Original Article

DOI: 10.7860/JCDR/2024/70863.19656

Role of Extracorporeal Shock Wave Therapy in Patients with Angiogenic Erectile Dysfunction Associated with Diabetes Mellitus Refractory to Pharmacotherapy: A Prospective Observational Study

Urology Section

SURAJ TUKARAM BHONDAVE[1], BHOOPAT SINGH BHATI[2]

ABSTRACT

Introduction: Erectile Dysfunction (ED) has a strong association with diabetes mellitus in men. The role of Extracorporeal Shock Wave Therapy (ESWT) in patients with ED is being evaluated and used as a treatment option by many urologists. It is considered a treatment modality intermediary between pharmacotherapies and prosthesis surgery. Literature on ESWT in patients with Diabetes Mellitus (DM) refractory to pharmacotherapy remains scarce.

Aim: To evaluate the role of ESWT in patients with angiogenic ED associated with diabetes mellitus refractory to pharmacotherapy.

Materials and Methods: The prospective observational study was carried out in the Outpatient Department of Urology (OPD) of Ruby Hall Clinic, Pune, Maharashtra, India between February 2020 and September 2021 on 40 patients fulfilling the inclusion criteria. Total 20 patients in each were randomised to the control group, and the ESWT group in a ratio of 1:1. Each patient was evaluated pre- and post-ESWT with colour Doppler imaging of the penis after injecting 30 mg to 40 mg of papaverine intracavernosally. Validated sexual function questionnaires such as the International Index of Erectile Function (IIEF)- Erectile Function (EF) domain, Sexual Health Inventory for Men (SHIM), and Erectile Hardness Score (EHS) were used. The IIEF questionnaire was administered to each patient at baseline, 3 months, 6 months, 9 months, and 12 months. Colour Doppler imaging of the penis, SHIM score, and EHS score were used to evaluate each patient at baseline, 6 months, and 12 months. Data were collected and tabulated in a Microsoft Excel sheet. Results were presented as mean±standard deviation. Repeated Analysis of Variance (ANOVA) tests, paired t-tests, and independent sample t-tests were utilised in the study. A p-value of less than 0.05 was considered statistically significant.

Results: The most common age group among the study population was 41 to 50 years (40%). When comparing the mean IIEF score- EF domain between the ESWT and control groups at 3, 6, 9, and 12 months, the difference was statistically significant (p-values obtained at 3, 6, 9, and 12 months were 0.009, 0.0001, 0.0001, and 0.0001, respectively). Comparing the mean SHIM score and EHS between the ESWT and control groups at 6 and 12 months, the difference was statistically significant (for SHIM score, p-values obtained at 6 and 12 months were 0.005 and 0.0001 respectively; for EHS, p-values obtained at 6 and 12 months were 0.0008 and 0.0001 respectively). The improvement in mean peak systolic velocity of the right and left cavernosal arteries at 6 months and 12 months was statistically significant in the ESWT group compared to the control group (p-value=0.001).

Conclusion: The ESWT for ED in diabetic patients is a novel treatment option with promising results. Clinicians and patients need to be aware about the various management strategies available for diabetic individuals who have not had success with pharmacotherapy alone.

Keywords: Erectile hardness score, Peak systolic velocity, Sexual health inventory for men

INTRODUCTION

The Erectile Dysfunction (ED) is defined as the inability to maintain an erection for sexual intercourse and is commonly encountered in the field of urology [1,2]. Diabetes is a known risk factor for ED, with a prevalence rate 3 times higher (35%-90%) among diabetic patients compared to non diabetic individuals [3]. The cause of diabetes-associated ED is multifactorial, but mainly includes endothelial dysfunction and impaired vascular structure [4]. In diabetic patients, there is an impairment of endothelium-dependent vasodilation due to endothelial Nitric Oxide Synthase (eNOS) deficiency [4]. Current non surgical treatment options for ED include the use of oral Phosphodiesterase 5 inhibitors (PDE5I) and intracavernosal injections of vasodilating agents [1]. However, these treatments do not alter the underlying pathophysiology of erectile tissues nor do they improve spontaneous erections [5,6]. The ideal aim for treating patients with ED should be to recover from the pathological changes in the corpus cavernosum and enable them to regain spontaneous sexual activity with few adverse effects [7].

