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RESEARCH ARTICLE

A STUDY OF CORRELATION BETWEEN SERUM TESTOSTERONE LEVEL AND PENILE BLOOD FLOW IN MALE DIABETIC PATIENTS WITH ERECTILE DYSFUNCTION

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INTRODUCTION

Erectile dysfunction (ED), also referred to as "impotence", is a problem not getting or keeping an erection hard enough for satisfactory sexual performance (Najari, 2016). The prevalence of ED is estimated as 3% to 76.5% across the globe (Kessler, 2019). The screening tools used for ED in population based studies are associated with discrepancies. ED constitutes a large burden on society given its high prevalence and impact on quality of life and also a risk factor for cardiovascular disease (CVD), dementia and all-cause mortality (Kessler, 2019). Age is a strong determinant of occurrence of ED and epidemiological studies indicate a strong relationship between ED and advancing age. It is estimated that elderly male (age between 50 and 59 years) have a 3.6 times more risk of developing ED compared to

younger male (age between 18 and 29 years). Onset of ED occurs 10–15 years earlier in men with diabetes than it does in sex-matched counterparts without diabetes (Chu, 2001; Isidro, 2012). One common cause of organic ED is diabetes having multifactorial pathophysiology of ED development. The most important mechanisms for ED development are vasculopathy and neuropathy. Autonomic neuropathy has a key role in the high incidence of ED in diabetes patients (Chu, 2001). Psychological factors also contribute to ED in diabetes. Drug related ED is associated with psychotropic drugs (especially Tricyclic antidepressants, Selective serotonin reuptake inhibitors), antihypertensive drugs (specially β -adrenergic-blockers, thiazide diuretics and spironolactone) and certain fibrates which are commonly used in diabetic patients. Recreational substances like opiates, marijuana, cocaine have all been associated with drug-related ED (McVary, 2007). Prevalence of ED in diabetes ranges from 35%

ABSTRACT

Introduction: Erectile dysfunction (ED) constitutes a large burden on society because of its high prevalence and impact on quality of life. One common cause of organic ED is diabetes. In diabetes, prevalence of ED lies between 35% to 85% depending on the study whereas in normal population ED prevalence is around 26%. Serum testosterone level and penile blood flow closely related to each other as well as to ED. **Material and methods:** It was a hospital-based cross-sectional study. Patients were divided into 4 categories according to International Index of Erectile Function (IIEF)-5 questionnaire: mild ED - score 17 to 21, mild-to-moderate ED - score 12 to 16, moderate ED - score 8 to 11 and severe ED - score 1 to 7. The presence of ED and its severity was correlated with age, duration of diabetes, lipid profile, glycemic status, complications, body mass index (BMI), Serum testosterone level, penile blood flow etc. **Results:** Prevalence of ED in male diabetes patients was found to be 69.28%. 17 had mild ED (17.6%), 27 had mild-to-moderate (27.8%), 24 had moderate ED (24.7%) and 29 had severe ED (29.9%) among 97 cases with ED. Prevalence of ED was found to be proportional to age. Most cases were associated with long-standing diabetes (>10 years) in ED group. ED was correlated with complications of diabetes like nephropathy, neuropathy and retinopathy but the correlation was not statistically significant. Statistically significant correlation of ED was found with FBS, PPBS & HbA1C. Significant correlation of ED was found with serum testosterone level and penile blood flow. Statistically significant correlation was also found between serum testosterone level and penile blood flow. **Conclusion:** ED prevalence among the diabetes patients increased with age and duration of the diabetes. Glycemic status was significantly associated with development of ED. Penile blood flow was significantly lesser in ED group. Serum testosterone level was below normal limits in most of ED patients. In patients with decreased serum testosterone level, penile blood flow was also decreased.

