COAGULATION PROFILE IN DIABETES MELLITUS AND ITS ASSOCIATION WITH MICROVASCULAR COMPLICATIONS

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ABSTRACT

BACKGROUND

This study intends to assess the changes in the simple routine coagulation parameters in diabetes mellitus and to investigate whether any relationship exists among changes in these coagulation parameters and development of microvascular complication in diabetes mellitus.

MATERIALS AND METHODS

Period of study was from 2010-2012. It was done in M.K.C.G. Medical College with the approval from Berhampur University. It is a case control study. 50 diabetic patients and 50 age and sex matched non-diabetic patients were randomly selected. Simple coagulation parameters like Activated Partial Thromboplastin Time (aPTT), Prothrombin Time (PT), serum fibrinogen, platelet count and Plasminogen Activator Inhibitor-1 (PAI-1) were measured. Statistical study was done using unpaired t-test and analysis and calculations were done using GraphPad software.

RESULTS

Serum fibrinogen was found to be increased in diabetic patients when compared to non-diabetic patients (mean 278 ± 26.9 v/s 232.52 ± 16.5, P value - 0.009, significant). PAI-1 levels was found to be higher among the diabetics when compared to non-diabetics (47.64 ± 8.82 v/s 31.06 ± 7.12, the two-tailed P value is <0.0001, considered extremely significant). Platelet count through within normal limits. It was found to be decreased in diabetic patient when compared to non-diabetic (2.25 ± 0.18 v/s 2.33 ± 0.03, P value - 0.022). Prothrombin Time (PT) (13.15 ± 0.52 v/s 13.04 ± 0.49, P value - 0.28) and PTT (33.04 ± 1.31 v/s 32.99 ± 1.29, P value 0.85, found to be statistically insignificant). Among 50 diabetic patients, 24 had neuropathy, 20 had nephropathy, 10 had retinopathy and 21 had none of these complications. On comparing diabetic patients with microvascular complications and without microvascular complications, significant age difference was observed (59.55 ± 5.06 v/s 51.00 ± 3.31, P=0.003). This probably was a reflection of increase in microvascular complications with increasing duration of diabetes. Serum fibrinogen was found to be increased among diabetic patients with microvascular complications when compared to diabetic patient without microvascular complications (285.28 ± 32.36 v/s 269.86 ± 13.08, P value 0.0449, statistically significant). PAI-1 levels was found to be higher among the diabetics with microvascular complications when compared to diabetics without microvascular complications (52.34 ± 7.40 v/s 41.12 ± 6.31, the two-tailed P value is <0.0001, considered extremely significant). Comparison of diabetic patients with nephropathy and without nephropathy showed significant difference in fibrinogen and PAI-1 levels (292.39 ± 20.19 v/s 269.80 ± 24.43, P value 0.002; 53.67 ± 7.59 v/s 43.62 ± 7.31, P value <0.001). Serum fibrinogen and PAI-1 levels had significant difference on comparison among diabetic patients with neuropathy and without neuropathy (288.92 ± 26.42 v/s 269.46 ± 24.38, p value 0.009; 52.86 ± 7.87 v/s 42.83 ± 6.85, P value <0.001). Comparison of diabetic patients with retinopathy and without retinopathy showed significant difference in fibrinogen levels (249.50 ± 27.19 v/s 286.13 ± 21.64, P value 0.0001). No significant difference in the PAI-1 levels was found among the diabetics with retinopathy when compared to diabetics without retinopathy (48.01 ± 6.95 v/s 47.55 ± 9.30, the two-tailed P value is 0.8846, considered not significant), aPTT and PT showed no significant difference in diabetic patients with and without microvascular complications.

CONCLUSION

From this simple study, it has been shown that diabetes mellitus is a procoagulant state. Hypercoagulability as evidenced by increased fibrinogen and hypofibrinolysis as evidenced by increased PAI-1 levels. Their levels are elevated in diabetic patients with microvascular complications when compared to those without. Though pathophysiology of microvascular complications not fully understood, it has been shown that there is significant coagulation abnormalities in diabetic patients with microvascular complications.

KEYWORDS

NAFLD, Clinical Profile, Biological Profile, NASH.