In 1996, Butz and Teichert introduced a modality of treatment known as ESWT. The investigators looked into advanced technologies that would affect endothelial function and help improve penile haemodynamics. The researchers were in search of a new treatment modality that would have a curative or rehabilitative effect on ED [8]. ESWT has been used in the treatment of a variety of conditions such as kidney stones (high-intensity waves) [9], tendonitis (medium-intensity waves) [10], Peyronie's disease [11], peripheral neuropathy, cardiac and peripheral vascular disease (low-intensity waves) [12].

The mechanism of action of LI-ESWT is still unclear. It has been shown that this low-intensity energy induces non enzymatic production of physiologic amounts of nitric oxide and activates a cascade of intracellular signaling pathways that lead to the release of angiogenic factors. At low energy density (0.03 mJ/mm^2), ESWT,

originally developed for clinical lithotripsy, has successfully been used for the anti-inflammatory treatment of soft-tissues. Since, Nitric Oxide (NO) plays a critical role in inflammation, it was hypothesised that ESWT induces neovascularisation and improves the flow in cavernosal arteries and increases NO production in cells [13].

Several recent studies have reported that ESWT has been developed for treating ED and has the potential to affect pharmacotherapy non responders [14,15]. Being a non invasive modality, it offers a good treatment option to patients. However, at the moment, evidence in this area is still scarce in the literature.

Therefore, the aim of present study was to evaluate the role of ESWT in patients with angiogenic ED associated with diabetes mellitus refractory to pharmacotherapy.

MATERIALS AND METHODS

The present study was a prospective observational study conducted between February 2020 and September 2021 among all diabetic patients presenting to the Urology Outpatient Department (OPD) of Ruby Hall Clinic, Pune, Maharashtra, India, with ED refractory to pharmacotherapy.

Sample size calculation: The sample size was determined using effect sizes from a previously published study by Yee CH et al., [15]. The total sample size to be enrolled for this study was 40 with the help of the following formula:

$$n=\frac{(Z_{\alpha/2}+Z_{\beta})^2}{(\Delta/S)^2}$$

Where, n=Sample size (per group). Zα/2=Standard normal variant at 5% level of significance=1.96. Z_{β}=cut-off value for power (1-β)=0.84. Δ/s=effect sizes in SD units=0.62.

s=pooled standard deviation=2.4

Δ=mean difference of pre and post intervention IIEF ED score=1.5

n=(1.96+0.84) 2/(0.78/1.63)2

n=20.07

n=20

Thus, the sample size according to this formula was 20.07, rounded up to 20 (minimum per group). Therefore, the included sample size was 40.

After obtaining Institutional Ethical Clearance in February 2020, written informed consent was obtained from the patients.

Inclusion criteria: The inclusion criteria were male patients aged 18 years or older, with a history of ED lasting atleast 6 months, involved in a heterosexual relationship for atleast 6 months, diagnosed cases of diabetes mellitus with ED, and undergoing pharmacotherapy for 3 to 6 months.

Exclusion criteria: The exclusion criteria were ED due to other endocrine diseases, drug treatments (such as psychiatric medications, antihypertensive drugs, recreational drugs, and antihistamines), neurological diseases, psychogenic ED, penile structural abnormalities, history of pelvic surgery or radical prostatectomy, history of pelvic irradiation, and patients with penile implants.

Study Procedure

The study procedures and follow-up were carried out on an outpatient basis for all 40 patients. The patients were assigned to either the treatment group (ESWT) or the control group in a 1:1 ratio i.e., 20 each using a computer-generated table of random numbers.

For patients who were receiving phosphodiesterase 5-inhibitor pharmacotherapy, they underwent a 2-week washout period before inclusion in the study. Each patient was evaluated pre- and post-ESWT with colour doppler of the penis after injecting 30 mg to 40 mg of papaverine intracavernosally.

