71.61 ± 11.31	65.42 ± 9.98	1.48	> 0.05*
MFVs of MCA after Diamox injection cm/sec	97.11 ± 14.53	80.42 ± 12.90	3.102	< 0.01***
Mean of Vaso - resoreactivities %	37.81 ± 5.33	22.88 ± 5.06	7.30	< 0.001***

N= number x= mean SD= standard deviation MFVs= Mean flow velocities
***= Highly significant MCAS = middle cerebral arteries *= significant

Table 10. Rheological data in Group IA Group IC.

Variable / Group	Group IA N=13 $\bar{X}$ ± SD	Group IC N=13 $\bar{X}$ ± SD	"t" test	"p" Value
Plasma viscosity	1.17 ± 0.10	1.89 ± 0.23	10.58	< 0.001***
RBCs formability	2.10 ± 0.17	1.35 ± 0.11	10.36	< 0.001***
Fibrinogen Gm/dl	2.08 ± 0.42	4.16 ± 1.08	6.46	< 0.001***

N= number x= mean SD= standard deviation ***= Highly significant

Table 11. Cerebral Blood flow in Group IA Group IC.

Variable / Group	Group IA N=13 $\bar{X}$ ± SD	Group IC N=13 $\bar{X}$ ± SD	"t" test	"p" Value
MFVs of MCAs before Diamox Injection Cm/sec.	71.61 ± 11.31	64.46 ± 10.51	1.67	> 0.05*
MFVs of MCA after Diamox injection cm/sec	97.11 ± 14.53	73.30 ± 12.07	4.54	< 0.01***
Mean of Vaso - resoreactivities %	37.81 ± 5.33	13.44 ± 8.84	8.52	< 0.001***

N= number x= mean SD= standard deviation
MFVs= Mean flow velocities ***= highly significant
MCAS = middle cerebral arteries *= significant

Table 12. Rheological data in Group IB Group IC.

Variable / Group	Group IB N=13 $\bar{X}$ ± SD	Group IC N=13 $\bar{X}$ ± SD	"t" test	"p" Value
Plasma viscosity	1.60 ± 0.12	1.89 ± 0.23	4.03	< 0.001***
RBCs formability	1.44 ± 0.17	1.35 ± 0.11	1.66	> 0.05*
Fibrinogen Gm/dl	3.07 ± 0.63	4.16 ± 1.08	3.15	< 0.001***

N= number x= mean SD= standard deviation
***= Highly significant *= significant

Table 13. Cerebral Blood flow in Group IB Group IC.

Variable \ Group	Group IB N=13 $\bar{X}$ ± SD	Group IC N=13 $\bar{X}$ ± SD	"t" test	"p" Value
MFVs of MCAs before Diamox Injection cm/sec.	65.42 ± 9.98	64.46 ± 10.51	0.24	> 0.05*
MFVs of MCA after Diamox injection cm/sec	80.42 ± 12.90	73.30 ± 12.07	1.45	> 0.05*
Mean of Vaso - resoreactivities %	22.88 ± 5.09	13.44 ± 8.84	3.35	< 0.01***

N= number x= mean SD= standard deviation MFVs= Mean flow velocities
***= highly significant MCAS = middle cerebral arteries *= significant

Table 14. Correlation between different clinical, laboratory, cerebral blood flow velocities and vasoreactivity values in all patient's group.

Parameter	Het	HbAic	TC	HDL-C	LDL-C	TG	Plasma Viscosity	RBCs Deform	Fibrinogen	MFVs Of McAs BD	MFVs of MCAs AD	Vaso-reactivity
D.O.D	0.29*	0.14	0.32*	0.09	0.30*	0.23	0.68*	-0.66*	0.78*	-0.31*	-0.60*	-0.83
Hct%	-	-0.16	0.07	0.07	-0.05	-0.06	0.20	-0.21	0.28*	-0.08	-0.19	-0.22
HbAIc%	-	-	0.04	0.19	0.06	0.11	0.09	0.10	0.10	0.02	-0.10	-0.19

Critical value for "r" = +/-0.2675
D.O.D = Duration of diabetes mellitus
HbAic = Glycated hemoglobin
HDL-C = High density lipoprotein cholesterol
TG= Triglycerides.
MFVs = Mean flow velocities
MCAs = Middle cerebral arteries
* = significant correlation.
Hct = Hematocrit
TC = Total cholesterol
LDL-C= low- density lipoprotein- holesterol
RBCS Deform = Red blood cells deformability.
AD = After Diamox
BD = Before Diamox

Table 15. Correlation between laboratory and cerebral blood flow velocities and vasoreactivity values in all patient's group.

