The Effect of Extracorporeal Shock Wave in Management of Erectile Dysfunction

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ABSTRACT

Background: The goal of treating erectile dysfunction is to restore the natural erection. It has previously been reported that penile low-intensity extracorporeal shockwave therapy can treat erectile dysfunction.

Objectives: To assess the effect of low-intensity extracorporeal shockwave therapy and the time needed for treatment of erectile dysfunction.

Methods: This is a prospective study with open-label single-arm of all patients who underwent low-intensity extracorporeal shockwave therapy for erectile dysfunction, at a single center (Blue urology private clinic) from October 2022 to November 2023. Patients were assessed with the simplified international index of erectile function and erection hardness scores before starting the treatment, one month, three months and at six months after. The changes of international index of erectile function and erection hardness scores across the duration of the treatment were assessed using repeated measures ANOVA test. The confidence interval was 95%.

Results: The study included 29 men with average age of 56.3 ± 5.8 years. The low-intensity extracorporeal shockwave therapy effect on erectile hardness score was significant (baseline: 2 ± 0.89; one month: 2.93 ± 0.88; three months: 3.41 ± 0.73; six months: 2.97 ± 0.82; P<0.001) with 0.763 effect size. In addition, the low-intensity extracorporeal shockwave therapy affects the international index of erectile function score significantly (baseline: 10.83 ± 3.55; one month: 15.62 ± 2.74; three months: 17.38 ± 2.64; six months: 15.69 ± 2.78; P<0.001) with 0.825 effect size.

Conclusions: This study demonstrates that low-intensity extracorporeal shockwave therapy is a well-tolerated treatment for patients with vasculogenic erectile dysfunction, showing modest improvements in hardness and erectile function as the erection hardness scores and international index of erectile function scores considerably improved in men who got low-intensity extracorporeal shockwave therapy.

Keywords: Erectile dysfunction, low-intensity extracorporeal shockwave therapy, International Index of Erectile Function score, Erection hardness score.

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Erectile dysfunction (ED) or impotence, is defined as "the persistent or recurring incapacity to achieve and/or sustain penile erection sufficient for sexual satisfaction" or "the inability to attain and/or maintain penile erection sufficient for satisfactory sexual performance"[1].

Numerous comorbidities and risk factors, including advanced age, tobacco use, obesity, low testosterone levels, cardiovascular illness, depression, prostate surgery, and penile trauma, are associated with its occurrence[2,3].

Oral phosphodiesterase 5 inhibitor (PDE5I), intracavernosal injection, hormone replacement therapy, vacuum erection device, penile prosthesis, low-intensity extracorporeal shock wave (LiESW), and stem cell injection therapy are the main treatments used currently to treat ED[4]. Any alternative may be used as the initial course of treatment depending on the circumstances. PDE5I is the most widely used therapy choice according to data because of its good non-invasiveness, safety, and efficacy. However, the increasing number of patients who do not respond well to PDE5I and the possibility of negative side effects have led to the development of safer and more efficient therapies.[5]

In 2010, it was the first reported use of low-intensity extracorporeal shockwave therapy (Li-ESWT) in the treatment of ED. Before that, the method had been proved to improve vascular function in other experiments, and, the method was tolerable and effective, indicating the physiological effects on cavernous hemodynamics. After 8 years of long-term clinical observation, Low-intensity shockwave therapy has gradually become a therapeutic option by physicians in ED treatment[6 ,7].

Low-intensity extracorporeal shockwave therapy has shown benefit, notably in individuals with severe ED not responding to PDE-5 inhibitor[8]. More specifically, shockwave therapy increases angiogenic factors that promote neovascularization, restore smooth muscle activity, and attract stem cells; it also increases vascular endothelial growth factor, neuronal nitric oxide synthase, and other, similar natural bioactive agents. These factors, along with penile revascularization, are thought to be the mechanism of action of shockwave therapy[9]. Moreover, shockwave generators, the kind of shockwaves they create, the parameters they are set to, and the therapy methods they employ vary greatly[10].