The ESWT protocol was similar to the protocol suggested by Vardi Y et al., [14]. During each session, ESWT was delivered by a special probe attached to a compact electrohydraulic unit with a focused shockwave source (Omnispec ED; Medispec, Germantown, MD, USA). The penis was manually stretched, and shockwaves were delivered to the distal, mid, and proximal penile shaft, as well as both the left and right crura. The duration of each ESWT session was approximately 20 minutes, with each session comprising 300 shocks per treatment point (1500 per session) at an energy density of 0.09 mJ/mm^2 and a frequency of 120/min. The volume of penile tissue exposed to shockwaves at each site was cylindrical (diameter: 18 mm; height: 100 mm). No analgesia was necessary during the procedure.

For the control group, the same probe used in ESWT therapy was utilised but the energy setting was set to 0 during treatment. Similar noise was produced during the procedure. The treatment course lasted for two months for both groups, with weekly treatments. Patients were followed-up at 3, 6, 9, and 12 months after therapy.

Each patient was evaluated pre- and post-ESWT with colour doppler of the penis and validated sexual function questionnaires: International IIEF-EF domain, SHIM, and EHS [16-18]. The IIEF questionnaire EF domain was used to assess each patient at baseline, 3 months, 6 months, 9 months, and 12 months. Colour Doppler of the penis, SHIM score, and EHS score were used to evaluate each patient at baseline, 6 months, and 12 months [Table/Fig-1].

[Table/Fig-1]: ED 1000 machine used for ESWT.

STATISTICAL ANALYSIS

Data was collected using a predesigned form and later tabulated in a Microsoft Excel sheet. Results for categorical data were presented as n (%) cases, and data for continuous measurements were expressed as mean±standard deviation. The model included change from baseline as the response variable, treatment given, visit as independent variables, and treatment multiplied by visit as interaction. Subject was considered as a random effect, and baseline was included as a continuous covariate. Repeated ANOVA was used in the mixed model for comparison between the ESWT group and the control group. Paired t-test was used for comparison in right and left PSV, and percent change was calculated. Independent sample t-test was used for comparison in scores between the ESWT group and the control group. Throughout the tests, a p-value of less than 0.05 was considered statistically significant.

RESULTS

The most common age group among the study population was 41 to 50 years (40%), followed by 51 to 60 years (37.5%) and 31 to 40 years (15%) [Table/Fig-2]. Total 23 (57.5%) patients presented with symptom duration between 12 to 23 months, 15 (37.5%) patients presented with symptom duration between 24 to 35 months, while only 2 (5%) patients presented with a symptom duration of more than or equal to 36 months [Table/Fig-3].

Age group (years)	Frequency (n)	Percentage (%)
31 to 40	6	15
41 to 50	16	40
51 to 60	15	37.5
61 to 70	3	7.5
Total	40	100.00

[Table/Fig-2]: Age distribution amongst study population.

Duration (months)	Frequency (n)	Percentage (%)
12 to 23	23	57.5
24 to 35	15	37.5
≥36	2	5
Total	40	100

[Table/Fig-3]: Duration of symptoms.

The control group had a mean age of 49.7±6.86 years, and the ESWT group had a mean age of 49.1±8.64 years. The mean symptom duration for the control group was 21.4±7.24 months, and for the ESWT group, it was 21.4±7.07 months [Table/Fig-4].

Patient demographics	Control group (n=20)	ESWT group (n=20)	Overall (N=40)	p-value
Age (years)	49.7±6.86	49.1±8.64	49.4±7.71	0.796
Symptom duration (months)	21.4±7.24	21.4±7.07	21.4±7.07	0.910

[Table/Fig-4]: Patient demographics.

