

EVALUATION OF HBA1C AND TUBERCULIN TEST IN WOUND COMPLICATIONS OF SURGICAL PATIENTS WITH DIABETES

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ABSTRACT

Background: Diabetes is a global epidemic and India is regarded as the “diabetes capital of world”. Wound healing deficit are often seen in patients with diabetes mellitus.

Aims & Objective: The present study was undertaken to correlate HbA1c level and plasma glucose level with wound complications in postoperative wounds in diabetic patients, to find out relationship of HbA1c and tuberculin test with wound complications, to correlate the role of HbA1c and tuberculin test in prediction of wound complications.

Materials and Methods: The study is a prospective analysis of 100 patients from June 2006 to June 2008, in University Hospital in North India. All known diabetic and recently diagnosed diabetic patients with surgical illness were included in the study. All patients were investigated for HbA1c (by micromat™ Hemoglobin A1c test), Mantoux test (intradermally injecting 0.1 ml Tuberculin PPD with tuberculin syringe), blood sugar F/PP, serum albumin. Wound complications have been noted in postoperative period along with comorbid condition of patients. Selected patients are divided in four group (i) clean wound; (ii) clean contaminated; (iii) contaminated and (iv) diabetic foot / dirty wound.

Results: Out of 100 diabetic patients, male to female ratio was 3:2. Maximum number of patients are in age group of 51-60 years, 51 out of 100 patients were associated with comorbid condition. HbA1c level in diabetic patients were < 6 in 13%, 6-8 in 43%, 8-10 in 30% and >10 percent in 14% patients. Mantoux test was positive in 31 out of 92 patients. Wound complication was present in 54 patients, mostly in uncontrolled diabetes. Out of 99 patients, 41 have clean wound, 31 have clean contaminated, 6 contaminated and 21 patients having dirty / diabetic foot.

Conclusion: Study show a fair correlation between HbA1c, Mantoux test and wound complication. There is decrease in cell mediated immunity leading to decrease in mantoux test positivity and increase in wound complication.

Key Words: Diabetes; Tuberculin Test; HbA1c Level; Wound Healing

Introduction

Diabetes is now a global epidemic. In 2003, the International Diabetes Federation estimated that approximately 194 million people around the world had diabetes. By 2025 this figure is expected to rise to 333 million, amounting to 6.3% of the world's population living with diabetes. The prevalence of type 2 diabetes is rising at an alarming rate throughout the world, due to increase in life expectancy, obesity, sedentary lifestyles, smoking and stressful behaviour. India also has the highest number of people with impaired glucose tolerance with an estimated 85.6 million people. A national urban survey in 2000 showed that the prevalence of diabetes in urban India was 12.1% in subjects aged >20 years. The prevalence in all cities was >9% (9.3-16.6%). Glycosylated (or glycated) haemoglobin (haemoglobin A1c, Hb1c, HbA1c or HbA1c) is a form of haemoglobin used primarily to identify the average plasma glucose concentration over prolonged periods of time. Its name is sometimes abbreviated to A1C. It is formed in a non-enzymatic pathway by haemoglobin's normal exposure to high plasma levels of glucose. Glycosylation of haemoglobin has been implicated in nephropathy and

retinopathy in diabetes mellitus. Monitoring the HbA1c in diabetic patients may improve treatment.^[1]

Glycosylated haemoglobin is recommended for both (a) checking blood sugar control in people who might be pre-diabetic and (b) monitoring blood sugar control in patients with more elevated levels. For a single blood sample, it provides far more revealing information on glycemic behaviour than a fasting blood sugar value. The American Diabetes Association guidelines advise that the glycosylated haemoglobin test be performed at least two times a year in patients with diabetes who are meeting treatment goals (and who have stable glycemic control) and quarterly in patients with diabetes whose therapy has changed or who are not meeting glycemic goals.^[2]

The tuberculin most widely used is purified protein derivative (PPD), which is derived from cultures of *M. tuberculosis*. When tuberculin is injected intradermally in a subject previously infected with *M. tuberculosis*, a hypersensitivity reaction occurs at the site of injection. This comprises an inflammatory response characterized by the accumulation of CD4 and CD8 T-lymphocytes, and the

consequent release of inflammatory mediators. This hypersensitivity is not the same phenomenon as immunity, although it is usually associated with immunity.

