ORIGINAL ARTICLE

Effect of low-intensity shock wave therapy in patients with erectile dysfunction of vascular origin: case reports

V. Osornio-Sanchez a,*, D.A. Preciado-Estrella a, J. Gomez-Sanchez a, J.A. Herrera-Muñoz a, E. Mayorga-Gomez a, G. Garza-Sainz a, I. Uberatagoyena-Tello de Meneses a, V. Cornejo-Davila a, M.A. Palmeros-Rodriguez a, J.E. Sedano-Basilio a, L. Trujillo-Ortiz a, C. Martinez-Arroyo a, M. Cantellano-Orozco a, J.G. Morales-Montor a, M.E. Reyes-Gutierrez b and C. Pacheco-Gahbler a

a Urology Division, Hospital General “Dr. Manuel Gea González”, Secretaría de Salud, Mexico City, Mexico
b National School of Medicine of the Instituto Politécnico Nacional, Mexico City, Mexico

Received 1 October 2014; accepted 16 January 2015
Available online 6 March 2015

KEYWORDS
Low-intensity shock waves; Erectile dysfunction; Monotherapy; Disease regression

Abstract
Background: Low-intensity shock waves have angiogenic properties and their use has been described in recently published studies on patients with erectile dysfunction of vascular origin with promising results in relation to disease regression.

Methods: Case reports on the application of a procedure are provided herein. Five patients answered the International Index of Erectile Function (IIEF-5) questionnaire before, during (week 5 and 9), and after (week 15 and 20) treatment. The patients underwent 2 sessions per week for 3 weeks, with a 3-week no treatment interval, followed by the repetition of 2 sessions per week for 3 weeks. Each session consisted of the application of 1,500 pulses with a density of 0.09 mJ/mm² and a frequency of 120/min, at 5 different points: 3 at the penile shaft (the proximal, middle, and distal parts) and 2 at the base (right and left crura).

Results: The mean patient age was 55 years (50-59), mean testosterone level was 508.8 ng/dl (400-580), and mean body mass index was 31 (27-37). Obesity, high blood pressure, and diabetes mellitus were the most frequent cardiovascular risk factors (60%). We reported the following description and follow-up for each patient: Patient 1: initial IIEF 10, final IIEF 17; Patient 2: initial IIEF 7, final IIEF 14; Patient 3: initial IIEF 16, final IIEF 18; Patient 4: initial IIEF 7, final IIEF 18; Patient 5: initial IIEF 13, final IIEF 17. None of the patients experienced pain or adverse effects during or after treatment.
Efecto de la terapia con ondas de choque de baja intensidad en pacientes con disfunción eréctil de origen vascular. Reporte de casos

Resumen

Antecedentes: Las ondas de choque de baja intensidad tienen propiedades angiogénicas, por lo que recientemente se han publicado estudios de su uso en pacientes con disfunción eréctil de origen vascular, teniendo resultados prometedores en la regresión de la enfermedad.

Material y métodos: Se trata de un reporte de casos con la aplicación de una intervención. Se incluyeron 5 pacientes a quienes se les realizó el cuestionario Index of Erectile Function (IIEF-5) antes, durante (semanas 5 y 9) y después (semanas 15 y 20) del tratamiento. Se dieron 2 sesiones semanales durante 3 semanas, con un intervalo de 3 semanas sin tratamiento, repitiendo 2 sesiones semanales durante 3 semanas. En cada sesión se aplicaron 1,500 golpes con una densidad de 0.09 mJ/mm2 y frecuencia de 120/min, divididos en 5 puntos: 3 en el cuerpo del pene (parte proximal, media y distal) y 2 en la base (crura derecha e izquierda).

Resultados: La edad promedio fue de 55 años (50-59), los niveles de testosterona promedio fueron 508.8 ng/dl (400-580), el índice de masa corporal promedio fue de 31 (27-37); la obesidad, hipertensión arterial y la diabetes mellitus fueron los factores de riesgo cardiovascular más frecuentes (60%). En la descripción y seguimiento de cada uno de los pacientes, reportamos lo siguiente: paciente 1: IIEF inicial 10, IIEF final 17; paciente 2: IIEF inicial 7, IIEF final 14; paciente 3: IIEF inicial 16, IIEF final 18; paciente 4: IIEF inicial 7, IIEF final 18; paciente 5: IIEF inicial 13, IIEF final 17. Ningún paciente reportó dolor ni efectos adversos durante ni después del tratamiento.

