

Shockwave Therapy and Anesthesia: What Evidence is there?

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Abstract

Introduction: The use of anesthetics on extracorporeal shockwave therapy (ESWT) for musculoskeletal disorders is a matter of debate. Although widely performed, especially on focal procedures, its scientific background is sparse. This study aims to review the current evidence on the use of anesthetics in ESWT.

Methods: A literature review of the PubMed, Web of Science, Embase, EBSCO, and Cochrane Library databases was performed. Studies assessing or comparing the use of any type of anesthetic in any form of shockwave therapy were collected.

Results: After inclusion and exclusion criteria assessment, a total of seven studies were found to directly address the subject and only four were original articles.

Conclusion: The produced evidence is small and lacks methodological quality. These facts support the necessity for new studies using the present technology to determine the real effect of anesthetics on ESWT.

Level of Evidence: Level V. Literature Review.

Keywords: Shockwave, Therapy, Extra-corporeal, Radial, Focal, Anesthesia, Anesthetics, Block, Extracorporeal shockwave therapy

Introduction

Extracorporeal shockwave therapy (ESWT) has been used for the treatment of several conditions affecting the musculoskeletal system [1, 2, 3]. Its use gathered substantial positive results when used to address many disorders, especially fasciitis and tendinopathies [4]. The safety of the procedure regarding major and minor complications was also strongly supported over the last decades [3, 5, 6, 7].

The use of anesthesia during ESWT is advocated by some authors and guidelines to minimize the potential pain generated by the treatment [1, 8, 9]. On the other hand, studies were produced demonstrating inferior functional results when using anesthetics in conjunction with ESWT [10, 11, 12]. The drug would alter the biologic response to the therapy by preventing activation and sensitization of primary

afferent nociceptive C-fibers [13]. Still, the quantity and quality of evidence produced to advocate its use or not are very limited [3, 14].

The importance of the determination if anesthesia is necessary for the use of ESWT is vast. It affects not only the daily practice and general costs but also the design and management of clinical studies, particularly clinical trials. Therefore, the objective of this study is to review the existing evidence towards the use of anesthetics in ESWT and provide a critical analysis of what was produced.

Methods

This review complied with the Health Insurance Portability and Accountability Act and the Declaration of Helsinki. Using PubMed, Web of Science, Embase, EBSCO, and Cochrane library databases a full search for translational or clinical studies was

performed in November 2021. References, citations, and similar articles (tool provided by the servers) were also reviewed. A librarian assisted with the strategy, that included the following key terms: “shockwave,” “shock,” “wave,” “therapy,” “anesthesia,” and “anesthetics” combined using Boolean operators “AND” or “OR.”

The inclusion criteria were studies that report results subsequent to the use of anesthesia in ESWT for musculoskeletal conditions. The exclusion criteria were scientific articles using the therapy for other systems (urinary, vascular, and neurologic) or not directly evaluating the interference of anesthetics on ESWT aftereffects. Studies on languages different than English were not excluded from the study.

Results

The search strategy retrieved initially 280 results. After inclusion and exclusion criteria

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assessment, a total of seven studies were found to directly address the subject [3, 4, 10, 11, 12, 13, 15]. From this group, only four were original articles [10, 11, 12, 13]. Three of the studies evaluated functional outcomes in populations treated with ESWT and demonstrated inferior outcomes using local anesthesia [10, 11, 12]. One study evaluated the local vascular and nociception response to shockwave in the human tissue and its results suggest that local anesthesia substantially alters the biological responses of ESWT [13].

Discussion

The use of anesthetics for ESWT is a paradigm that needs to be better studied. One of these concepts is the possible negative effect when used in conjunction to the shockwave. Very few studies supported this affirmation over the years, mainly based on findings over a frail methodology. Anesthesia allows the application of higher energies as in cases of kidney stones and nonunion, in which higher intensities are needed. In addition, some devices such as electrohydraulics cause more pain during their application and, without anesthesia (local or non-local), the patient often cannot support the treatment [7, 13, 15, 16].

Evidence points to a central role of the peripheral nervous system in mediating the cellular effects of shock waves applied to the musculoskeletal system [17, 18, 19]. The pain generated by ESWT stimulates nociceptors (C-fibers), which, in addition to their sensory function, release a variety of neuropeptides that induce protein extravasation, fibroblast stimulation, and cell activation. And some neuropeptides, such as substance P, initiate central and local trophic effects [20, 21, 22, 23, 24]. We know that local anesthetics disrupt the pain stimulus transmission by blocking sodium channel conductance and stopping potential action deflagration and might also interfere with cytokine or nerve growth factors release [13]. Klonschinski et al. study provided evidence that ESWT activates and sensitizes primary afferent nociceptive C fibers and that both activation and sensitization were avoided if local anesthetic was applied [13].