The aim of the present study is to correlate HbA_{1c} level and plasma glucose level with wound complication in surgically postoperative wounds in diabetic patients, to correlate HbA_{1c} and tuberculin test together with wound complications and to find out the role of HbA_{1c} and tuberculin test in prediction of wound complications pre-operatively.

Materials and Methods

The present study was carried out in the Department of General Surgery, S.S. Hospital, Banaras Hindu University, Varanasi between June 2006 to June 2008. One hundred diabetic patients were included in the study with various type of patient undergoing surgery. The diagnosis of diabetes in these patients was established as per the American Diabetes Association Criteria.

Criteria for the Diagnosis of Diabetes Mellitus: (1) Symptoms of diabetes plus random plasma glucose concentration ≥ 200 mg/dl (11.1 mmol/l). Random is defined as any time of day without regard to time since last meal. The classic symptoms of diabetes include polyuria, polydipsia, and unexplained weight loss. (2) Fasting plasma glucose (FPG) ≥ 126 mg/dl (7.0 mmol/l). Fasting is defined as no calorie intake for at least 8 h. (3) 2-hr post load glucose ≥ 200 mg/dl (11.1 mmol/l) during an oral glucose tolerance test (OGTT). The test should be performed as described by WHO, using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water. (4) HbA_{1c} level.

All known diabetic and recently diagnosed diabetic patients with surgical illness are included in the study. All the patients were investigated for HbA_{1c}, Mantoux test, blood glucose level fasting and PP and serum albumin. Wound complications have been noted in the post-operative period and correlated with the levels of HbA_{1c} and Mx test. Comorbid conditions of patients are also noted. Selected cases are divided in four groups (i) Group I: Clean wound; (ii) Group II: Clean contaminated wound; (iii) Group III: Contaminated wound and (iv) Group IV: Diabetic foot / dirty wound.

All the diabetic patients undergoing surgery were included in the study after prior informed consent. In the first visit, detailed history was taken with special emphasis on duration of diabetes, family history of diabetes, type of treatment, prior history of hypertension, smoking,

Mantoux test is performed by intradermally injecting SPAN'S Tuberculin PPD of desired strength with tuberculin syringe. HbA_{1c} was estimated by micromat™ II Haemoglobin A_{1c} Test.

Statistical analysis was done using SPSS software for windows version 16.0. Chi-square, Student's 't' test and ANOVA test was used. P-value less than 0.05 was considered as significant.

Results

One hundred diabetic patients were included in the study. 22 patients were less than 40 years, 24 patients were between 41 to 50 years, 35 patients were between 51 to 60 years, 19 patients were more than 60 years of age, about one third of patients were in age group of 51-60 years, while rest of the groups had almost similar number of patients. The maximum and minimum age of the patients was 85 years to 35 years. The male outnumbered the females and male to female ratio was 3:2. 16% patients were on insulin treatment while 47% were taking oral hypoglycemic agent and 37% were on diet therapy.

Out of all the studied patients almost half (100/49) of the patients were free of any co-morbid illness. Among the rest 51, hypertension was present in 19 (19%), obesity in 16 (16%), hypertension with obesity in 6 (6%), obesity with cardiac disease and cancer in 3 (3%), obesity with cancer in 2 (2%), hypertension with cardiac disease and isolated cardiac disease in 1 (1%). Pus was sent for culture and sensitivity in 30 cases. Culture was sterile in 8 cases. E coli was isolated in 14 cases out of 30 culture reports and it was sensitive to amikacin, gentamycin piperacillin and tazobactam in most of the patients. Out of the 99 patients, 41 was having clean wound, 31 clean contaminated, 6 contaminated and 21 patients were having dirty or diabetic foot wound. One patient of ileocaecal TB was managed by antitubercular drug and improved. After surgery total 54 patients developed wound complications. Only inflammation and induration was present in 13 cases while wound infection was in 12 cases, 6 patients developed wound dehiscence.

Mantoux test was done in 92 cases and it was positive in 31% of cases (Table 1). The patients having past history of tuberculosis was found to have high positivity of Mantoux test which was also statistically significant ($p < 0.05$). HbA_{1c} level was measured in all diabetic patients. 43% of patients have level between 6-8%, 30% had level 8-10% while 13% were having normal HbA_{1c}, while 14 patients were in very poor controlled diabetic and in those HbA_{1c} was $>10\%$.