to 85% depending on the various studies whereas 26% in general population. In diabetes, ED is approximately 3.5-times more prevalent (Kouidrat et al., 2017), more severe & is less responsive to phosphodiesterase-5 (PDE5) inhibitors (Fonseca, 2004) than in men without diabetes. In men with diabetes, the severity of ED increases with age & duration of diabetes and more commonly associated with poor glycemic control. Micro and macrovascular complications of diabetes are also associated with ED (Kalter-Leibovici et al., 2005). Now, Erectile dysfunction is considered as a major health problem for healthy aging population but its presence is poorly evaluated in routine clinical practice. The emergence and severity of ED are associated with inflammatory mediators and endothelial dysfunction (Vlachopoulos, 2007). An erection is the result of increased blood flow into penis. When a man is sexually excited, muscles in the penis relax, allowing increased blood flow through the penile arteries, filling two chambers inside penis. As the chambers fill with blood, the penis grows rigid. Penile blood flow is directly related to serum testosterone level. Following testosterone therapy, serum testosterone levels restore within 3-6 months according to a study. Connection between diabetes and ED is related to blood circulation and nervous system. Poorly controlled blood sugar levels can damage small blood vessels and nerves. Damage to the nerves that control sexual stimulation and response can impede a man's ability to achieve an erection firm enough to have sexual intercourse. Reduced blood flow from damaged blood vessels can also contribute to ED (Garg, 2013) India is a country where conversations about ED are often a taboo and left unspoken. ED is an issue that greatly impacts a patient's quality of life and can have detrimental effects on his relationship with his partner. So more and more research is needed in this area. Though there have been similar studies in the past, but this study is one of its kind in the tribal region. Tribal zone is further full of their own taboos and apprehensions so this study can act as tool for further research.

MATERIAL AND METHODS

Study Design: Cross-sectional hospital-based study.

Study Population: Male diabetes patients attending medical, psychiatry and endocrinology OPD as well as those admitted in these wards were enrolled in the study after taking informed consent.

Study Period: December 2021 to August 2022.

Inclusion Criteria: Diabetic males who are sexually active with age of ≥ 18 years & willing to participate in the study by giving informed consent.

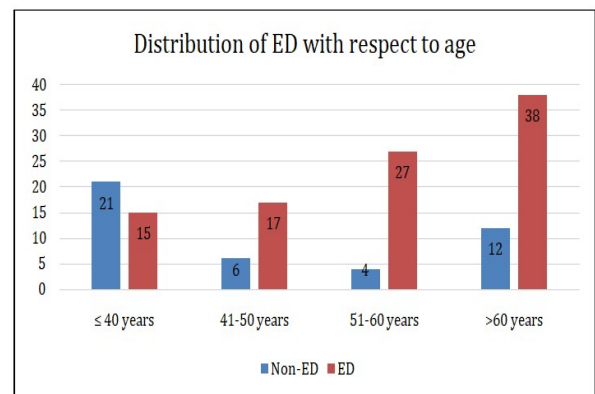
Exclusion Criteria

- Endocrine disorders other than Diabetes like Thyroid disorder, Addison disease, Acromegaly etc.
- History of pelvic trauma, pelvic surgery (hernia, hydrocele).
- Neurogenic causes like spinal cord injury, Multiple sclerosis.
- Men with debilitating disease e.g., TB, HIV etc.
- Men with unfavourable penile anatomy for sexual act.
- Patients presenting to urology OPD and wards for erectile dysfunction evident enough and requiring surgery.

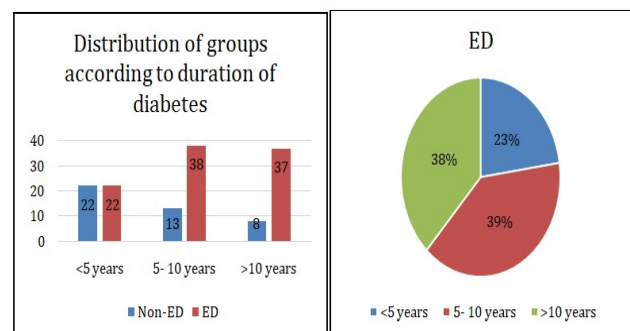
The prevalence period was 9 months and sampling took place over 5 days, randomly selected per month. Detailed history, general physical examination and systemic examination were done. Patients were divided using International Index of Erectile Function (IIEF)-5 questionnaire into 4 categories: mild ED with score 17 to 21, mild-to-moderate ED with score 12 to 16, moderate ED with score 8 to 11 and severe ED with score 1 to 7. After this, blood investigations were done. Then, the presence of ED and its severity was correlated with age, duration of diabetes, glycemic control, lipid profile, complications, body mass index (BMI), serum testosterone level & penile blood flow etc.