Comparing the mean IIEF score- EF domain between the two groups at three months, the ESWT group achieved a score of 20.3±2.92, and the control group achieved a score of 17.8±2.86, the difference of which was statistically significant (p-value=0.009). The percent change in the ESWT group was 16.66%. At six months, the ESWT group achieved a score of 22.5±2.48, and the control group achieved a score of 17.2±3.05, the difference of which was statistically significant (p-value=0.0001). The percent change in the ESWT group was 29.31%. At 9 months, the ESWT group achieved a score of 24.3±2.20, and the control group achieved a score of 17.4±3.12, the difference of which was statistically significant (p-value=0.0001). The percent change in the ESWT group was 39.65%. At 12 months, the ESWT group achieved a score of 25.9±1.53, and the control group achieved a score of 17.3±3.09, the difference of which was statistically significant (p-value=0.0001). The percent change in the ESWT group was 48.85% [Table/Fig-5].

IIEF score-EF (Erectile Function) domain	Mean±SD			% change in ESWT group	p-value
	Control group (n=20)	ESWT group (n=20)	Overall (n=40)		
Baseline	16.3±3.14	17.4±3.47	16.8±3.32	-	0.278
3 months	17.8±2.86	20.3±2.92	19.1±3.12	16.66	0.009
6 months	17.2±3.05	22.5±2.48	19.9±3.84	29.31	0.0001
9 months	17.4±3.12	24.3±2.20	20.8±4.39	39.65	0.0001
12 months	17.3±3.09	25.9±1.53	21.6±4.98	48.85	0.0001

[Table/Fig-5]: Comparison of mean IIEF score- EF domain between ESWT group and control group. (Independent sample t-test was used for comparison in scores between ESWT group and control group, p-value <0.05 was considered as statistically significant).

Comparing the mean SHIM score between the two groups at six months, the ESWT group achieved a score of 16.8±3.0, and the control group achieved a score of 13.6±2.23, the difference of which was statistically significant (p-value=0.005). The percent change in the ESWT group was 29.23%. At 12 months, the ESWT group achieved a score of 20.5±2.46, and the control group achieved a score of 13.1±2.48, the difference of which was statistically significant (p-value=0.0001). The percent change in the ESWT group was 57.69% [Table/Fig-6].

SHIM score	Mean±SD			% change in ESWT group	p-value
	Control group (n=20)	ESWT group (n=20)	Overall		
Baseline	12.1±2.40	13±3.28	12.6±2.87	-	0.328
6 months	13.6±2.23	16.8±3.0	15.2±3.07	29.23	0.0005
12 months	13.1±2.48	20.5±2.46	16.8±4.49	57.69	0.0001

[Table/Fig-6]: Comparison of mean SHIM score between ESWT group and control group. (Independent sample t-test was used for comparison in scores between ESWT group and control group, p-value <0.05 was considered as statistically significant).

Comparing the mean EHS between the two groups at six months, the ESWT group achieved a score of 3.3±0.55, and the control group achieved a score of 2.7±0.49, the difference of which was statistically significant (p-value=0.0008). The percent change in the ESWT group was 22.22%. At 12 months, the ESWT group achieved a score of 3.9±0.31, and the control group achieved a score of 2.7±0.49, the difference of which was statistically significant (p-value=0.0001). The percent change in the ESWT group was 44.44% [Table/Fig-7].

EHS	Mean±SD			% change in ESWT group	p-value
	Control group (n=20)	ESWT group (n=20)	Overall		
Baseline	2.4±0.60	2.7±0.59	2.5±0.60	-	0.190
6 months	2.7±0.49	3.3±0.55	3.0±0.60	22.22	0.0008
12 months	2.7±0.49	3.9±0.31	3.3±0.75	44.44	0.0001

[Table/Fig-7]: Comparison of mean EHS between ESWT group and control group. (Independent sample t-test was used for comparison in scores between ESWT group and control group, p-value <0.05 was considered as statistically significant).

The mean right cavernosal artery peak systolic velocity at baseline was 19.39±3.15, at six months was 33.24±3.58, and at 12 months was 45.20±3.79 for the ESWT group. The change was statistically significant (p-value=0.001). The p-value was calculated by paired t-test, with a p-value <0.05 considered statistically significant. The mean left cavernosal artery peak systolic velocity at baseline was 19.97±2.96, at six months was 34.74±3.83, and at 12 months was 46.43±3.61 for the ESWT group. The change was statistically significant (p-value=0.001). The p-value was calculated by paired t-test, with a p-value <0.05 considered statistically significant [Table/Fig-8].