Parameter	Hdl-C	LDL-C	TG	Plasma Viscosity	RBCs Deform	Fibrinogen	MFVs Of MCAs BD	MFVs of MCAs AD	Vaso-reactivity
TC	0.12	0.98*	0.34*	0.267*	0.002	0.23	-0.13	-0.15	0.11
HDL-C	-	0.05	-0.18	-0.01	0.09	-0.03	0.10	0.095	0.009
LDL-C	-	-	0.21	0.23	0.009	0.23	-0.11	-0.143	-0.10
TG	-	-	-	0.27*	-0.11	0.08	-0.24	-0.17	-0.07

Critical value for "r" = +/- 0.2675
TC = Total cholesterol
HDL-C = High density lipoprotein cholesterol
TG = Triglycerides.
MCAs = Middle cerebral arteries
MFVs = Mean flow velocities
* = significant correlation.
LDL-C =low- density lipoprotein- cholesterol
RBCs Deform = Red blood cells deformability.
AD = After Diamox
BD = Before Diamox

Table 16. Correlation between different rheological and cerebral blood flow velocities and vasreactivity values in all patient's group.

Parameter	RBCs Deform	Fibriongen	MFvs of MCAs BD	MFV of MCAs AD	Mean Of vasoreactivity
Plasma viscosity	-0.47*	0.43*	-0.30*	-0.40*	-0.43*
RBCs Deform	--	-0.62*	0.21	0.45*	0.63*
Fibrinogen	--	--	-0.34*	-0.59*	-0.70*
MFVs of MCAs B.D.	--	--	--	0.89*	0.22
MFVs of MCAs A.D.	--	--	--	--	0.59*

Critical value for "r" = +/- 0.2675 * = significant correlations. RBCs Deform = Red Blood cells deformability AD = After Diamox MFVs = Mean flow velocities BD = Before Diamox MCAs = Middle cerebral arteries

DISCUSSION

In this study, the cerebral vasoreactivity was significantly low in those with a disease duration more than 5 years (group IB and IC) compared to both controls and those with a disease duration less than 5 years (group IA). It showed a significant inverse correlation with diabetes duration, plasma viscosity and fibrinogen level, and a significant positive correlation with RBCs deformability.

This is in agreement with Dandona et al.[7] as they reported a significant reduction in basal cerebral blood flow (at rest) as age increases and a significant reduction of cerebral vasoreactivity with long term disease. Also Rodriguez et al.[8] found that a significant inverse correlation between basal cerebral blood flow (at rest) and diabetes duration and found no significant correlation between cerbrovascular reactivity and glycemic contral which is the same in our study, however they failed to detect a linear correclation between cerebral vasoreactivity and diabetes duration which could be due to the relatively small sample of their patients.

Others[6] found impaired cerebrovoscular reactivity in patients with disease duration more than 10 years compared to both controls and group of short duration and this impaired cerebrovascular reactivity inversely correlated with diabetes duration. Meanwhile, they detected no significant change in basal cerebral blood flow in the two groups of patients compared to controls or to each others. This disagrees with our study as we found an earlier decrease in basal cerebral blood flow and cerebrovascular reactivity in type - 1 diabetics with a disease duration more than 5 years compared to controls. This may be due to difference in patients selection in the two studied populations.

This impairment of cerebral vasoreactivity and cerebral blood flow could be due to pathological changes of the small vessels in the form of microatheroma formation, lipid and hyaline deposits and thickening of the basement membrane[6] which is not directly related to glycemic control as evidenced by the absence of a significant correlation between basal cerebral blood flow and vosoreactivity and HbAIc % but could be related to disease duration which supported by the positive correlation between basal cerebral blood flow and cerebral vosoreactivity with disease duration.

These pathological alterations might explain the slower and less intensive vasodilatory response of the cerebral vessels after administration of acetazolamide. Impaired cerebrovascular reactivity probably refers to micro-angiopathic changes of the cerebral vessels and these changes are part of the generalized micro angiopathy caused by diabetes[6]. Also the disturbed haemorheological parameters (plasma viscosity, fibrinogen and RBCs deformability) could be important contributing factors that may

accelerate the cerebral microangiopathic and macroangiopathic changes in type-1 diabetics[9,10,11].