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BACKGROUND

Diabetes mellitus, a common metabolic disorder characterised by hyperglycaemia is a rapidly growing health problem. The worldwide prevalence of diabetes mellitus has risen dramatically over the past 2 decades. According to the statistics released by World Health Organisation (WHO),

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August 2011 showed 346 million people worldwide have diabetes. Diabetes increases the risk of heart disease and stroke. 50% of people with diabetes die of cardiovascular disease (primarily heart disease and stroke). Combined with reduced blood flow, neuropathy in the feet increases the chance of foot ulcers and eventual limb amputation. Diabetic retinopathy is an important cause of blindness and occurs as a result of long-term accumulated damage to the small blood vessels in the retina. After 15 years of diabetes, approximately 2% of people become blind and about 10% develop severe visual impairment. Diabetes is among the leading causes of kidney failure. 10-20% of people with diabetes die of kidney failure. Diabetic neuropathy is damage to the nerves as a result of diabetes and affects up to 50% of people with diabetes. Although, many different problems can occur as a result of diabetic neuropathy, common symptoms are tingling, pain, numbness or weakness in the feet and hands. India has the highest number of diabetics worldwide. The International Diabetes Federation (IDF) estimates the total number of people in India with diabetes to be around 50.8 million in 2010, rising to 87.0 million by 2030.

Diabetes is still the most common cause of blindness and end-stage renal disease and a major reason for peripheral neuropathy. Patients are considered to have a hypercoagulable state if they have laboratory abnormalities associated with increased risk of thrombosis.[1] Diabetics suffer from accelerated atherosclerosis too. Vascular endothelium, primary defence against thrombosis is abnormal in diabetes, which plays a role in enhanced activation of platelets and clotting factors seen in diabetes.[1] Various mechanisms have been proposed for endothelial dysfunction. Coagulation activation markers as indicated by many studies such as thrombin-antithrombin complexes and prothrombin activation fragment 1+2 are elevated in diabetes.[2,3] Plasma levels of many clotting factors including fibrinogen[4,5,6] factor VII,[5] factor VIII,[7] factor XI,[8] factor XII,[8] kallikrein[8] and vWF[6,7,9] are elevated in diabetes. Conversely, the level of anticoagulant protein C is decreased.[10]

Diabetes is a procoagulant state.[5] The pathophysiology of this procoagulant state is only poorly understood. The fibrinolytic system is relatively sluggish in diabetes due to abnormal clot structure that is more resistant to degradation and an increase in PAI-1, which inhibits tissue plasminogen activator.[6,11,12,13] This study intends to assess the changes in a few routine coagulation parameters in patients with diabetes mellitus and to investigate whether any relationship exists among changes in these parameters in the development of microvascular complications.

MATERIALS AND METHODS

In this study, 50 diabetic patients were selected as per the inclusion and exclusion criteria mentioned in the study protocol. Cases with diabetes mellitus was diagnosed as per the American Diabetes Association 2011 Criteria for the diagnosis of diabetes mellitus. Diabetic nephropathy was diagnosed in the study population in those with diabetes mellitus having persistent proteinuria ≥500 mg/24 hours or diabetic patients with microalbuminuria (microalbuminuria is defined as protein excretion of 30-300 mg/day on at least 2 consecutive occasions) or overt proteinuria, i.e. Albustix test positive in ≥2 consecutive urine samples without urinary infection, cardiac disease or prostate disease were considered to have nephropathy. Diabetic neuropathy was diagnosed in the study population in those with diabetes mellitus having symptoms and signs of neuropathy, i.e. any or combination of neuropathic pain, distal sensory loss, motor weakness of isolated cranial nerve palsies and autonomic symptoms such as orthostatic hypotension, abdominal bloating, constipation, diarrhoea, erectile dysfunction, etc. Ewing's blood pressure tests were performed to detect cardiovascular autonomic neuropathy. These included blood pressure response to standing and sustained handgrip. Diabetic retinopathy was diagnosed on the basis of fundoscopic examination and fluorescein angiography.

Those patients receiving medications that would alter coagulation parameters; those suffering from liver disease; those patients who are suffering from genetic diseases like haemophilia, thrombophilia and von Willebrand disease; and those people who are suffering from infectious disease like malaria and dengue fever were excluded as these diseases may alter the coagulation profile.

