The impact of diabetes mellitus on penile length in men undergoing inflatable penile prosthesis implantation

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ABSTRACT

Objective: To evaluate the changing cavernosal length of patients with diabetes mellitus (DM) and organic erectile dysfunction (ED) who were treated with inflatable, three-piece penile prostheses, a current surgical treatment option in our clinic, over the course of 12 years.

Materials and methods: Between April 2000 and December 2012, we retrospectively investigated data from patients who were diagnosed with organic ED and undergone penile prosthesis implantation (PPI). Of the 239 patients, 235 of them were included in the study. Four patients who were operated on for transsexuals were excluded from the study. All patients were divided into two groups as those with (Group 1) or without DM (Group 2). Data, including age, body mass index (BMI) in kg/ m2, surgical history, comorbidities, International Index of Erectile Function (IIEF) questionnaire scores, combined intracavernous injection and stimulation (CIS) test results, length of corpus cavernosum while implanting the penile prosthesis, complications, operative times, mean hospital stay, and satisfaction of the patient and partner, were recorded. Kruskal-Wallis and Mann-Whitney U tests were used for statistical analysis. A p-value of <0.05 was considered to be statistically significant.

Results: The mean age was 57.9±10.5 years. Study population consisted of patients with DM (n=65), hypertension (n=21), DM, and hypertension (n=28), hyperlipidemia (n=5), a history of previous radical pelvic surgery with (n=4) or without DM (n=51) or cases without any comorbidity (n=62). Mean length of the corpus cavernosum was 17.277±0.1509 cm in Group 1 and 17.289±0.1598 cm in Group 2 (p<0.05). Additionally, the other parameters, including age, operative time, and the satisfaction of the patient and partner, were not different between these groups (p>0.05).

Conclusion: The length of the corpus cavernosum and the destruction of cavernosal tissues do not depend only on DM. We conclude that these features may have multifactorial causes.

Key words: Corpus cavernosum; diabetes mellitus; erectile dysfunction; penile prosthesis; penis.

Introduction

Erectile dysfunction (ED) is sexual dysfunction characterized by the inability to develop or maintain penile erection of the penis during sexual performance.^[1]

Although ED was previously accepted as a psychologically based disease, ED has been considered as a 75% organically based disease in recent years.^[2] By developing technologies for methods of diagnosis, the etiologic factors have been accurately determined. Thus, these developments provided us treatment options for the cause.^[3] Currently, when patients are diagnosed as ED, medical treatment options are offered as the first step of treatment. When these options are inadequate for treatment, surgical treatment options are considered.^[4] Inflatable, three-piece penile prostheses are the current option for the surgical treatment of ED.^[5]

Implanting an inflatable penile prostheses is the gold-standard surgical treatment option for ED. Moreover, research on the etiology of ED is continuing.^[6,7]

There are several proven etiologic factors in ED that are often related to poor health state or illnesses, such as atherosclerosis, diabetes mellitus (DM), depression, and hypogonadism.^[8]

Men with DM may have ED at an earlier age with a significantly higher prevalence, reaching as high as 75 percent.^[9] However, the etiology of ED in DM is multifactorial. There is a greater incidence of peripheral neuropathy, microangiopathy, and arterial insufficiency in individuals with DM and ED compared with those individuals with normal function. Changes in the endocrine function and the control of sexual arousal by central nervous system may also have an important role in the

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pathogenesis of ED associated with DM. Thus, shortening of the length of the cavernosum is an issue in patients with DM.

In our study, we evaluated the changing cavernosal length of patients with DM and organic ED who were treated with inflatable, three-piece penile prostheses, a current surgical treatment option in our clinic, over the course of 12 years. We hypothesized that DM causes ED and that DM induces the shortening of penile length.

Material and methods

In this retrospective study, we included 235 patients (mean age 57.9 ± 10.5 years) who underwent inflatable, three-piece penile prosthesis implantation (PPI) between April 2000 and March 2012. Signed informed consent was obtained from all patients. The study protocol was approved by the institutional review board.

All patients were divided into two groups as those with (Group 1), and without DM (Group 2).

Recorded data for statistical analyses included age, body mass index (BMI) in kg/m^2 , surgical history, comorbidities, International Index of Erectile Dysfunction (IIEF) questionnaire results, combined intracavernous injection and stimulation (ICSI) test results, length of the corpus cavernosum at the time of penile prosthesis implantation, complications, operative time, mean hospital stay, and the satisfaction levels of the patients and their partners. Additionally, nocturnal penile tumescence (NPT) tests and color Doppler ultrasonography examination were performed on the patients according to the individuals' clinical conditions.

Moreover, all patients consulted to a psychiatry outpatient clinic. We implanted inflatable, three-piece penile prostheses in all patients, as Montague et al.^[10] previously described. The surgical approach, such as penoscrotal or infrapubic, was determined by our surgeon (MU) based on surgical histories and physical examination results of the patients. Four patients who were operated on for transsexuality were excluded from the study.

Patient and partner satisfaction were evaluated via face-to-face interviews or by telephone conversations.

Statistical analysis

Kruskal-Wallis and Mann-Whitney U tests were used for statistical analysis. A p-value of <0.05 was considered to be statistically significant.

Results

Study population (Group 1, $n=97$, and Group 2, $n=138$) consisted of patients with DM ($n=65$), hypertension ($n=21$), DM, and

hypertension ($n=28$), hyperlipidemia ($n=5$), a history of previous radical pelvic surgery with ($n=4$) or without DM ($n=51$) or cases without any comorbidity ($n=62$).

The mean measured length of the corpus cavernosum was 17.277 ± 0.1509 cm in Group 1 and 17.289 ± 0.1598 cm in Group 2 ($p < 0.05$). Moreover, the mean operative time, satisfaction level of the patient and partner, and complications were not significantly different between the two groups (Table 1).