Parameters	Mean±SD	p-value
Right cavernosal artery PSV at baseline	19.39±3.15	
Right cavernosal artery PSV at 6 months	33.24±3.58	0.001
Right cavernosal artery PSV at 12 months	45.20±3.79	0.001
Left cavernosal artery PSV at baseline	19.97±2.96	
Left cavernosal artery PSV at 6 months	34.74±3.83	0.001
Left cavernosal artery PSV at 12 months	46.43±3.61	0.001

[Table/Fig-8]: Comparison of mean right and left cavernosal artery peak systolic velocity at 6 months and 12 months from baseline for ESWT group. (p-value was calculated by paired t test, p-value <0.05 considered as statistically significant).

The mean right cavernosal artery peak systolic velocity at baseline was 18.84±3.01, at six months was 18.45±2.62, and at 12 months was 18.93±2.92 for the control group. The change was statistically not significant (p-value=0.076). The p-value was calculated by paired t-test, with a p-value <0.05 considered statistically significant. The mean left cavernosal artery peak systolic velocity at baseline was 19.42±2.83, at six months was 19.55±2.79, and at 12 months was 19.42±3.08 for the control group. The change was statistically not significant (p-value=0.412). The p-value was calculated by paired t-test, with a p-value <0.05 considered statistically significant [Table/Fig-9].

Parameters	Mean±SD	p-value
Right cavernosal artery PSV at baseline	18.84±3.01	
Right cavernosal artery PSV at 6 months	18.45±2.62	0.076

Right cavernosal artery PSV at 12 months	18.93±2.92	0.708
Left cavernosal artery PSV at baseline	19.42±2.83	
Left cavernosal artery PSV at 6 months	19.55±2.79	0.412
Left cavernosal artery PSV at 12 months	19.42±3.08	0.98

[Table/Fig-9]: Comparison of mean right and left cavernosal artery peak systolic velocity at 6 months and 12 months from baseline for control group. (p-value was calculated by paired t-test, p-value <0.05 considered as statistically significant).

DISCUSSION

In the present study, when comparing the mean IIEF score- EF domain, SHIM score, and EHS between the ESWT and control groups, the ESWT group achieved a higher score when followed-up at regular intervals, and the difference between the two groups was statistically significant. The improvement in mean systolic velocity of the right and left cavernosal artery was statistically significant in the ESWT group compared to the control group when the patients were followed-up.

In the present study, the most common age group among the study population was 41 to 50 years (40%), followed by 51 to 60 years (37.5%), 31 to 40 years (15%), and 61 to 70 years (7.5%). The control group had a mean age of 49.7±6.86, and the ESWT group had a mean age of 49.1±8.64. in the study conducted by Yee CH et al., which included 58 participants, with the control group having a mean age of 63.3±6.4 and the ESWT group having a mean age of 58.9±7.6 [15] whereas in a study conducted by Vardi Y et al., on 20 patients, the mean age of the patients was 56.1±10.7 years [14].

In the present study, 23 (57.5%) patients presented with symptom duration between 12 to 23 months, while 15 (37.5%) patients presented with symptom duration between 24 to 35 months, and only 2 (5%) patients presented with a duration of symptoms more than or equal to 36 months. The control group had a mean duration of symptoms of 21.35±7.24 months, while the ESWT group had a mean duration of symptoms of 21.35±7.07 months. The duration of symptoms was less in the study conducted by Chi-Hang Yee et al., in their study, the participants in the control group had a mean duration of symptoms of 7.4±4.3 years, and the ESWT group had a mean duration of symptoms of 6.5±2.8 years [15]. However, Vardi Y et al., reported the patients' mean duration of symptoms as 34.7 months [14].