50 patients with diabetes mellitus who fulfilled the inclusion and exclusion criteria were taken as the cases. Another 50 age and sex matched patients without diabetes mellitus and those who fulfilled the exclusion criteria were taken as the controls. From this study population, baseline demographic data was collected and detailed physical examination was performed. Full routine blood investigation were done. Special investigations like prothrombin time, activated partial thromboplastin time, serum fibrinogen level and plasminogen activator inhibitor-1 were measured. Study population was divided into cases and controls. Cases were again divided into diabetic patients with microvascular complication and those without microvascular complication. Cases were divided into diabetic patients with neuropathy and without neuropathy; with nephropathy and without nephropathy; with retinopathy and without retinopathy. Statistical analysis was done to assess the association of these coagulation parameters,[14] between cases and controls,[15] between diabetic patients with microvascular complication and without microvascular complication,[1] between diabetic patients with neuropathy and without neuropathy,[3] between diabetic patients with nephropathy and without nephropathy,[4] and between diabetic patients with retinopathy and without retinopathy.

Among the 50 cases in the study group, 29 patients had microvascular complication of diabetes mellitus as per the criteria mentioned in the study protocol. 21 cases had no microvascular complication of diabetes mellitus. Among the diabetic patients with microvascular complications, 6 patients had retinopathy, nephropathy and neuropathy, 11 patients had neuropathy and nephropathy, 2 patients had both retinopathy and neuropathy, 5 patients had only neuropathy, 3 patients had only nephropathy, 2 patients had only retinopathy, and 50 age and sex matched non-diabetic patients were taken as the control population. Among the 29 cases in the study group with diabetic microvascular complication, 16 were males and 13 were females. Among the 21 cases without diabetic microvascular complications, 12 were males and 9 were females.

For coagulation and fibrinolysis, 7 mL blood sample was collected in special tubes containing 3.2% sodium citrate. PT and aPTT were estimated by standard methods as described by Dacie and Lewis. Serum fibrinogen levels were measured by Clauss method. PAI-1 was measured using AssayMax Human Plasminogen Activator Inhibitor-1 (PAI-1) ELISA kit. Comparative analysis was done using unpaired Student's T-test. Statistical analysis was done using GraphPad software.

RESULTS

In comparison between the 50 diabetic patients and 50 non-diabetic patients, there was no significant difference between the age distribution among the subjects (55.96 ± 6.11 v/s 55.90 ± 6.23, P value is 0.9613, considered not significant); there was no significant difference between the prothrombin time among the subjects (13.16 ± 0.52 v/s 13.05 ± 0.49, two-tailed P value is 0.2812, considered not significant); there was no significant difference between the aPTT among the subjects (33.041 ± 1.317 v/s 32.994 ± 1.298, P value is 0.8589, considered not significant). Serum fibrinogen level was found to be higher among the diabetic patients when compared to non-diabetic patients (278 ± 26.975 v/s 261.38 ± 20.637; the two-tailed P value is 0.0005, considered extremely significant). PAI-1 levels was found to be higher among the diabetics when compared to non-diabetics (47.64 ± 8.82 v/s 31.06 ± 7.12; the two-tailed P value is <0.0001, considered extremely significant). The platelet count though it was within normal limits was found to be decreased in diabetic patients (2.257 ± 0.134 v/s 2.339 ± 0.2129, P value is 0.0220, considered significant).

In comparison between the 29 diabetic patients with microvascular complications and 21 diabetic patients without microvascular complications, mean age was found to be higher among the diabetic patients with microvascular complications (59.55 ± 5.06 v/s 51.00 ± 3.31, P value is <0.0001, considered extremely significant); there was no significant difference between the prothrombin time among the two groups (13.12 ± 0.51 v/s 13.21 ± 0.55, two-tailed P value is 0.5420, considered not significant); there was no significant difference between the aPTT also (33.03 ± 1.48 v/s 33.06 ± 1.07, P value is 0.9356, considered not significant). Platelet count was lower among the diabetic patients with microvascular study (2.257 ± 0.134 v/s 2.339 ± 0.2129, P value is 0.0220, considered significant). Serum fibrinogen level was found to be higher among the diabetic patients with microvascular complications when compared to diabetic patients without microvascular complications (285.28 ± 32.36 v/s 269.86 ± 13.08, the two-tailed P value is 0.0449, considered significant). PAI-1 levels was found to be higher among the diabetics with microvascular complications when compared to diabetics without microvascular complications (52.34 ± 7.40 v/s 41.12 ± 6.31, the two-tailed P value is <0.0001, considered extremely significant).