Conclusión: Las ondas de choque de baja intensidad como monoterapia parecen ser efectivas en la mejoría de la función eréctil durante y después del tratamiento; es un procedimiento indoloro, con baja tasa de complicaciones y efectos adversos. Se requiere de un estudio con una muestra más grande para poder dar un poder estadístico mayor a nuestros resultados.

© 2014 Sociedad Mexicana de Urología. Publicado por Masson Doyma México S.A. Todos los derechos reservados.

PALABRAS CLAVES
Seguridad clínica; Diálisis; Encuesta; Promoción de la salud

Introduction

There is a 1-10% prevalence of erectile dysfunction in men under 40 years of age, 2-9% between 40 and 49 years, 20-40% between 60 and 69 years, and 50-100% in men over 70 years of age.1,2

Risk factors associated with erectile dysfunction development of vascular origin include: atherosclerosis, high blood pressure, hyperlipidemia, smoking, diabetes mellitus, and pelvic radiation. However, endothelial dysfunction has been clearly defined as the common denominator in all these factors.3

Although the majority of patients with erectile dysfunction can be adequately treated with non-surgical therapies (such as type 5 phosphodiesterase inhibitors and intracavernous vasodilators) this is not true for 30-40% of the patients, due to intolerance, adverse effects, or refractory erectile dysfunction, which is secondary to diabetes mellitus or cavernous nerve damage, as is the case with patients that have undergone radical prostatectomy.4,5

The abovementioned has propelled research on different technologic strategies that include low-intensity shock wave therapy, which has been used in wound cicatrization (e.g.: diabetic foot), in peripheral neuropathy, and in cardiac revascularization. Recently published studies have described its use in patients with erectile dysfunction, showing promising results in relation to disease regression.6

The results of different studies coincide with the fact that angiogenesis induction, secondary to stimulation of diverse growth factors due to mechanical stress and
microtrauma is the main action mechanism. However, other mechanisms have been identified such as mesenchymal stem cell recruitment, endothelial restoration, vascular smooth muscle restoration, and nerve regeneration, bringing about a final result of neovascularization and improvement in the tissular blood supply.\textsuperscript{7-9}

Aims

To demonstrate whether low-intensity shock wave therapy has an effect on disease regression in patients with erectile dysfunction of vascular origin, as well as to evaluate treatment safety, its complications, and possible adverse effects.

Methods

Case reports with the application of a procedure are presented herein. The study universe consisted of all the patients with erectile dysfunction registered at the Urology Division of the Hospital General “Dr. Manuel Gea González” during the first trimester of 2014. The study sample was made up of the limited number of 5 patients due to the cost of the treatment.

The patients included in the study had the following characteristics: age between 50 and 70 years, a history of erectile dysfunction of more than 6 months, erectile dysfunction of vascular origin, not having received any type of drug treatment for erectile dysfunction for one month, the presence of at least one cardiovascular risk factor (high blood pressure, diabetes mellitus, dyslipidemia, obesity, smoking), and total testosterone > 350 ng/dl. All the patients accepted to participate in the study and signed statements of informed consent.

Patients that presented with erectile dysfunction of another origin (neurologic, endocrine, pharmacologic) were excluded from the study.

The shock waves were applied with the Omnispec eD1000 (Medispec\textsuperscript{®}) electrohydraulic unit.

Treatment consisted of 2 sessions per week for 3 weeks, a 3-week interval with no treatment, and repetition of 2 sessions per week for 3 weeks. The International Index of Erectile Function (IIeF-5) questionnaire was applied before, during (week 5 and 9), and after (week 15 and 20) treatment. At each session 1,500 pulses were applied at a density of 0.09 mJ/mm\textsuperscript{2} and a frequency of 120/min at 5 different points of the penis: 3 in the shaft (the proximal, middle, and distal part) and 2 at the base (the right and left crura).

Results

Case 1

History

A 59-year-old man (Crr) with the following remarkable history in relation to the disease under study:

- Testosterone levels of 512 ng/dl
- As cardiovascular risk factors: obesity (BMI of 30) and high blood pressure being treated with captopril.

Results

a) IIeF-5 Questionnaire that describes erectile dysfunction status with the following scores denoting improvement of the pathology studied:

- Pre-treatment score: 10
- Score at week 5: 15
- Score at week 9: 15
- Score at week 15: 17
- Score at week 20: 17

b) Pain measured through the VAS. The mean score in all measures was 1.5, in other words, practically no pain.

a) Adverse effects: none were registered.