In the present study, when comparing the mean IIEF score- EF domain between the two groups at 3 months, 6 months, 9 months, and 12 months, the ESWT group achieved a higher score, and the difference between the two groups was statistically significant. Comparing the mean SHIM score and EHS between the two groups at 6 months and 12 months, the ESWT group achieved a higher score, and the difference between the two groups was statistically significant. Yee CH et al., investigated the role of LI-ESWT in the treatment of ED. This was a double-blinded single-centre, prospective, randomised, placebo-controlled trial. After a 2-week PDE5I washout period patients were assessed with the SHIM, IIEF-ED domain scores, and erection hardness score. After the 9-week treatment period, patients were followed-up four weeks later. A total of 70 patients were recruited in the study, with 58 patients completing the study. Total 28 patients were randomised into the sham therapy arm, and 30 patients were randomised into the low-intensity ESWT arm. The trial showed the tolerability and clinical efficacy of low-intensity ESWT in a subgroup of patients with ED [15].

In the present study, the improvement in mean peak systolic velocity of the right and left cavernosal artery at six months and 12 months was statistically significant in the ESWT group compared to the control group. In the study conducted by Lurz K et al., there was an increase in mean cavernosal artery peak systolic velocity post-treatment, but it was not statistically significant [19].

In the present study, none of the patients developed any pain during the treatment period and follow-up and no adverse events were recorded. These findings were consistent with studies conducted by Vardi Y et al., and Yee CH et al., [14,15].

Recently, ESWT has been considered a potential modality for the treatment of ED [20]. The mechanism by which ESWT acts to improve ED symptoms is incompletely understood [21]. Based on animal studies, it is tempting to suggest that ESWT may be beneficial for patients with diabetes-induced ED. From the present study, ESWT induces neovascularisation and improves the flow in cavernosal arteries thus supporting the hypothesis. Few studies exist regarding the role of ESWT as a treatment modality in patients with ED [14,15]. The results are promising, but still in the investigational stage.

Limitation(s)

The present study was a single-centre study; further randomised studies with larger sample sizes, standardised treatment protocols, optimal treatment targets, and long-term follow-up are required to confirm present findings.

CONCLUSION(S)

The ESWT can be considered as a treatment in patients with diabetes mellitus and ED, as pharmacological therapies alone are not as successful and surgical interventions may pose higher risks for these patients. Further human studies should be conducted to fully understand the mechanism of this shock wave therapy so that non pharmacological and non surgical therapeutic modalities become recognised curative treatments for patients with ED.