In comparison between the 24 diabetic patients with neuropathy and 26 diabetic patients without neuropathy, mean age was found to be higher among the diabetic patients with neuropathy (59.96 ± 4.58 v/s 55.27 ± 4.94, P value is <0.0001, considered extremely significant); there was no significant difference between the prothrombin time among the two groups (13.14 ± 0.52 v/s 13.16 ± 0.54, two-tailed P value is 0.8540, considered not significant); there was no significant difference between the aPTT also (32.94 ± 1.49 v/s 33.13 ± 1.298, P value is 0.6148, considered not significant). Platelet count was found to be lower among diabetic patients with neuropathy (2.20 ± 0, 14 v/s 2.30 ± 0.11; the two-tailed P value is 0.0098, considered very significant). Serum fibrinogen level was found to be higher among the diabetic patients with neuropathy when compared to diabetic patients without neuropathy (288.92 ± 26.43 v/s 269.46 ± 24.39, the two-tailed P value is 0.0094, considered very significant). PAI-1 levels was found to be higher among the diabetics with neuropathy when compared to diabetics without neuropathy (52.86 ± 7.87 v/s 42.83 ± 6.85, the two-tailed P value is <0.0001, considered extremely significant).

In comparison between the 20 diabetic patients with nephropathy and 24 diabetic patients without nephropathy, mean age was found to be higher among the diabetic patients with neuropathy (60.30 ± 5.22 v/s 53.16 ± 4.86, P value is <0.0001, considered extremely significant); there was no significant difference between the prothrombin time among the two groups (13.08 ± 0.55 v/s 13.21 ± 0.51, two-tailed P value is 0.4053, considered not significant); there was no significant difference between the aPTT also (32.74 ± 1.63 v/s 33.24 ± 1.04, P value is 0.1904, considered not significant). No significant difference in the platelet count was observed (2.45 ± 0.92 v/s 2.26 ± 0.14, P value is 0.6835, considered not significant). Serum fibrinogen level was found to be higher among the diabetic patients with nephropathy when compared to diabetic patients without nephropathy (292.30 ± 20.19 v/s 269.80 ± 27.44, the two-tailed P value is 0.0029, considered very significant). PAI-1 level was found to be higher among the diabetics with nephropathy when compared to diabetics without nephropathy (53.67 ± 7.59 v/s 43.62 ± 7.31, the two-tailed P value is <0.0001, considered extremely significant).

In comparison between the 10 diabetic patients with retinopathy and 40 diabetic patients without retinopathy in the study population, no significant was found in the mean age of 2 groups (57.9 ± 4.07 v/s 55.47 ± 6.47, P value is

0.2660, considered not significant); there was no significant difference between the prothrombin time among the two groups (12.98 ± 0.55 v/s 13.20 ± 0.51, P value is 0.2362, considered not significant); there was no significant difference between the aPTT also (33.54 ± 0.69 v/s 32.92 ± 1.42, P value is 0.1827, considered not significant). No significant difference in the platelet count was observed (2.29 ± 0.12 v/s 2.24 ± 0.14, the two-tailed P value is 0.2910, considered not significant). Serum fibrinogen level was found to be lower among the diabetic patients with retinopathy when compared to diabetic patients without retinopathy (249.5 ± 27.19 v/s 286.13 ± 21.64, P value is <0.0001, considered extremely significant). No significant difference in the PAI-1 levels was found among the diabetics with retinopathy when compared to diabetics without retinopathy (48.01 ± 6.95 v/s 47.55 ± 9.30, the two-tailed P value is 0.8846, considered not significant).

Parameters	Cases - Diabetic Patients	Controls - Non-diabetic Patients	P Value	Significance
Number of subjects	50	50	-	-
Sex - M/F	28/22	28/22	-	-
Age	55.96 ± 6.11	55.90 ± 6.23	0.96	NS
HbA1c	7.7 ± 0.62	5.5 ± 0.45	<0.001	S
Serum fibrinogen	278 ± 26.975	261.38 ± 20.637	0.0005	S
Prothrombin time	13.16 ± 0.52	13.05 ± 0.49	0.281	NS
Activated partial thromboplastin time	33.041 ± 1.317	32.994 ± 1.298	0.859	NS
Platelet count	2.257 ± 0.134	2.339 ± 0.2129	0.02	S
Plasminogen activator inhibitor-1	47.64 ± 8.82	31.06 ± 7.12	<0.001	S

Table 1. Analysis of Parameters Among the Cases (Diabetic Patients) and Controls (Non-Diabetic Patients)