Low-intensity shockwave therapy has been found to be relatively useless in men with severe ED, but it is a reasonable, safe, and moderately effective initial therapy for generally healthy men with mild to moderate erectile dysfunction, with an overall success rate at 30 months of about 40%. Negative risk factors that limited successful outcomes include advanced age, hypertension, smoking, obesity, hyperlipidemia, high pre-therapy SHIM (Sexual Health Inventory for Men) scores, and prolonged duration of ED[11].

For a period of up to six months, Li-ESWT had a favorable effect on erectile function in relatively young patients with vasculogenic mild ED and it is feasible and easy to administer[12]. Li-ESWT was more well-liked by young ED patients and their partners than on-demand sildenafil.[13]

The International Index of Erectile Function's (IIEF-EF) erectile function domain and the Erection Hardness Score (EHS) were the most commonly used tools to evaluate the therapeutic efficacy of Li-ESWT treatment for erectile dysfunction, recently Li-ESWT considered as a potentially effective treatment for people with mild to moderate erectile dysfunction[14].

According to new researches, more energy and targeted treatment regimens may lead to better outcomes[15].

This study aims to assess the effect of low-intensity extracorporeal shockwave therapy and the time needed for treatment of erectile dysfunction.

Methods

This study designed as a prospective study with open-label single-arm of all patients who underwent low-intensity extracorporeal shockwave therapy for erectile dysfunction, at a single center (Blue urology private clinic) from October 2022 to November 2023. Patients were assessed with the simplified International Index of Erectile Function (IIEF-5) and Erection hardness (EHS) scores before starting the treatment, one month, three months and six months after.

The procedure was carried out on men who agreed to participate by signing the informed consent and neither had psychological disturbance nor active skin lesion on the dorsum of the penis, with a total IIFE-5 score of less than 22 and EHS less than 4, (Table 1).

The analysis included 29 out of 35 men who started the study, five men were lost in follow up and did not continued the treatment sessions, one was excluded as he was hardly to assess as he is not in a relationship, (Figure 1).

Table 1: Assessment scores for erectile dysfunction.

Score	Erection Hardness (EHS)
0	Penis does not enlarge
1	Penis is larger, but not hard
2	Penis is hard, but not hard enough for penetration
3	Penis is hard enough for penetration, but not completely hard
4	Penis is completely hard and fully rigid
Score	**International Index of Erectile Function (IIEF-5)**
5 to 7	Severe
8 to 11	Moderate
12 to 16	Mild to moderate
17 to 21	Mild
22 to 25	No ED

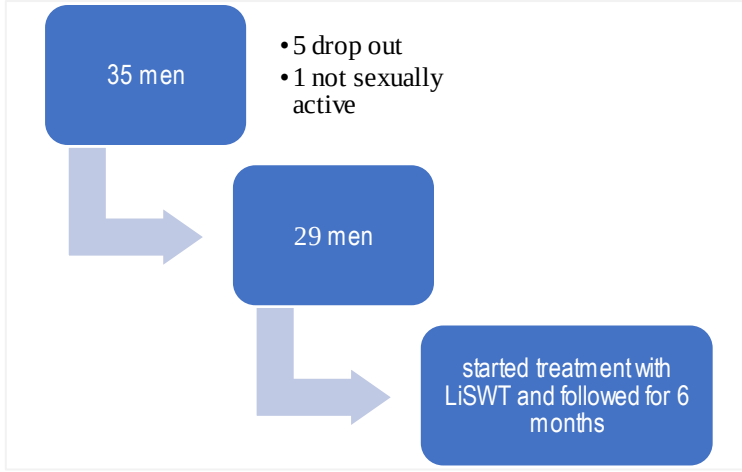

Figure 1: Flowchart for patient inclusion and follow-up.

The procedure conducted utilizing ESWT machine. Protocol for treatment comprised a treatment session once a week. Every session 2000 shocks were given to the perineum and similar number of shocks with an energy flow density of 0.16 (mJ/mm^2) on the dorsum of the penis.

The rising of IIEF-5 and EHS considered as improvement of erectile function, other variables were age, body mass indices of the participants, in addition to the duration of diagnosis of erectile dysfunction, smoking status, and other comorbidities.

Ethical approvals were taken from the patients themselves for their participation in the current study. No rewards were given for them for signing the informed consents for the enrolment.

