The effects of extracorporeal shock wave therapy on pain patients

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Abstract

The method of shock wave therapy (ESWT) was used for the treatment of several symptoms of chronic pain. There were especially: cervical syndromes, lumbago, plantar fasciitis, achillodynia, metatarsalgia and humeral epicondylitis. We confirmed the positive effect of shock wave therapy for pain relief on these syndromes. This method is also effective in other pain syndromes. The effect of this application is very individual and therefore it is necessary to indicate differing numbers of therapeutic applications. We recommend this method as a very useful tool for completion possibilities in the treatment of chronic pain.

INTRODUCTION

Based on the background of above mentioned finding, we decided to study the effect of shock wave therapy in the treatment of several syndromes of chronic pain. The aim of the study was also establish various methodological approaches identifiable in the course of pain relief.

Extracorporeal shock wave therapy (ESWT) was introduced in Germany in 1980s. It has been used for the management of urolithiasis, cholelithiasis and sialolithiasis (Ogden et al. 2001).

With its wide range of clinical applications, ESWT is a unique treatment method which is gradually being recommended in the treatment of diseases of musculoskeletal system. It is being implemented in a diverse range of areas due to its usefulness in clinical application since it is non-invasive and can be repeated and utilized in a relative safer manner (Jeon et al. 2012).

Extracorporeal shock wave therapy (ESWT) has been increasingly used as a safe alternative treatment option since many published papers have reported a beneficial effect (Malay et al. 2006).

ESWT can be used for pain relief as well as improving muscle strength through appropriate motor simulation of the muscles and tendons with extracorporeal shockwaves (Svernlöv & Adolfsson 2001).

The ESWT equipment currently used in clinical settings is divided into radial and focused methods...
in accordance with the manner in which the shock wave reaches the target. There are three methods of generating a focused-type shock wave; namely, piezoelectric, electromagnetic and electrohydraulic. The shock wave is generated using the principle by which electricity is converted into a shock wave through rapid physical movement of the electricity through a liquid medium. Each type of equipment uses charged condensers with variable voltage from each other, and conversion into shock wave is achieved as electricity becomes rapidly discharged in an acoustic transducer (McClure & Dorfmuller 2003).

Although the mechanisms of action of shock waves are still not fully clear yet, the surprising clinical benefits induced by ESWT resulted in a continuous increase of requests for such treatment, which is recently starting also to be used in regenerative medicine. Nevertheless, further experimental studies are needed to better elucidate the exact mechanisms triggered by ESWT in healthy and pathological human tissues (Padulo et al. 2014).

METHODS AND PATIENTS

A shock wave is a single-impulse acoustic wave generated by an electromagnetic, electrohydraulic or piezoelectric source. The energy at the focal point is recorded in millijoules per area (mJ/mm²) and based on this value; shock waves are classified as low, medium, or high energy (Rompe et al. 1998).

In our study, we used the device Duolith Ultra SD1 produced by Storz Medical AG.

Patients

The measurements were provided in total number of 18 patients, 6 men and 12 women. The average age was 54.3 years (for men 50.5 women 57.2). The patients were selected according their pain syndromes and special complaints. The most frequent diagnosis was cervical syndromes (8), lumbago (5), plantar fasciitis (2), achilloydynia (1), metatarsalgia (1) and radial/ulnar humeral epicondylitis (1): the total number of patients being 18.

RESULTS

In all patients the pain was measured before the application of shock wave therapy and after this application. The numbers of applications were different and we quantified the first and last application.

In the column treatment period in the Table 1 the numbers represent the interval between the first and last application. In the column before the application, the number represents the intensity of pain before the therapy; in the column after are the levels after the application.

Pain Δ % documents the percentage of pain relief after the shock wave therapy. The relief was positive in 16 cases; in two cases there was no amelioration.

DISCUSSION

In general, it is known that the effect of an extracorporeal shock wave in living tissues induces characteristic changes within the cells due to the conversion of the mechanical signal into biochemical or molecular biological signal – mechanotransduction (Zimmermann et al. 2009).