Parameters	Diabetic Patients with Microvascular Complications	Diabetic Patients without Microvascular Complications	P Value	Significance
Number of subjects	29	21	-	-
Sex - M/F	16/13	12/9	-	-
HbA1c	8.05 ± 0.47	7.17 ± 0.36	<0.001	S
Age	59.55 ± 5.06	51.00 ± 3.31	<0.001	S
Serum fibrinogen	285.28 ± 32.36	269.86 ± 13.08	0.044	S
Prothrombin time	13.12 ± 0.51	13.21 ± 0.55	0.54	NS
Activated partial thromboplastin time	33.03 ± 1.48	33.06 ± 1.07	0.93	NS
Platelet count	2.23 ± 0.15	2.29 ± 0.098	0.02	S
PAI-1	52.34 ± 7.40	41.12 ± 6.31	<0.001	S

Table 2. Comparison of Parameters Between Diabetic Patients With Microvascular Complications and Without Microvascular Complications

Parameters	Diabetic Patients with Neuropathy	Diabetic Patients without Neuropathy	P Value	Significance
Number of subjects	24	26	-	-
Sex - M/F	14/10	14/12	-	-
Age	59.96 ± 4.58	55.27 ± 4.94	<0.001	S
Serum fibrinogen	288.92 ± 26.43	269.46 ± 24.39	0.009	S
Prothrombin time	13.14 ± 0.52	13.16 ± 0.54	0.85	NS
Activated partial thromboplastin time	32.94 ± 1.49	33.13 ± 1.298	0.61	NS
Platelet count	2.20 ± 0.14	2.30 ± 0.11	0.009	S
Plasminogen activator inhibitor-1	52.86 ± 7.87	42.83 ± 6.85	<0.001	S

Table 3. Analysis of Parameters Among Diabetic Patients With Neuropathy and Without Neuropathy

Parameters	Diabetic Patients with Nephropathy	Diabetic Patients without Nephropathy	P Value	Significance
Number of subjects	20	30	-	-
Sex - M/F	11/9	18/12	-	-
Age	60.30 ± 5.22	53.16 ± 4.86	<0.001	S
Serum fibrinogen	292.30 ± 20.19	269.80 ± 27.44	0.002	S
Prothrombin time	13.08 ± 0.55	13.21 ± 0.51	0.40	NS
Activated partial thromboplastin time	32.74 ± 1.63	33.24 ± 1.04	0.19	NS
Platelet count	2.45 ± 0.92	2.26 ± 0.14	0.68	NS
Plasminogen activator inhibitor-1	53.67 ± 7.59	43.62 ± 7.31	<0.001	S

Table 4. Analysis of Parameters Among Diabetic Patients With Nephropathy and Without Nephropathy

Parameters	Diabetic Patients with Retinopathy	Diabetic Patients without Retinopathy	P Value	Significance
Number of subjects	10	40	-	-
Sex - M/F	5/5	22/18	-	-
Age	57.9 ± 4.07	55.47 ± 6.47	0.26	NS
Serum fibrinogen	249.5 ± 27.19	286.13 ± 21.64	<0.001	S
Prothrombin time	12.98 ± 0.55	13.20 ± 0.51	0.23	NS
Activated partial thromboplastin time	33.54 ± 0.69	32.92 ± 1.42	0.18	NS
Platelet count	2.29 ± 0.12	2.24 ± 0.14	0.29	NS
Plasminogen activator inhibitor-1	48.01 ± 6.95	47.55 ± 9.30	0.88	NS

Table 5. Analysis of Parameters Among Diabetic Patients With Retinopathy and Without Retinopathy

DISCUSSION

In comparison between the diabetic patients with microvascular complications and diabetic patients without microvascular complications, mean age was found to be higher among the diabetic patients with microvascular complications (59.55 ± 5.06 v/s 51.00 ± 3.31, P value is <0.0001, considered extremely significant). This probably was a reflection of increase in complications with increasing duration of diabetes. In our study, the platelet count though was within normal limits was found to be decreased in diabetic patients (2.257 ± 0.134 v/s 2.339 ± 0.2129, P value is 0.0220 considered significant). This is comparable with the study done by Ritu Madan et al in Safdarjung Hospital.