Table-1: Correlation of Mantoux test with various other parameters (92 patients)

Variables	Mantoux Test	N	Mean ± SD	T value	P value
Age	Positive	31	55.42 ± 10.93	1.798	0.076
	Negative	61	50.82 ± 11.92		
BMI	Positive	31	24.48 ± 3.37	1.545	0.126
	Negative	61	23.22 ± 3.84		
Duration of DM	Positive	31	84.16 ± 118.32	0.667	0.507
	Negative	61	70.45 ± 77.64		
Haemoglobin	Positive	31	12.12 ± 1.99	2.287	0.025
	Negative	60	10.95 ± 2.46		
TLC	Positive	21	9219.05 ± 3152.55	1.146	0.257
	Negative	32	8250.00 ± 2915.91		
Random Blood Sugar	Positive	31	201.12 ± 59.33	1.153	0.252
	Negative	61	183.58 ± 73.31		
Fasting Blood Sugar	Positive	31	155.69 ± 66.51	0.075	0.940
	Negative	61	154.65 ± 60.29		
Total Protein	Positive	20	6.49 ± 0.90	1.420	0.161
	Negative	41	6.14 ± 0.87		
Serum Albumin	Positive	20	3.70 ± 0.56	0.777	0.440
	Negative	43	3.54 ± 0.80		
INR	Positive	13	1.21 ± 0.15	2.572	0.017
	Negative	12	1.06 ± 0.12		
HbA1c	Positive	31	7.13 ± 1.39	2.118	0.037
	Negative	61	8.09 ± 2.33		
Past history of TB Present	Positive	11			0.023
	Negative	9			
Past history of TB Absent	Positive	20			
	Negative	52			

Table-2: Correlation of HbA1c level with BMI, duration of diabetes, type of treatment, any previous surgery and type of surgery

Parameters	HbA1c								p-value	
	< 6 (13)		6-8 (43)		8-10 (30)		>10 (14)			
	N	%	N	%	N	%	N	%		
BMI (kg/m ²)	<18	0	0	1	2.30	0	0	2	14.30	0.018
	18-25	11	84.60	28	65.10	18	60.00	12	85.70	
	>25	2	15.40	14	32.60	12	40.00	0	0	
Duration (months)	<1	7	53.80	10	23.30	3	10.00	1	7.10	0.002
	1-12	2	15.40	11	25.60	7	23.30	2	14.30	
	13-60	0	0	5	11.60	12	40.00	6	42.90	
	60-120	0	0	3	7.00	5	16.70	0	0	
	>120	7	30.80	14	32.60	3	10.00	5	35.70	
Treatment	Insulin	0	0	7	16.30	6	20.00	3	21.40	0.069
	OHA	6	42.60	23	53.50	16	53.50	2	14.30	
Previous Surgery	Diet	7	53.80	13	30.20	8	26.70	9	64.30	0.003
	Present	4	30.80	23	53.50	15	50.00	0	0	
Type of Surgery	Absent	9	69.20	20	46.50	15	50.00	14	100.00	<0.001
	Clean	11	84.60	14	32.60	14	48.30	2	14.30	
	Clean-Contaminated	2	15.40	17	39.50	7	24.10		35.70	
Dirty/Diabetic Foot	Contaminated	0	0	6	14.00	0	0	0	0	
	Dirty/Diabetic Foot	0	0	6	14.00	8	27.60		50.00	

Level of Hb1Ac was found to be statistically associated with BMI of the patient. Patient having BMI >25 have higher level of HbA1c. Level of HbA1c was found to be statistically associated with duration of diabetes. The type of treatment taken for control of diabetes was not found to have any correlation with level of Hb1Ac. Patients having previous history of surgery were having higher level of Hb1Ac. Type of surgery was significantly correlated with the level of HbA1c. In dirty or diabetic foot there is higher level of HbA1c (Table 2).

Table-3: Correlation between Mantoux test * and HbA1c

Mantoux Test	HbA1c								Total	
	< 6 (13)		6-8 (43)		8-10 (30)		>10 (14)		N	%
	N	%	N	%	N	%	N	%		
Positive	2	20.00	23	56.10	6	22.20	0	0.00	31	33.70
Negative	8	80.00	18	43.90	21	77.80	14	100.00	61	66.30
Total	10	100.00	41	100.00	27	100.00	14	100.00	92	100.00