REFERENCES

[1] Shamloul R, Ghanem H. Erectile dysfunction. Lancet. 2013;381(9861):153-65.
[2] Pushkar' Dlu, Kamalov AA, Al'-Shukri SKh, Erkovich AA, Kogan MI, Pavlov VN, et al. Analysis of the results of epidemiological study on prevalence of erectile dysfunction in the Russian Federation. Urologiia. 2012;6:05-09.
[3] Feldman HA, Goldstein I, Hatzichristou DG, Krane RJ, Mckinlay JB. Impotence and its medical and psychosocial correlates: Results of the Massachusetts male aging study. J Urol. 1994;151(1):54-61.
[4] Cellek S, Cameron NE, Cotter MA, Muneer A. Pathophysiology of diabetic erectile dysfunction: Potential contribution of vasa nervorum and advanced glycation endproducts. Int J Impot Res. 2013;25(1):01-06.
[5] Angulo J, Gonzalez-Corrochano R, Cuevas P, Fernández A, La Fuente JM, Rolo F, et al. Diabetes exacerbates the functional deficiency of NO/cGMP pathway associated with erectile dysfunction in human corpus cavernosum and penile arteries. J Sex Med. 2010;7(2 Pt 1):758-68.
[6] La Vignera S, Condorelli RA, Vicari E, D'Agata R, Calogero AE. Endothelial apoptosis decrease following tadalafil administration in patients with arterial ED does not last after its discontinuation. Int J Impot Res. 2011;23(5):200-05.
[7] Lin H, Yuan J, Ruan KH, Yang W, Zhang J, Dai Y, et al. COX-2-10aa-PGIS gene therapy improves erectile function in rats after cavernous nerve injury. J Sex Med. 2013;10(6):1476-87.
[8] Nurzynska D, Di Meglio F, Castaldo C, Arcucci A, Marlinghaus E, Russo S, et al. Shock waves activate in vitro cultured progenitors and precursors of cardiac cell lineages from the human heart. Ultrasound Med Biol. 2008;34(2):334-42.
[9] Chaussy C, Brendel W, Schmiedt E. Extracorporeally induced destruction of kidney stones by shock waves. Lancet. 1980;2(8207):1265-68.
[10] Notarnicola A, Moretti B. The biological effects of extracorporeal shock wave therapy (eswt) on tendon tissue. Muscles Ligaments Tendons J. 2012;2(1):33-37.
[11] Shimpi RK, Jain RJ. Role of extracorporeal shock wave therapy in management of Peyronie's disease: A preliminary report. Urol Ann. 2016;8(4):409-17.
[12] Ciccone MM, Notarnicola A, Scicchitano P, Sassara M, Carbonara S, Maiorano M, et al. Shockwave therapy in patients with peripheral artery disease. Adv Ther. 2012;29(8):698-707.
[13] Mariotto S, Cavalieri E, Amelio E, Ciampa AR, de Prati AC, Marlinghaus E, et al. Extracorporeal shock waves: From lithotripsy to anti-inflammatory action by NO production. Nitric Oxide. 2005;12(2):89-96.
[14] Vardi Y, Appel B, Jacob G, Massarwi O, Gruenwald I. Can low-intensity extracorporeal shockwave therapy improve erectile function? A 6-month follow-up Pilot study in patients with organic erectile dysfunction. Eur Urol. 2010;58(2):243-48.
[15] Yee CH, Chan ES, Hou SSM, Ng CF. Extracorporeal shockwave therapy in the treatment of erectile dysfunction: A prospective, randomized, double-blinded, placebo controlled study. Int J Urol. 2014;21(10):1041-45.
[16] Rosen RC, Cappelleri JC, Smith MD, Lipsky J, Peña BM. Development and evaluation of an abridged, 5-item version of the International Index of Erectile Function (IIEF-5) as a diagnostic tool for erectile dysfunction. Int J Impot Res. 1999;11(6):319-26.
[17] Cappelleri JC, Rosen RC. The Sexual Health Inventory for Men (SHIM): A 5-year review of research and clinical experience. Int J Impot Res. 2005;17(4):307-19.

[18] Mulhall JP, Goldstein I, Bushmakin AG, Cappelleri JC, Hvidsten K. Validation of the erection hardness score. J Sex Med. 2007;4(6):1626-34.
[19] Lurz K, Dreher P, Levy J, McGreen B, Piraino J, Brevik A, et al. Low-intensity shockwave therapy in the treatment of erectile dysfunction. Cureus. 2020;12(11):e11286.
[20] Liu J, Zhou F, Li GY, Wang L, Li HX, Bai GY, et al. Evaluation of the effect of different doses of low energy shock wave therapy on the erectile function of streptozotocin (STZ)-induced diabetic rats. Int J Mol Sci. 2013;14(5):10661-73.
[21] Gruenwald I, Appel B, Kitrey ND, Vardi Y. Shockwave treatment of erectile dysfunction. Ther Adv Urol. 2013;5(2):95-99.

PARTICULARS OF CONTRIBUTORS:
1. Assistant Professor, Department of Urology, Dr. D. Y. Patil Medical College, Hospital and Research Centre, Pimpri, Pune, Maharashtra, India.
2. Senior Consultant Urologist, Ruby Hall Clinic, Pune, Maharashtra, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Suraj Tukaram Bhondave,
Krishiwel, Near Pushpa Park, Sai Chowk, New Sangvi,
Pune-411027, Maharashtra, India.
E-mail: dr.surajb@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Mar 23, 2024
- Manual Googling: May 03, 2024
- iThenticate Software: Jun 08, 2024 (16%)

ETYMOLOGY: Author Origin

EMENDATIONS: 6

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Mar 22, 2024**
Date of Peer Review: **Apr 30, 2024**
Date of Acceptance: **Jun 10, 2024**
Date of Publishing: **Jul 01, 2024**