Serum fibrinogen level was found to be higher among the diabetic patients when compared to non-diabetic patients. Serum fibrinogen level was found to be higher among the diabetic patients with microvascular complications when compared to diabetic patients without microvascular complications. Serum fibrinogen level was found to be higher among the diabetic patients with neuropathy when compared to diabetic patients without neuropathy. Serum fibrinogen level was found to be higher among the diabetic patients with nephropathy when compared to diabetic patients without nephropathy. In the study done on the coagulation profile in diabetes mellitus by Ritu Madan et al in Safdarjung Hospital, India, also found similar results. In the study done by Shihabi ZK et al, the mean plasma level of fibrinogen in the type II diabetics was higher than that of the normal population.[16] In the study done by Miles R et al found significant increase in the serum fibrinogen in diabetic patients with nephropathy when compared to diabetic patients without nephropathy.[17] In the study done by Dr. Kafle and P. Shrestha found significant higher serum fibrinogen levels in patients with diabetes mellitus in comparison to normal population.[18] According to study done by Demirci Huseyin et al titled "Association between Serum Fibrinogen Levels and Diabetic Microvascular Complications in Type 2 Diabetes Mellitus." The plasma fibrinogen levels were significantly higher in patients with retinopathy and/or nephropathy than in patients without these complications, but not significantly higher in patients with neuropathy than in patients without neuropathy.[19] In the study done by Hideki Asakawa et al titled elevation of fibrinogen and thrombin-antithrombin III complex levels of type 2 diabetes mellitus patients with retinopathy and nephropathy found that fibrinogen levels were significantly higher in patients with retinopathy or nephropathy than in patients without these complications.[20] These studies gave results, which are comparable with our study.

In our study, PAI-1 levels was found to be higher among the diabetics when compared to non-diabetics indicating decreased fibrinolysis in diabetics. PAI-1 levels was found to be higher among the diabetics with microvascular complications when compared to diabetics without microvascular complications. PAI-1 was also found to be higher in diabetic patients with neuropathy and nephropathy. PAI-1 was not raised in diabetic patients with retinopathy when compared to those without. This may be due to small sample size of the diabetic patients with retinopathy. In the study done on the coagulation profile in diabetes mellitus by Ritu Madan et al in Safdarjung Hospital, India, also found similar results. PAI-1 levels were increased in diabetics as compared to controls. PAI-1 was raised in diabetic patients with complications compared to those without complications and again the difference was statistically significant. In the study done by A. Pandolfi et al, Plasminogen Activator Inhibitor-1 (PAI-1) increases in diabetes.[21] In the study done by Galajda P et al, elevated PAI-1 levels were described in different insulin-resistant conditions including diabetes mellitus type II.[22] In the study done by Andreas Festa et al, elevated serum levels of fibrinogen (mean ± SD; 287.8 ± 58.8 vs. 275.1 ± 56.0 mg/dL; P = 0.013); and PAI-1 (24 (15, 37.5) vs. 16 ng/mL (9, 27); P = 0.0001) in diabetes mellitus type II.[23]

In our study, there was no significant difference between the prothrombin time (13.16 ± 0.52 v/s 13.05 ± 0.49, two-tailed P value is 0.2812, considered not significant); aPTT between the diabetic and non-diabetic patients subjects (33.041 ± 1.317 v/s 32.994 ± 1.298, P value is 0.8589, considered not significant). In the study done on the coagulation profile in diabetes mellitus by Ritu Madan et al in Safdarjung Hospital, India, also found similar results. In the study done by Oo Alao et al, Prothrombin Time (PT) of diabetic subjects (15.7 ± 2.1) was significantly prolonged compared to that of non-diabetic controls (14.9 ± 2.3) even though the values were within normal limits. Partial Thromboplastin Time (APTT) in the diabetic subjects was significantly prolonged than that of controls (P <0.005), although within normal limits.

CONCLUSION

Our study was on the coagulation profile in diabetes mellitus and the aim of the study was to investigate whether any association between the coagulation and diabetic

microvascular complications. From my study, I found that the age was significantly higher among the diabetic patients with microvascular complications when compared to those without. The microvascular complications were present in diabetic patients with poor glycaemic control. This is evident by higher levels of Glycosylated Haemoglobin (HbA1c) between these two groups. There was no significant difference in the PTT and aPTT in diabetic patients and non-diabetic patients and also diabetic patients with microvascular complications when compared to those without. It has been shown that diabetes is a procoagulant state. The pathophysiology of this procoagulant state is partially understood. Hypercoagulability as evidenced by increased fibrinogen levels and hypofibrinolysis as evidenced by increased PAI-1 levels contribute to procoagulant state observed in diabetes. This procoagulant state not only contributes to major vessel diseases, but also contributes to microvascular complications as has been observed in this study. This is evidenced by significant increase in fibrinogen level in diabetic patients with neuropathy, nephropathy and retinopathy and also by increased PAI-1 levels in neuropathy and nephropathy.

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