χ²= 18.75; df=3, p=0.000; * Mantoux test done in 92 patients

Table-4: Correlation with other parameter and HbA1c

	HbA1c	N	Mean	F value	P value
Age	<6	13	42.38±13.72	7.873	0.000
	6-8	43	56.93±9.83		
	8-10	30	48.83±10.55		
	>10	14	54.36 ± 9.18		
BMI	<6	13	23.19 ± 4.44	2.666	0.052
	6-8	43	23.47 ± 3.24		
	8-10	30	24.65 ± 3.86		
	>10	14	21.43 ± 2.74		
Duration of DM	<6	13	45.81 ± 68.20	1.570	0.202
	6-8	43	93.42 ± 112.33		
	8-10	30	55.62 ± 65.01		
	>10	14	91.64 ± 97.19		
Haemoglobin	<6	13	13.36 ± 2.25	10.542	0.000
	6-8	42	11.85 ± 2.01		
	8-10	30	10.22 ± 2.22		
	>10	14	9.67 ± 1.89		
TLC	<6	4	7775.00 ± 1450.00	2.599	0.062
	6-8	26	9115.38 ± 2704.32		
	8-10	19	9489.47 ± 3110.71		
	>10	8	6337.50 ± 3233.28		
Random Blood Sugar	<6	13	153.15 ± 31.23	2.494	0.065
	6-8	43	193.52 ± 66.51		
	8-10	30	187.28 ± 54.28		
	>10	14	221.68 ± 101.26		
Fasting Blood Sugar	<6	13	98.40 ± 49.54	10.808	0.000
	6-8	43	159.32 ± 63.89		
	8-10	30	139.40 ± 35.63		
	>10	14	211.31 ± 44.04		
Postprandial Blood Sugar	<6	5	100.83 ± 21.89	9.994	0.000
	6-8	28	203.02 ± 53.60		
	8-10	16	208.67 ± 59.47		
	>10	2	330.25 ± 0.00		
Total Protein	<6	7	6.91 ± 0.36	2.701	0.053
	6-8	32	6.31 ± 0.85		
	8-10	18	6.23 ± 0.89		
	>10	8	5.68 ± 0.92		
Serum Albumin	<6	11	4.19 ± 0.57	4.278	0.008
	6-8	32	3.47 ± 0.78		
	8-10	16	3.74 ± 0.58		
	>10	8	3.13 ± 0.70		
INR	<6	0	0.	6.272	0.007
	6-8	16	1.20 ± 0.14		
	8-10	2	1.12 ± 0.02		
	>10	8	1.00 ± 0.10		

* P<0.001, ** P<0.0

Mantoux test was significantly associated with level of Hb1Ac, there was more chance of Mantoux test negative at higher level of HbA1c (Table 3). Blood parameters were evaluated and their correlation with Hb1Ac was tested statistically. Age, Hb, fasting blood sugar, pp blood sugar, total protein and albumin and INR was found to be statistically significant with the level of Hb1Ac (Table 4).

Table-5: Correlation between Mantoux test, HbA1c and wound complications

	Mantoux test				Total		HbA _{1c}								Total	
	Positive (31)		Negative (61)				< 6 (13)		6-8 (43)		8-10 (30)		>10 (14)			
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Inflammation and Induration	3	18.80	10	33.33	13	28.2	2	40.00	2	10.50	1	5.2	8	72.70	13	24.07
Wound infection	3	18.80	5	16.6	8	17.3	0	0.00	4	21.10	5	26.3	3	27.30	12	22.22
Haematoma/seroma	0	0.00	5	16.6	5	10.8	3	60.00	2	10.50	4	21.0	0	0.00	9	16.6
Dehiscence	0	0.00	3	10	3	6.5	0	0.00	2	10.50	1	5.2	0	0.00	3	5.5
Hypertrophic scar	4	25.00	2	6.6	6	13.0	0	0.00	4	21.10	2	10.5	0	0.00	6	11.11
Wound infection + Haematoma	3	18.80	0	0.00	3	6.5	0	0.00	0	0.00	3	15.7	0	0.00	3	5.5
Inflammation + seroma	0	0.0	4	13.3	4	8.6	0	0.00	2	10.50	2	10.5	0	0.00	4	7.4
Inflammation + Hypertrophic scar	0	0.00	1	3.0	1	2.17	0	0.00	0	0.00	1	5.2	0	0.00	1	1.85
Inflammation + Infection + Dehiscence	3	18.80	0	0.00	3	6.5	0	0.00	3	15.80	0	0.00	0	0.00	3	5.5
Total	16	100.00	30	100.00	46	100.00	5	100.00	19	100.00	19	100.00	11	100.00	54	100.00