<table>
<thead>
<tr>
<th>Patients</th>
<th>Pain syndromes</th>
<th>treatment period</th>
<th>pain before</th>
<th>pain after</th>
<th>pain Δ %</th>
<th>Δ pain</th>
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<tbody>
<tr>
<td>1</td>
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<td>80</td>
<td>60</td>
<td>25,00</td>
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<td>32</td>
<td>11</td>
<td>65,63</td>
<td>21</td>
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<tr>
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<td>10</td>
<td>52</td>
<td>43</td>
<td>17,31</td>
<td>9</td>
</tr>
<tr>
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<td>11</td>
<td>43</td>
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<td>-16,28</td>
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</tr>
<tr>
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<td>13</td>
<td>50</td>
<td>51</td>
<td>-2,00</td>
<td>-1</td>
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<tr>
<td>6</td>
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<td>25</td>
<td>62</td>
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<tr>
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<tr>
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<td>7</td>
<td>33</td>
<td>11</td>
<td>66,67</td>
<td>22</td>
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<tr>
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<td>73</td>
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<tr>
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<td>Radial epicondylitis</td>
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<td>48</td>
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<tr>
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<td>92</td>
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There is currently great interest in the use of ESWT, and in ascertaining the mechanism of action of this kind of treatment, keeping in mind the favorable results reported in clinical practice (Rebuzzi et al. 2008). Some authors speculate that shockwaves relieve pain in insertional tendinopathy by hyper-stimulation analgesia (Hausdorf et al. 2004).

The experimental results show that ESWT significantly stimulated the ingrowth of neovascularization associated with increased expressions of angiogenic growth indicators in tendon, bone and tendon-bone interface. Neovascularization may play a role in the improvement of blood supply and healing of tendon. There is a close relationship between the decrease of substance P release and clinically known treatment pain, with consecutive pain reduction in the shockwave treatment of tendon insertion diseases. Nitric oxide appears to play an essential role in the molecular mechanisms of ESWT (Notarnicola & Moretti 2012).

Low energy shock wave treatment induces angiogenesis in acute ischemia via VEGF Receptor 2 stimulation and shows the same promising effects as known from chronic myocardial ischemia. It may therefore develop an adjunct to the treatment armamentarium of acute muscle ischemia in limbs and myocardium (Holfeld et al. 2014a,b).

Wang et al. (2003) demonstrated that ESWT induces neovascularization, as confirmed by early release of angiogenesis-related markers, including Vascular Endothelial Growth Factor (VEGF), endothelial nitric oxide synthase (eNOS) and proliferating cell nuclear antigen (PCNA) at the Achilles tendon-bone junction. Therefore, these authors suggested that neovascularization can improve blood supply and induce tissue regeneration at the tendon-bone junction.

The recent study, which investigated the potential impact of ECSWT on reducing AIC in rat, provided several valuable implications. First, the in vitro results showed that ECSW therapy remarkably inhibits inflammatory reaction and the productions of ROS and oxidative stress. Second, ECSWT treatment substantially reduced the hematuria and the urine levels of proteinuria and IL-6. Third, the inflammatory response at the cellular, gene and protein levels were markedly reduced in the bladder after ECSW therapy. Finally, the generation of ROS and oxidative stress in bladder were suppressed, whereas the integrity of urinary bladder (i.e., including epithelial and smooth muscle layers) was preserved after ECSW therapy (Chen et al. 2014).

It was found that SN acts as an endogenous enhancer of VEGF-binding to its co-receptor neuropilin 1 and to heparan sulfate proteoglycan binding sites. They propose SN as a novel agent in the treatment of ischemic cardiomyopathy for several reasons: SN acts...
as stimulator of several growth factor RTKs known to play essential roles in angiogenesis, i.e. VEGFR2 and FGFR3 in the coronary vasculature (Albrecht-Schgoer et al. 2012). Furthermore, SN also affects coronary artery SMCs as was shown in this and previous studies, to induce growth of SMC-covered blood vessels known to be more stable than capillaries. Finally, SN improved LV-function and -remodeling in an in-vivo model of MI. Future studies also should be able to determine appropriate vectors for efficient delivery of this peptide in large animal models and in human trials (Wang et al. 2003).

Nedelka et al. (2014) presented retrospective study which was done on 62 selected patients with unilateral chronic lumbar facet pain. There were 32 women and 30 men, divided into SWT group, corticosteroid injections group, radiofrequency group. Nociceptive and neuropathic pain intensity and severity of pain were measured. Results: Shockwave therapy had shown better long term results compared to the facet joint injections group and little inferior efficacy compared to radio frequency medial branch neurotomy. We did not observe any adverse effects and complications in the ESWT group. Moreover, in ESWT and radio frequency medial branch neurotomy groups, significant long term improvement in daily activities limitation, was observed (Nedelka et al. 2014).

REFERENCES

CONCLUSIONS
We confirmed the positive effect of shock wave therapy for the pain relief in several types of chronic pain syndromes. It was especially useful in cervical syndrome: lumbago and plantar fasciitis. This method is also effective in other pain syndromes. The effect of this application is very individual and therefore it is necessary to indicate different numbers of therapeutic applications. We recommend this method as a very useful tool for completion possibilities in the treatment of chronic pain.

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