In this study, basal cerebral blood flow and cerebrovoscular reactivity showed a significant inverse correlation with plasma viscosity and fibrinogen and significant positive correlation with RBCs deformability. These rheological properties of blood are important in determining blood flow in large and small vessels as in the microcirculation[9].

Fibrinogen level in our study was significantly high in patients with a disease duration more than 5 years (group IB and IC) with a significant positive correlation with disease duration, plasma viscosity and a significant inverse correlation with basal cerebral blood flow and vosoreactivity. This is in agreement with Zimmermann et al.[9] who reported a significant increase in plasma fibrianogen level in type-1 diabetic patients with disease duration more than 15 years, and Fulsedi et al.[6] who documented a significant increase in fibrinogen level in type-1 diobetic patients with disease duration more than 10 years. Previous researchers[12,13] reported also significant correlation between CBF, fibrinogen and plasma viscosity.

Regarding RBCs deformability in our study, it was significantly low in patients with disease duration more than 5 years, with a significant inverse correlation with fibrinogen, plasma viscosity and disease duration and a significant positive correlation with MFVs of MCAs 15 minutes after diamox injection and cerebral vasoreactivity. This is consistent with the results of Linderkamp et al.[14].

Concerning plasma viscosity in this study, it was significantly high in patients with disease duration more than 5 years, with a significant positive correlation with disease duration and a significant inverse correlation with basal cerebral blood flow velocity and cerebral vasoreactivity. These results are in agreement with previous reports[9,12,13,15].

These rheological disturbances (increased fibrinogen and plasma viscosity and decrease RBCs deformability) in our study could explain the early decrease in basal cerebral blood flow and impaired cerebrovoscular reactivity in those with a disease duration ≥ 5 years.

As regard, lipid profile TC, LDL-C and TG were significantly high and HDL- C was low in all subgroup of patients compared to controls. This is in agreement with Fahiem[16] and Stern[17], however few other reports[18,19] were unable to confirm these results probably due to different selection criteria.

In conclusion, this study demonstrated significant alterations in basal cerebral blood flow, cerbrovascular reactivity and haemorheological parameters in type-1 diabetics. All these changes could contribute to the high incidence of early vascular complications in diabetic children and adolescents. The need to monitor theses changes and to try to modify them early in the course of the disease is clearly validated and justified.

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الملخص العربي

الإرواء الدموى للمخ فى مرضى السكر المعتمد على الأنسولين

مقدمة:

تعد اضطرابات التدفق الدموى أحد المضاعفات المصاحبة للإصابة بمرضى البول السكرى حيث أسفرت العديد من الدراسات عن التباين فى معدلات التدفق الدموى وما لذلك من اثر على درجة الإرواء الدموى للمخ بالاضافة لمدى قدرة الاوعية الدماغية على التفاعل مع شتى المتغيرات الطارئة عليها فى المرضى المصابين بالسكر.

هدف الدراسة:

تقييم دور فحص الاوعية الدماغية بالموجات فوق الصوتية مع الحقن بمادة الاسيتازولاميد(الديامكس) كمقياس لسرعة الإرواء الدموى للمخ، وقدرة الاوعية الدماغية التفاعلية فى مرضى السكر من النوع الأول بالاضافة الى تقدير مدى الآثار الواقعة على المعايير المختلفة لقياس معدلات التدفق الدموى.

مواصفات عينة البحث وخطوات الدراسة:

تم دراسة 39 مريضاً بالسكر من النوع الاول فى مراحل الطفولة والمراهقة بعد تقسيم هذه العينة إلى ثلاث مجموعات متساوية:

الاولى : وتشمل 13 مريضاً لا تتجاوز فترة إصابتهم خمسة اعوام.

الثانية: وتشمل 13 مريضاً تتراوح فترة إصابتهم ما بين خمسة أعوام إلى عشرة أعوام.

الثالثة: وتشمل 13 مريضاً لأكثر من عشرة اعوام.

كما تم اختيار عدد مماثل من الاطفال والمراهقين الاصحاء كمجموعه ضابطة.

خضع كافة أفراد مجموعات المرضى والمجموعه الضابطة للفحص بالموجات فوق الصوتية على الشرايين الدماغية مع الحقن بالديامكس وذلك لقياس سرعة الإرواء الدموى للشريان الدماغى الاوسط، بالاضافة الى القدرة التفاعلية للأوعية الدماغية، كما تم قياس درجة لزوجة بلازما الدم وقدرة كرات الدم الحمراء على التباين وتركيز الهيموجلوبين ونسبة الهيموجلوبين النشوى بالإضافة الى نسب دهون الدم.