Statistical analysis done using Statistical Packages of Social Sciences (SPSS ver. 26). Categorical variables were presented by number and percentages. Numerical values presented by mean and standard deviation. The changes of IIEF-5 and EHS across the duration of the treatment were assessed using repeated measures ANOVA test. The confidence interval was 95%.

Results

The study included 29 men who were diagnosed with ED for 1.3 ± 0.5 years in average. Their average age was 56.3 ± 5.8 years and range from 43 to 61 years, ten patients were younger than 50 years. They were overweighed in general 24 (82.8%)

with average body mass index of 28.1 ± 4.5 kg/m^2.

More than one third of the participants (34.5%) were current smokers, 79.3% had other comorbidities like dyslipidemia in 65.5%, hypertension in 51.7%, type 2 diabetes mellitus in 27.6%, and ischemic heart disease in 10.3%. Only one patient of them had benign prostatic hyperplasia, (Table 2).

The included men investigated for their erection hardness and the average score was 2.0 ± 0.89, then they were re-assessed after subjected to low-intensity extracorporeal shockwave therapy by one month and the average score rise to 2.93 ± 0.88, then after three months rise to 3.41 ± 0.73, then fall down to 2.97 ± 0.82, this overall change in the score was statistically significant (P<0.001) with high effect size of the therapy (within-subjects effects) was 0.763 and extremely high effect size (between-subjects effects) on the score 0.934, (Table 3 and Figure 2). No significant differences in erection hardness scores were noted according to patients' age, comorbidities and body mass index categories.

Table 2: General characteristics of the study groups, n=29.

Variables	Mean	Standard deviation
Age (year)	56.3	5.8
Body mass index (kg/m^2)	28.1	6.8
Duration since diagnosis of ED (year)	1.3	0.5
Variables	**Number**	**%**
Smoking	10	34.5
Co-morbidities	23	79.3
Dyslipidemia	19	65.5
Hypertension	15	51.7
Diabetes	8	27.6
Ischemic heart disease	3	10.3
Benign prostatic hyperplasia	1	3.4

Table 3: Comparison of erection hardness score of the participants, across time since low-intensity extracorporeal shockwave therapy.

Erection hardness score	Mean	Standard deviation	P-value
Baseline	2	0.89	<0.001*
1 month	2.93	0.88	
3 months	3.41	0.73	
6 months	2.97	0.82	
Treatment with age groups			0.705
Treatment with comorbidities			0.412
Treatment with body mass index categories			0.294

*Significant at 0.05 level by repeated measures ANOVA.

The International Index of Erectile Function (IIEF) of the study group was 10.83 ± 3.55 at the beginning then after one month of Li-ESWT it significantly rose to 15.62 ± 2.74, furthermore, rising was shown in the third month of treatment 17.38 ± 2.64, then it declined to 15.69 ± 2.78. The total change across the six months was statistically significant (*P*<0.001) with high effect size of the therapy (within-subjects effects) was (0.825) and extremely high effect size (between-subjects effects) on the score (0.85), (Table 4 and Figure 2).

The International Index of Erectile Function progression was significantly lower among patients with comorbidities, while their age and body mass indices did not show significant effect on the score progression.

Figure 2 illustrates the difference of both erection hardness score and International Index of Erectile Function across the duration since low-intensity extracorporeal shockwave were all the difference were significant (*P*<0.001) and signed by three stars, while the differences between the 6th and 3rd month of treatment were not significant and signed by (NS) [6th vs. 3rd EHS P= 0.326, IIEF P=0.161].

Table 4: Comparison of International Index of Erectile Function of the participants, across time since low-intensity extracorporeal shockwave therapy.