Rompe et al. [10] in 2005 enrolled eighty-six patients with chronic plantar faciitis. They were randomly assigned to receive low energy with or without local anesthesia. They used

an electromagnetic device, given weekly for 3 weeks. At 3 months, the average pain score was 2.2 ± 2.0 for patients of group I (without anesthesia), and 4.1 ± 1.5 points for group II (with anesthesia). The mean between group difference was 1.9 points (95% CI: [1.1–2.7 points]; $P < 0.001$). Significantly more patients of group I achieved 50% reduction of pain compared to group II (67% vs. 29%, $P < 0.001$).

The authors say there remain some interesting points to be clarified. The biomechanical changes that occur with or without local anesthesia are unknown, if there are differences between applying directly to the area or remote application (block) and further clinical trials will also have to analyze if there are a central neuromodulation effects in different modalities of ESWT [10].

Labek and Auersperg [11] in 2005 reported they had enrolled 60 patients with a chronic plantar faciitis in a triple arm study, prospective, randomized, and observer-blinded pilot trial. Patients are randomly assigned to receive three sessions of active ESWT. Group I without local anesthesia (energy flux density per shock 0.09 mJ/mm^2), group II ESWT with local anesthesia (energy flux density per shock 0.18 mJ/mm^2), and group III ESWT with local anesthesia (energy flux density per shock 0.09 mJ/mm^2). At 6 weeks, there was a significant improvement in pain during the first step in the morning in all groups, by 4.2 points in group I, by 2.6 points in group II and 2.4 points in group III. They conclude, at 6 weeks success rates after low energy ESWT with local anesthesia were lower than after identical low energy ESWT without local anesthesia.

This is a monocenter study and the treatment was performed by one expert team of orthopedic surgeons, patients were not matched for activity level before treatment, no placebo group was included and results of the current trial cannot be extrapolated to other ESWT treatment devices and pathologies.

Furia [12], in 2006, a Case control study, treated Thirty-five patients with chronic insertional Achilles tendinopathy with 1 dose of electromagnetic high-energy extracorporeal shock wave, and thirty-three patients in the control group were managed with traditional non-operative measures.

Twelve of the ESWT patients were treated with a local anesthesia field block (LA subgroup), and 23 of the ESWT patients were treated with an regional block (NLA subgroup), The author find a mean improvement in visual analog score for the local anesthesia subgroup was significantly less than that in the nonlocal anesthesia subgroup ($F = 16.77$ vs. $F = 53.95$, $P < 0.001$) and the percentage of patients with successful Roles and Maudsley scores did not differ among the local and nonlocal anesthesia.

The data from this study demonstrate that ESWT is a safe and effective to treat patients with chronic insertional Achilles tendinopathy. This treatment effect may be compromised by application of a local anesthesia before ESWT. Further prospective studies are needed to confirm these findings.

Based on what we found, we believe that the concept of anesthesia having a deleterious effect on ESWT needs revision until further data is produced. The few available studies that support this assertion have some bias. All used electromagnetic devices, what may not properly translate results when using electrohydraulic or piezoelectric or radial. The local anesthetic of choice was mainly mepivacaine, which is an anesthetic with less vasodilating action than lidocaine and was used in the reviewed studies. What is also unknown is if a peripheral anesthetic block can have an influence on ESWT and it has not been investigated and it is not known whether the use of anesthetics interferes with the release of endothelial growth factors, neovascularization, neoangiogenesis, and mechanotransduction.

Conclusion

The current available information does not recommend the use of local anesthesia for soft tissues but should be considered for bone indications. However, the produced evidence is small and lacks methodological quality. These facts support the necessity for new studies using the present technology to determine the real effect of anesthetics on ESWT.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

Conflicts of Interest: Nil. **Source of Support:** None.