$\chi^2 = 23.178$; $df = 9$; $p = 0.006$; $\chi^2 = 49.08$; $df = 27$, $p = 0.006$

Figures in parenthesis indicate percentage

Table-6: Correlation between Mantoux test, HbA1c and wound complications

HbA _{1c}	Mantoux test	Complications	
		Present	Absent
<6	Positive	06	05
	Negative	10	09
6-8	Positive	19	09
	Negative	26	14
8-10	Positive	03	01
	Negative	10	05
>10	Positive	03	00
	Negative	15	03

Of 61 patients with negative Mantoux, 30 patients had wound complication while 31 patients with positive Mantoux, 16 had wound complication (table 5). Patients having Mantoux test negative is 65.2% and positive is 34.7% that means Mantoux test negative patients have high wound complication compared to Mantoux test positive means Mantoux test negative patients have low immunity.

Patients having higher level of HbA_{1c} have significantly more rate of wound complications and patients having Mantoux test negative is 65.2% and positive is 34.7% that means Mantoux test negative patients with higher HbA_{1c} have high wound complication compared to Mantoux positive test (table 5). 80% (12/15) patients in group >10 HbA_{1c} with Mantoux test negative developed wound complication while 16.67% (01/06) patients in group < 6 HbA_{1c} with Mantoux test positive had wound complication (table 6).

Discussion

The Wound healing is a complex process that involves the interaction of many time dependent components. Hence, the evaluation of the outcome of healing can be measured versus time. This time of healing curve is called "wound healing trajectory". The shift of trajectory to left or right suggests whether the wound will heal faster or slower. Any local or systemic deterrent to the wound healing process would shift the trajectory to the right towards impaired healing. Diabetic foot ulcers have numerous underlying

deterrents that make them to be the most common non-healing wounds if not managed properly. Clinical management of diabetic foot ulcers continues to receive considerable attention in view of its serious debilitating complication.

Among the patients included in the study, 59% of the patients were males and 41% were females. In the study population incidence of diabetes were highest in the 6th decade (35%) of life followed by 5th decade (24%). Vijay et al^[3] in a study from South India had found a preponderance of males with diabetic foot lesions and the mean age of their patients was 54.9 ± 9.4 years. Other Indian authors^[4,5] also showed that type 2 DM is usually an adult onset disease. In the National Rural Diabetes Survey (1989-91), it was found that subjects of more than 45 years age had higher prevalence of diabetes; the mean age was 52.3 years. The mean age of subjects with diabetes in our study was 55.42 ± 10.93 years.

History of patients taking insulin was found in 16%. All the patients who were diabetic were on glycemic control treatment. OHA was the main mode of treatment in 47% of cases while 37% cases were controlled on diet therapy. History of co-morbid condition was found in 51% patients of diabetes. Hypertension alone in 19% or in association with other co-morbid illness was the main factor followed by obesity.

History of previous ulceration had been reported to be a major risk factor for diabetic foot ulcer.^[6] Ebskov et al^[7] had found the rate of lower limb amputations to be 15 times higher in diabetics as compared to non-diabetic and that more than 50% of amputees need a subsequent amputation of the contralateral limb within 4 years of the loss of the first leg. This indicates the progressive nature of the peripheral vascular involvement in patients with diabetes. This could be attributed to the shorter life span seen in this group of subjects, owing to the higher prevalence of associated vascular complications.

Amongst the various bacterial isolates from the diabetic wound, E.coli was the commonest organism followed by fungal infection, Staphylococcus, Klebsiella. Presence of gram negative bacteria like E. coli in diabetic wound and foot ulcers indicates very poor personal as well as community hygiene, because most of the people are in the habit of barefoot walking and the fecal bacteria may come either from the soil contaminated with the feces or by contaminated fingers of the patient himself, In our study E coli was isolated in 14 cases out of 30 culture reports and it was sensitive to amikacin, gentamycin piperacillin and tazobactam in most of the patients,. Most of the isolates have been gram positive organisms in studies by Tentolours et al.^[8] A similar result has also been reported from India by Pathera et al.^[9] In contrast to these reports, gram negative isolates were more common in our study. The findings of the study by Shankar et al^[10] on bacterial etiology of diabetic foot infection were similar to ours. They also had isolated gram negative bacteria (57.6%) more often than gram positive (42.3%) one, but in their study the most frequent bacterial isolate was pseudomonas followed by staphylococcus aureus, coagulase negative staphylococci and Enterobacteriaceae. Fungal infection in diabetic wound though rare, should always be kept in mind while treating non healing diabetic ulcers. In four patient who did not improve with standard care and Mupimet™, fungal infection was suspected. Antifungal treatment with oral fluconazole and a topical antifungal ointment was started empirically after that fungal culture was found to be positive in 4 patients and the patient dramatically improved in next 5 weeks.