Case 2

History

A 55-year-old man (rMD) with the following remarkable history in relation to the disease under study:

- Testosterone levels of 562 ng/dl
- As cardiovascular risk factors:
  - Obesity (BMI of 37)
  - High blood pressure treated with captopril
  - DM2 being treated with NPH insulin and gabapentin for diabetic neuropathy
  - Dyslipidemia being treated with atorvastatin

Current disorder

Erectile dysfunction of 13-year progression, initially managed with sildenafil, with a partial symptom response. However for 5 years there has been no response to any 5PDE inhibitor. The patient underwent a washout period of 10 weeks for the former treatment before undergoing shock wave therapy.

Results

b) IIeF-5 Questionnaire that describes erectile dysfunction status with the following scores denoting improvement of the pathology studied:

- Pretreatment score: 7
- Score at week 5: 8
- Score at week 9: 10
- Score at week 15: 12
- Score at week 20: 14

c) Pain measured through VAS. The mean score for all the measures was 1.8, but as the sessions advanced there was a slight increase in pain...
Results

a) IIEF-5 Questionnaire that describes erectile dysfunction status with the following scores denoting improvement of the pathology studied:
  • Pre-treatment score: 7
  • Score at week 5: 11
  • Score at week 9: 16
  • Score at week 15: 18
  • Score at week 20: 18

2) Pain measured through VAS. The mean score in all the measures was 1, in other words, practically no pain.

3) Adverse effects: none were registered.

Case 3

History

A 54-year-old man (LMA) with the following remarkable history in relation to the disease under study:
  • Testosterone levels of 400 ng/dl
  • As cardiovascular risk factors: obesity (BMI 32), type 2 diabetes mellitus being treated with glibenclamide and metformin

Current disorder

Erectile dysfunction of 7-year progression managed with sildenafil with adequate symptom response. The patient underwent an 8-week washout period for the former treatment before undergoing shock wave therapy.

Results

a) IIEF-5 Questionnaire that describes erectile dysfunction status with the following scores denoting improvement of the pathology studied:
  • Pretreatment score: 16
  • Score at week 5: 16
  • Score at week 9: 17
  • Score at week 15: 17
  • Score at week 20: 18

b) Pain measured through VAS. The mean score in all the measures was 1, in other words, practically no pain.

c) Adverse effects: none were registered.

Case 4

History

A 50-year-old man (OMJB) with the following remarkable history in relation to the disease under study:
  • Testosterone levels of 580 ng/dl
  • As cardiovascular risk factors: obesity (BMI of 32), DM2 being treated with metformin and glibenclamide

Current disorder

Erectile dysfunction of 5-year progression, first treated with sildenafil with initial response, but not having the desired effect, the patient changed to tadalafil and then vardenafil with no response to oral drugs. He then underwent intracavernous therapy (trimix: papaverine, phentolamine, and alprostadil) with little improvement and intense pain upon application, developing a 1 x 1 cm fibrous plaque on the dorsal part of the penile tunica albuginea, without causing penile curvature. The patient underwent a 12-week washout period for the former treatment before undergoing shock wave therapy.

Results

a) IIEF-5 Questionnaire that describes erectile dysfunction status with the following scores denoting improvement of the pathology studied:
  • Pretreatment score: 13
  • Score at week 5: 15
  • Score at week 9: 17
  • Score at week 15: 17
  • Score at week 20: 17

b) Pain measured through VAS. The mean score in all the measures was 1, in other words, practically no pain.

c) Adverse effects: none were registered.

Result analysis

The mean age of the 5 patients studied was 55 years, with a 50 to 59-year range. According to their BMI, one patient presented with overweight and 4 with obesity. Obesity, high blood pressure, and diabetes mellitus were the most frequent cardiovascular risk factors (60%) (table 1).
The patients’ mean testosterone level was 508.8 ng/dl (400-580) (fig. 1).

The study patients had undergone drug treatment prior to the shock wave therapy, but before initiating this procedure they went through a mean washout period of 9 weeks (fig. 2). Erectile dysfunction time of progression was a mean 8.2 years (range between 5 and 12 years).

In regard to the aspects measured throughout the treatment, according to the IIEF-5 questionnaire, there was a tendency towards increase in all the scores, using the initial score as a reference (table 2 and fig. 3).

As can be observed, the patient that was the youngest and that had the shortest period of time with erectile dysfunction presented with the greatest increase in the questionnaire score, but the second youngest patient (54 years old and 7-year progression) only had an increase of 3 points, making this observation inconclusive.