RESULTS

This study was done in Maharana Bhupal Hospital, Udaipur, Rajasthan from December 2021 to August 2022. Total 450 patients were screened and 172 of them were eligible for the study after applying the exclusion criteria. Out of them, 140 were screened for ED as 32 of them either didn't give consent or didn't complete the questionnaire. 97 were found to have ED, whereas 43 had no ED out of 140 cases. Therefore, in male diabetes patients, prevalence of ED was found to be 69.28%. Among 97 cases with ED, 17 had mild ED (17.6%), 27 cases had mild-to-moderate (27.8%), 24 cases had moderate ED (24.7%) and 29 had severe ED (29.9%). Graph 1 depicts that in the ED group, maximum patients were in the elderly age group, i.e., >60 years (39.2%) and in the non-ED group, maximum patients were in the younger age group, i.e., ≤ 40 years (48.8%). Prevalence of ED in < 40 years group was 41.66% , in 41-50 years group was 73.91% whereas in 51-60 years age group, it was 87.1% and in >60 year age group was 76.0%. P value was found to be significant. As age increases risk of having ED increases. Graph 2 depicts that a majority of cases in ED group were those with long-standing diabetes, i.e 5-10 years (39.2%) or >10 years (38.1%) whereas non-ED group was formed mainly by cases with short history of diabetes (51.2%).



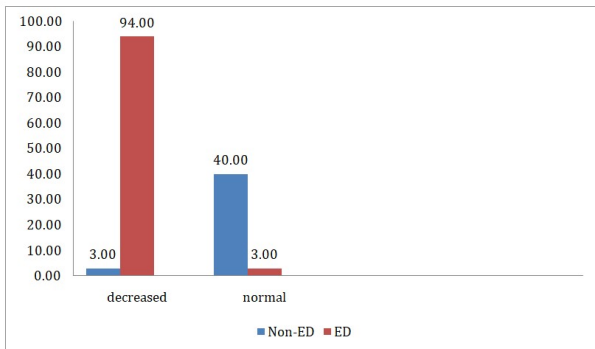
Graph no. 1. Distribution of ED with respect to age



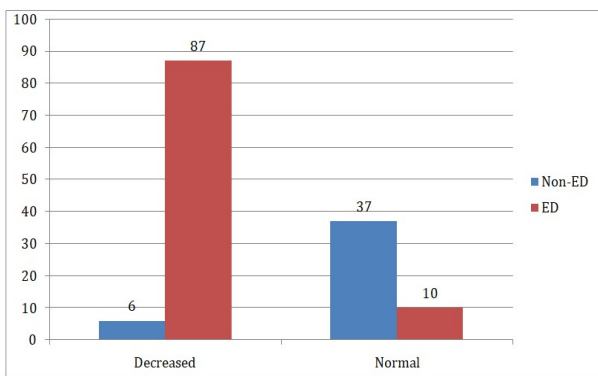
Graph no. 2. Distribution of groups according to duration of diabetes

Table 1 depicts that 19 out of 97 ED (19.6%) cases had nephropathy as a complication, whereas in non-ED group only 3 out of 43 cases had nephropathy (7.0%). 29 out of 97 ED (29.9%) cases had neuropathy as a complication, whereas in non-ED group 7 out of 43 cases had neuropathy (16.3%). 8 out of 97 ED (8.2%) cases had retinopathy as a complication, whereas 1 out of 43 non-ED (2.3%) case found to have retinopathy. The correlation of ED with nephropathy, neuropathy & retinopathy were not found to be statistically significant ($p > 0.05$). ED group had more cases with hypertension, i.e., 32%, while 23.3% in non-ED group had hypertension, but this correlation was not found to be significant ($p = 0.322$). ED group had more proportion of cases who were smokers, i.e., 24.7%, as opposed to non-ED group which had 18.6% of