International Index of Erectile Function	Mean	Standard Deviation	P-value
Baseline	10.83	3.55	<0.001*
1 month	15.62	2.74	
3 months	17.38	2.64	
6 months	15.69	2.78	
Treatment with age groups			0.534
Treatment with comorbidities			0.031*
Treatment with Body Mass Index categories			0.067

*Significant at 0.05 level by repeated measures ANOVA

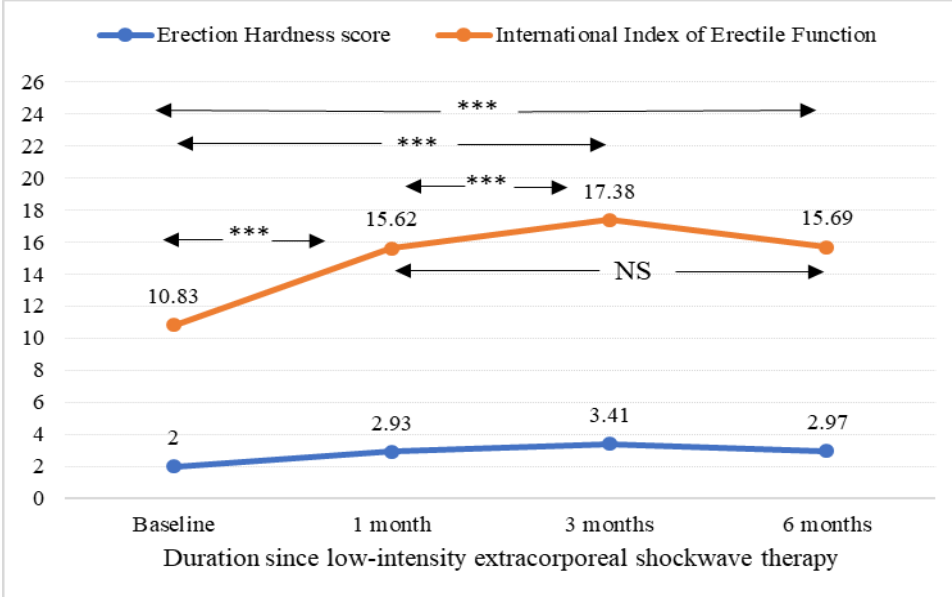

Figure 2: Difference in the erection hardness score and International Index of Erectile Function across the duration since low-intensity extracorporeal shockwave.

Discussion

Low-intensity extracorporeal shockwave therapy has been increasingly adopted as a new noninvasive therapeutic method for erectile dysfunction. In this prospective study, twenty-nine men subjected to low-intensity extracorporeal shockwave therapy. There was no significant difference between the age groups and the response to treatment regarding both scores, all of them were overweighed due to high dietary fat and carbohydrates and low physical activity in this age group with no significant correlation with patients' response to treatment which is similar to Mulhall et al study 2018[16]. Most of the patients had other comorbidities like dyslipidemia, hypertension, type 2 diabetes mellitus, and ischemic heart disease. Only one patient of them had benign prostatic hyperplasia. Patients with comorbidities, especially diabetes had lower scores of (IIED) compared to others who did not have any morbidities. This might be due to the effect of the diseases on the nervous system of the patients and hence affect their response, that was in consistent with William Lay Keat Ong et al study 2022 and Peter Bill Juul Ladegaard et al study 2021[17,18].

There was a significant rise in erection hardness score after three months of exposure to Li-ESWT that's also shown in Peter Bill Juul Ladegaard et al study 2021[18] and Ortac et al study 2021[19].

The erection hardness score in the current study showed slight insignificant decline but remained high between three months of Li-ESWT exposure to six months. This decline might be either due to the tolerance to the shocks or due to the differences of responses of the patients with comorbidities and their effect on response. That's also consistent with what was found in Mazhar Ortac et al study 2021[12].

The International Index of Erectile Function (IIEF) of the participants in the current study increased to its peak level after three months of Li-ESWT and then mild decrease occurred in its level at the sixth month. The total change of IIEF across the six months' treatment with Li-ESWT was statistically significant that's also found in Liang Dong et al study 2019[14].

In conclusion, this study demonstrates that Li-ESWT is a well-tolerated treatment for patients with vasculogenic ED, showing modest improvements in hardness and erectile function as the EHS and IIEF-EF scores considerably improved in guys who got Li-ESWT.

A recommendation for additional researches are required to determine which patients are better candidates for this technique, what Li-ESWT protocol will produce the greatest results, and how ED-related variables connect to Li-ESWT's effectiveness.

Conflicts of Interest: None.
I hereby confirm that all the figures and tables in the manuscript are mine.

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