Peyronie's disease was diagnosed in Groups 1 ($n=12$; 12%), and 2 ($n=15$; 10%). Manual remodeling was used for patients in Groups 1 ($n=4$), and 2 ($n=5$). Plaque incision was also performed in Groups 1 ($n=3$), and 2 ($n=5$). Plaque incision, and patching of the rectus muscle fascia were used in 5 patients in Group 1, and 5 patients in Group 2.

Clinical characteristics were comparable between groups.

Discussion

Diabetes mellitus is a heterogeneous group of disorders characterized by high blood glucose levels. The pancreatic beta cell and its secretory product, insulin, are central in the pathophysiology of diabetes.^[11] Type 1, or insulin-dependent, DM (T1DM) results from an absolute deficiency in insulin due to autoimmune beta cell destruction. In type 2, non-insulin-dependent DM (T2DM), liver, muscle, and fat cells are resistant to the actions of insulin. The compensatory attempt by beta cells to release more insulin is not sufficient to maintain blood glucose levels within a normal physiological range, ultimately leading to the functional exhaustion of the surviving beta cells.^[12] Vickers et al.^[13] demonstrated that patients with DM have high rates of ED, and Vickers and Wright^[13] reported that ED was present in 32% of men with T1DM and 46% with T2DM. Moreover, the Massachusetts Male Aging Study revealed that the prevalence of ED in diabetic men is 50.7 per 1.000 population-years compared with 24.8 in those individuals without diabetes.^[14] Studies in experimental animal models and diabetic patients have revealed several mechanisms responsible for diabetes-associated ED, such as impaired vasodilatory signaling, nonadrenergic-noncholinergic (NANC) dysfunction, endothelial dysfunction, oxidative stress, proinflammatory changes, cavernosal hypercontractility, venoocclusive dysfunction, and hypogonadism.^[15] Notably, endothelial dysfunction caused by independent or concomitant cardiovascular risk factors not only results in atherosclerosis but is also a common denominator among the comorbidities of T2DM. It has also been established that dysfunction in the nitric oxide cascade is the primary link between insulin resistance, coronary artery disease, and ED.^[16] Moreover, in DM the cavernosal tissue is under the attack in DM by harmful oxygen free radicals, such as O_2 . This agent reacts with nitric oxide, forming peroxynitrite, which reacts

Table 1. Comparisons of data for the groups

Parameter	Group 1 (n=97)	Group 2 (n=138)	p-value
Mean age (years)	63.165±0.67	62.906±0.56	0.392
Mean diameter of corpus cavernosum (cm)	17.277±0.1509	17.289±0.1598	0.994
Mean operation time (min)	63.113±0.97	62.804±0.63	0.461
Mean patient and partner satisfaction	0.979±0.014	0.978±0.146	0.478
Mean number of complications (n)	0.051±0.022 (5)	0.028±0.014 (4)	0.188

with lipids, proteins, and nucleic acids.^[17,18] However, a mechanism was described for the association of ED and DM. Recently, Cartledge et al.^[19] reported the destruction of cavernosal tissue in patients with DM and ED due to vasculopathy and autonomic neuropathy. In the light of these, we evaluated the changing cavernosal length of patients with DM and organic ED who were treated with inflatable, three-piece penile prostheses, a current surgical treatment option.

Jevtich et al.^[20] described fibrous proliferation in 90% of penile arteries. Moreover, Ruzbarsky and Michal^[21] reported intimal proliferation, medial fibrosis and calcification, and thrombosis in the cavernosal arteries. However, our study did not include a histopathology step. From a clinical aspect, there was macroscopic fibrosis and insufficient blood supply in the cavernosal tissues. Additionally, it was difficult to dilate the cavernosal tissues with so called ‘spark plugs’ during the operations performed on DM patients. Although DM damages penile microcirculation, nerves, and smooth muscles, cavernosal length was similar between the two groups. Damage to the cavernosal tissues might occur at the micro level but not at the macro level in this series.

Our findings on operative time and patient and partner satisfaction paralleled the results of Mulcahy and Carlson.^[22] However, patient and partner satisfaction rate in their series, and our study population was over 90%, and 98 %, respectively. Lotan et al.^[23] reported that decreased infection rates could be obtained during PPI performed by experienced hands. We agree with this finding. Our surgeon (MU) participated in a long fellowship program and over 12 years of experience in PPI. Therefore, a lower infection rate could be achieved in our series than in the literature.^[24]

There are several reports that indicate that DM increases or does not increase infectious complications in PPI.^[25,26] In our series, there were three mechanical defects in Group 1, and 2 in Group 2. There was no statistically significant difference between two groups as for mechanical defects. Our findings paralleled the results of Montague et al.^[26] In a recent large series, it was reported that the use of an antibiotic-impregnated penile prosthesis could decrease revisions due to infectious complications in DM patients.^[22] Although our study population consisted of

limited number of DM patients, our findings were not similar to the results of Mulcahy and Carlson.^[22] In the future, the risk of infection caused by DM in PPI patients can be shown in a large population series. Clinicians should closely follow up all patients after PPI, regardless of the patients’ infectious comorbidities, and mechanical defects.

In our series, we aimed to compare the cavernosal length of DM and non-DM patients in order to investigate macrolevel damage by DM. Our study have certain limitations. For instance it has a retrospective design, and the cavernosal tissues were not subjected to histopathological and biochemical analyses. These deficiencies may be addressed in another study in the future.

In conclusion, the gold standard surgical treatment option for ED is implantation of an inflatable PPI. Decrease in cavernosal length does not only associated with DM. Given our findings, this cavernosal damage may be related to multifactorial causes. More detailed, large-population and multidisciplinary studies are needed on this topic.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

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