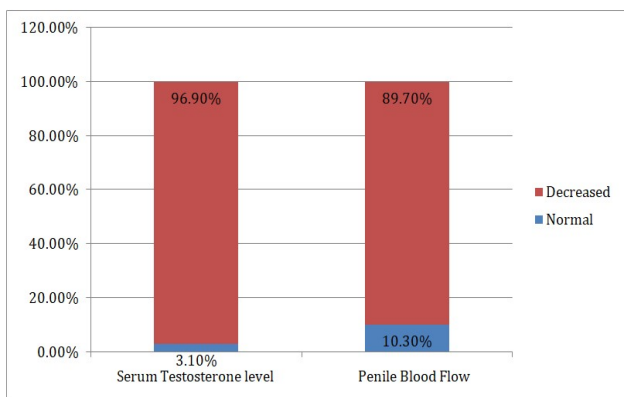
smokers, but this correlation was not found to be statistically significant (p = 0.516). The proportion of patients who consumed alcohol was more in the ED group (18.6%), as opposed to non-ED group which had 9.3% of alcohol consumers, but this correlation was not found to be statistically significant (p = 0.212). Table 2 shows the comparison of mean values of different biochemical parameters among ED and non-ED group.



Graph No. 3. Correlation of Serum Testosterone level with ED



Graph No. 4. Distribution of groups according to normal or decreased Penile Blood



Graph no. 5. Correlation between serum testosterone level & penile blood flow in ED patient

Correlation for FBS, PPBS, HbA1c was found to be statistically significant. Graph 3 shows the correlation of serum testosterone level with ED. ED group contains more proportion of cases who had decreased serum testosterone level (94 out of 97) i.e 96.9% as opposed to non-ED group which had only (3 out of 43) i.e 7.0% cases with decreased serum testosterone level. This correlation was found to be statistically significant (P value 0.00).

Graph no. 4 depicts correlation of Penile blood flow with ED. ED group contains more proportion of cases who had decreased penile blood flow i.e 89.7% as opposed to non-ED group which had only

14.0% cases with decreased penile blood flow. This correlation was found to be statistically significant (P value 0.00). Graph no. 5 depicts correlation of serum testosterone level with Penile Blood Flow. In 94 out of 97 (96.9%) ED cases serum testosterone level was decreased. Similarly, 87 out of 97 (89.7%) cases had decreased penile blood flow. In majority cases with decreased serum testosterone level, penile blood flow was also decreased. This correlation was found to be statistically significant (P value- 0.00)

Table No 1. Comparison on the Basis of Diabetic Complications, Hypertension and Substance Abuse

Variables	Non-ED (n=43) N (%)	ED (n= 97) N(%)	Total (n=140) N (%)	P- value
Present	3 (7)	19 (19.6)	22 (15.7)	0.078
Absent	40 (93)	78 (80.4)	118 (84.3)	
Neuropathy				
Present	7 (16.3)	29 (29.9)	36 (25.7)	0.098
Absent	36 (83.7)	68 (70.1)	104 (74.3)	
Retinopathy				
Present	1 (2.3)	8 (8.2)	9 (6.4)	0.275
Absent	42(97.7)	89(91.8)	131 (93.6)	
Hypertension				
Present	10 (23.3)	31 (32.0)	41(29.3)	0.322
Absent	33(76.7)	66 (68.0)	99 (70.7)	
Smoking				
Present	8 (18.6)	24 (24.7)	32 (22.9)	0.516
Absent	35 (81.4)	73 (75.3)	108 (77.1)	
Alcohol intake				
Present	4 (9.3)	18 (18.6)	22 (15.7)	0.212
Absent	39 (90.7)	79 (81.4)	118 (84.3)	

Table no. 2. Comparison between groups

Parameter	Groups	N	Mean	SD	P value
FBS	Non-ED	43	132.14	29.29	.011
	ED	97	157.31	60.67	
PPBS	Non-ED	43	188.02	43.06	.025
	ED	97	214.59	71.25	
HbA1c	Non-ED	43	8.100	2.17	.015
	ED	97	9.265	2.75	
BMI	Non-ED	43	21.76	1.94	.062
	ED	97	22.65	2.83	
TG	Non-ED	43	137.19	46.58	.382
	ED	97	146.21	59.88	
LDL	Non-ED	43	104.88	40.65	.739
	ED	97	102.16	45.94	
HDL	Non-ED	43	41.88	10.23	.292
	ED	97	44.06	11.65	
TC	Non-ED	43	174.20	47.74	.935
	ED	97	174.99	54.93	