References

1. Wang CJ. Extracorporeal shockwave therapy in musculoskeletal disorders. *J Orthop Surg Res* 2012;7:11.
2. Moya D, Ramon S, Schaden W, Wang CJ, Guiloff L, Cheng JH. The role of extracorporeal shockwave treatment in musculoskeletal disorders. *J Bone Joint Surg Am* 2018;100:251-63.
3. Schmitz C, Csaszar NB, Milz S, Schieker M, Maffulli N, Rompe JD, et al. Efficacy and safety of extracorporeal shock wave therapy for orthopedic conditions: A systematic review on studies listed in the PEDro database. *Br Med Bull* 2015;116:115-38.
4. Korakakis V, Whiteley R, Tzavara A, Malliaropoulos N. The effectiveness of extracorporeal shockwave therapy in common lower limb conditions: A systematic review including quantification of patient-rated pain reduction. *Br J Sports Med* 2018;52:387-407.
5. Schaden W, Thiele R, Kolpl C, Pusch M, Nissan A, Attinger CE, et al. Shock wave therapy for acute and chronic soft tissue wounds: A feasibility study. *J Surg Res* 2007;143:112.
6. Barbachan Mansur NS, Matsunaga FT, Carrazzone OL, Dias dos Santos P, Schiefer Dos Santos B, Nunes CG, et al. Shockwave therapy plus eccentric exercises versus isolated eccentric exercises for achilles insertional tendinopathy: A double-blinded randomized clinical trial. *J Bone Joint Surg Am* 2021;103:1295-302.
7. Schaden W, Mittermayr R, Haffner N, Smolen D, Gerdesmeyer L, Wang CJ. Extracorporeal shockwave therapy (ESWT)--first choice treatment of fracture non-unions? *Int J Surg* 2015;24:179-83.
8. Valchanou VD, Michailov P. High energy shock waves in the treatment of delayed and nonunion of fractures. *Int Orthop* 1991;15:181-4.
9. Treatment ISFMS. ISMST Guidelines. Italy: University of Florence; 2019.
10. Rompe JD, Meurer A, Nafe B, Hofmann A, Gerdesmeyer L. Repetitive low-energy shock wave application without local anesthesia is more efficient than repetitive low-energy shock wave application with local anesthesia in the treatment of chronic plantar fasciitis. *J Orthop Res* 2005;23:931-41.
11. Labek G, Auersperg V, Ziemhöld M, Poullos N, Böhler N. Influence of local anesthesia and energy level on the clinical outcome of extracorporeal shock wave-treatment of chronic plantar fasciitis. *Z Orthop Ihre Grenzgeb* 2005;143:240-6.
12. Furia JP. High-energy extracorporeal shock wave therapy as a treatment for insertional Achilles tendinopathy. *Am J Sports Med* 2006;34:733-40.
13. Klonschinski T, Ament SJ, Schlereth T, Rompe JD, Birklein F. Application of local anesthesia inhibits effects of low-energy extracorporeal shock wave treatment (ESWT) on nociceptors. *Pain Med* 2011;12:1532-7.
14. Ramon S, Español A, Yebra M, Morillas JM, Unzurrunzaga R, Freitag K, et al. Current evidences in shockwave treatment. SETOC (spanish society of shockwave treatment) recommendations. *Rehabilitacion (Madr)* 2021;55:291-300.
15. Schultheiss R. Stoßwellen-technologie in orthopädie und unfallchirurgie. In: Chaussy C, Eisenberger F, Jocham D, Wilbert D, editors. *Die Stoßwelle. Forschung und Klinik. Germany: Attempto, Tübingen*; 1995.
16. Lohrer H, Nauck T, Korakakis V, Malliaropoulos N. Historical ESWT paradigms are overcome: A narrative review. *Biomed Res Int* 2016;2016:3850461.
17. Maier M, Averbek B, Milz S, Refior HJ, Schmitz C. Substance P and prostaglandin E2 release after shock wave application to the rabbit femur. *Clin Orthop Relat Res* 2003;406:237-45.
18. Hausdorf J, Lemmens MA, Kaplan S, Marangoz C, Milz S, Odaci E, et al. Extracorporeal shockwave application to the distal femur of rabbits diminishes the number of neurons immunoreactive for substance P in dorsal root ganglia L5. *Brain Res* 2008;1207:96-101.
19. Schmitz C, DePace R. Pain relief by extracorporeal shockwave therapy: An update on the current understanding. *Urol Res* 2009;37:231-4.
20. Weber M, Birklein F, Neundorfer B, Schmelz M. Facilitated neurogenic inflammation in complex regional pain syndrome. *Pain* 2001;91:251-7.
21. Hsieh ST, Lin WM. Modulation of keratinocyte proliferation by skin innervation. *J Invest Dermatol* 1999;113:579-86.
22. Goto T, Yamaza T, Kido MA, Tanaka T. Light-and electron-microscopic study of the distribution of axons containing substance P and the localization of neurokinin-1 receptor in bone. *Cell Tissue Res* 1998;293:87-93.
23. Brain SD, Williams TJ. Substance P regulates the vasodilator activity of calcitonin gene-related peptide. *Nature* 1988;335:73-5.
24. Fischer AA. Pressure algometry over normal muscles. Standard values, validity and reproducibility of pressure threshold. *Pain* 1987;30:115-26.

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