In our study the Mantoux test was positive in 31% patients of diabetes The patients having past history of tuberculosis was found to have high positivity of Mantoux test which was also statistically significant. In a review by Udani et al^[11] tuberculin testing using 1-TU PPD RT 23 was positive in 52.3% (range 19.3-73.3%) of children with tuberculosis and the sensitivity improved if 5 TU was used. The positivity was lower in children with severe malnutrition, disseminated disease miliary or tubercular meningitis. In our study correlation of wound complication and Mantoux test was significant, Mantoux test was negative in 32 (66.6%) patients and positive in 16 (33.3%) patients of wound complication means Mantoux negative patients have low immunity there for have more chance of infection and delayed or impaired wound healing.

In 21 patients (21%) diabetes was diagnosed only when the patients were evaluated as they presented in hospital for surgery and non-healing ulcer. This reflects the lack of awareness of the community regarding diabetes and its

complications and also indicates lack of screening programmes which could help identify diabetics at the earliest so that proper treatment can be started and complications can be avoided. In our study the majority of patients (21+22 =43%) had recently diagnosed diabetes mellitus (< 1 year). Out of these patients almost 50 % of patients diagnosed during hospital admission for their surgical problem. Level of HbA1c was found to be statistically associated with duration of diabetes. More the duration, patients have higher level of HbA1c means diabetes are uncontrolled so increased chance of infection and decrease wound healing.

Traditionally, HbA1c has been thought to represent average glycemia over the past 12 to 16 weeks.^[12] In fact, glycation of haemoglobin occurs over the entire 120-day life span of the red blood cell,^[13] but within these 120 days recent glycemia has the largest influence on the HbA1c value. Indeed, theoretical models and clinical studies suggest that a patient in stable control will have 50% of their HbA1c formed in the month before sampling, 25% in the month before that, and the remaining 25% in month's two to four prior to sampling.^[14]

In our study patients having previous history of surgery and co-morbid condition like hypertension, obesity, cancer and cardiac disease was having higher level of Hb1Ac. And that was significant, it also observed that they have low immunity, Mantoux test negative in 66.6% and have the impaired wound healing. As observed in our study Mantoux test was significantly associated with level of Hb1Ac, There was more chance of negative Mantoux test at higher level of HbA1c, means that there is decrease in cell mediated immunity leading to decrease in Mantoux test positivity and increase in wound complication and delayed wound healing.

In our study increasing HbA1c (%) level were associated with increasing level of average blood sugar and maximum patients are in the 6 to 10 HbA1c (%) level in 73%. Patients having higher level of Hb1Ac and co-morbid condition along with low level of total protein and albumin have significantly more rate of wound complications. Hyperglycemia has been proposed as one of the risk factors for PVD.^[15] Hyperglycemia also impairs healing of wound. An adequate glycemic control is essential for wound healing. Hyperglycemia accelerates atherosclerosis by causing glycation of proteins, alteration in lipoproteins, platelet function abnormalities, monocyte chemotaxis abnormalities, altered cellular growth and replication, changes in extracellular matrix and hypercoagulable state. All these have been correlated with increased risk of

PVD.^[15] This poor glycemic control may be because of non-compliance on the part of the patients, decreased dose of insulin being prescribed by the physician or insulin resistance. The effects of diabetes on healing are diverse, multifactorial, complex and inter-related.^[16] It is one of the well-known intrinsic factors which affect wound healing. In fact, diabetes affects almost all stages of wound healing to some extent. Thickening of basement membrane in the microcirculation can lead to ischaemia and decreased tissue perfusion, which in turn results in impaired wound healing.^[17]

Conclusion

The Mantoux test negative patient have high rate of infection due to low immunity and high HbA1c level. Increasing HbA1c level associated with higher blood sugar level. It lead to high rate wound complication in the diabetic patients as compared to low HbA1c level. By knowing the level of HbA1c we can predict the preoperative complication in diabetic patients. Level of HbA1c was found to be statistically associated with duration of diabetes. More the duration patients have higher level of HbA1c means diabetes is uncontrolled so increase chance of infection and decrease wound healing.

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