DISCUSSION

In our study we evaluated 140 male diabetic patients who satisfied inclusion and exclusion criteria, 97(69.28%) of them were found to have ED, therefore prevalence of ED in male diabetic patients was found to be 69.28%. Garg et al¹⁰ in study of 50 male diabetic patients noted that in 39 (78%) patients ED was present. Sasayama et al¹¹ studied 6,112 Japanese male patients from 447 OPD based clinics and ED was found in 81% of patients. Among ED group, maximum patients were present in elderly age group i.e> 60 years (39.2%) and among non-ED group maximum patients were present in younger age group i.e≤40 years (48.8%). Prevalence of ED in < 40 years group was 41.66% , in 41-50 years group was 73.91% whereas in 51-60 years age group was 87.1% and in >60 year age group is 76.0%. As age increases risk of having ED increases. . Majority of cases in ED group are those with long standing diabetes i.e>10 years (40.9%) whereas non-ED group is formed mainly by cases with short history of diabetes (54.8%). Complications of diabetes (Nephropathy, Neuropathy, Retinopathy) were not significantly associated with ED. This study also showed that glycemic control, as assessed by FBS, PPBS and HbA1c level, was significantly associated with ED in

diabetic men. Similar results were found in study by De angelis et al. and Wing RR et al. (2001). Wing, 2013 in which glycemic control was associated significantly with presence of ED. Similar results were found in a study by Cho et al. (2006). In our study, serum testosterone in ED group was less than normal range whereas in Non-ED group was normal. In our study, in ED group 94 out of 97 cases (96.9%) testosterone level below normal range whereas in Non-ED group, only 3 out of 43 (7.0%) had testosterone level below normal range which was statistically significant (P value- 0.00). This was supported by a study by EO El Saghier et al. (2015) including 70 diabetic men ages between 30 to 50 years evaluated symptoms of androgen deficiency and ED. Low serum testosterone was found in 40% of studied men, and 92.9% of them reported overt symptoms of androgen deficiency.

ED was detected in 85.7% of those with low serum testosterone, as opposed to 31.0% of those with normal total testosterone (P < 0.000). The clinical application of this association done by AM Isidori et al (2005) in their study on 656 subjects. Their meta analysis showed that in men with an average testosterone level at baseline below 12 nmol/l, Testosterone treatment moderately improved the number of nocturnal erections, sexual thoughts and motivation, number of successful intercourses, scores of erectile function and overall sexual satisfaction. In our study, Penile Colour Doppler showed decreased penile blood flow in patients with ED. In ED group 87 cases out of 97 (89.7%) showed decreased penile blood flow whereas in Non-ED group, only 6 cases out of 43 (14%) showed decreased blood flow. This was statistically significant (P value-0.00). The same was supported by cross-sectional study by de Silva NL (de Silva, 2022) conducted at the Diabetes Clinic, National Hospital of Sri Lanka, from January to September 2020. Men with diabetes aged 18 to 70 years undergoing annual assessment were recruited consecutively. Two hundred and twelve participants were recruited with a mean age of 54.1. Arterial insufficiency was seen among 50% of the participants who underwent penile colour Doppler ultrasonography.

CONCLUSION

ED prevalence was high among the diabetic men and it increased with age and duration of the disease. Presence of diabetic complications was not significantly associated with ED. Glycemic control (FBS, PPBS, HbA1C) was significantly associated with development of ED therefore diabetic diet & frequent blood sugar monitoring should be recommended to all patients. BMI was associated with development of ED however it was not statistically significant therefore lifestyle modification should be recommended to all patients. We demonstrated that serum testosterone level & penile blood flow are lower in patients with ED than in the control group. So, penile colour Doppler & serum testosterone along with clinical findings & questionnaires might be helpful in identifying patients with ED and developing treatment strategies. Erectile dysfunction in men with diabetes is likely to become a more serious problem in the future with the rapidly increasing prevalence and earlier onset of diabetes. We recommend screening of all diabetic men for ED since it is a neglected medical problem and also a culturally sensitive matter.

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