**Table 1** Coexisting pathologies of the patients studied

<table>
<thead>
<tr>
<th>Patient</th>
<th>HBP</th>
<th>HBP</th>
<th>DMII</th>
<th>DMII</th>
<th>SMOKING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 1** Testosterone levels of the patients studied

**Figure 2** Years of erectile dysfunction progression in the patients studied

The study patients had undergone drug treatment prior to the shock wave therapy, but before initiating this procedure they went through a mean washout period of 9 weeks (fig. 2). Erectile dysfunction time of progression was a mean 8.2 years (range between 5 and 12 years).

In regard to the aspects measured throughout the treatment, according to the IIEF-5 questionnaire, there was a tendency towards increase in all the scores, using the initial score as a reference (table 2 and fig. 3).

As can be observed, the patient that was the youngest and that had the shortest period of time with erectile dysfunction presented with the greatest increase in the questionnaire score, but the second youngest patient (54 years old and 7-year progression) only had an increase of 3 points, making this observation inconclusive.

**Table 2** Increased IIEF-5 questionnaire scores per patient and their relation to age and length of time of erectile dysfunction progression in the patients studied

<table>
<thead>
<tr>
<th>Age</th>
<th>Years of progression</th>
<th>Patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>59</td>
<td>10</td>
<td>Patient 1</td>
</tr>
<tr>
<td>55</td>
<td>13</td>
<td>Patient 2</td>
</tr>
<tr>
<td>54</td>
<td>7</td>
<td>Patient 3</td>
</tr>
<tr>
<td>50</td>
<td>5</td>
<td>Patient 4</td>
</tr>
<tr>
<td>57</td>
<td>7</td>
<td>Patient 5</td>
</tr>
</tbody>
</table>

**IIEF-5 Score**
Once the tendency toward a score increase was determined, the Friedman statistical test and range comparison with a 95% confidence interval from the measurement of the scores were performed to determine whether said increase was attributable to the treatment. The resulting association between the treatment and erectile dysfunction improvement was statistically significant ($X^2 = 18.505$, gl = 4, $p < 0.05$).

Figure 4 shows the mean of the Friedman test ranges in each of the scores throughout the treatment weeks of progression and the red numbers show the increase between one score and the other. The most important increase was detected at week 5 and after week 9; thereafter the increases were more modest, but statistically significant.

Discussion

Given the recent application of low-intensity shock waves as erectile dysfunction treatment, it was interesting to describe a first approach to their use and the corresponding results in a small group of patients.

Since 2010 there have been at least 4 studies with small numbers of patients that have explored the success of this procedure together with patient characteristics. Ours is the first approach to this theme in Mexico that has shown an association between treatment and effect, but unlike the other studies, there was no group comparison given its very small sample size. Nevertheless, the data it provides on Mexican patients serve as a base for planning a future prospective study with a relevant sample size. The results of our study concur with those reported in the literature.10–13

Conclusions

The following conclusions were reached, based on the abovementioned results:

1. The mean IIEF-5 questionnaire scores were: pretreatment, 10.6; during treatment, 13 (week 5) and 15 (week 9); and after treatment, 16.2 (week 15) and 16.8 (week 20). These data showed a tendency toward erectile dysfunction improvement.

2. The comparison of the scores during and after treatment suggested continuing improvement, given that the last 2 scores corresponded to the post-treatment period.

3. Through the statistical data analysis, the Friedman test indicated that erectile dysfunction improvement according to the IIEF-5 questionnaire score was associated with the shock wave therapy, with a statistically significant result ($X^2 = 18.505$, gl = 4, $p < 0.05$).

4. The Friedman test showed that the best result was obtained in the first stage of treatment, in other words, before week 5, with a mean increase of 2.4 points. The second increase was of 2 points and was obtained between weeks 5 and 9. Even though the post-treatment (weeks 15-20) increases were lower, erectile function continued to improve.

5. In regard to pain perception during the procedure, there were practically no significant reports, given that 3 was the maximum pain score reported.

6. No cases of complications or adverse effects were reported.

7. With all the elements listed above, we believe that the hypothesis that states that low-intensity shock waves as monotherapy in patients with erectile dysfunction of vascular origin are effective for improving erectile function during and after treatment has been confirmed with 95% confidence.

8. Based on the above, we can deduce that low-intensity shock waves improve erectile function during treatment and the improvement continues at least up to week 20, when the last measurement was made.

Financial disclosure

No financial support was received in relation to this article.
Conflict of interest

The authors declare that there is no conflict of interest.

References