Effects of Extracorporeal Shockwave Therapy: A Pilot Study Using a Rat Model

K.F. Woodmansey*, R.K. White*, Rhodes SC*, P.R. Kramer*
*Texas A&M University Baylor College of Dentistry, Dallas, TX

Abstract

Objectives: This pilot study was designed to assess the effects of extracorporeal shockwave therapy (ECSWT) on dental pulp, brain, lung and osteonecrosis of the jaw (ONJ) in rats.

Methods: With approval from the Texas A&M University Baylor College of Dentistry IACUC, seven male rats were enrolled in this study. One was retained as an untreated control. Six were treated with intraperitoneally injected Zoledronic acid thrice weekly for 8 weeks. At the end of the seventh week, four rats had three adjacent maxillary molars extracted to induce ONJ. One rat did not survive the anesthesia. One rat was retained as a treated control. Experimental animals were treated using the Sanuwave shockwave device applied to the extraction site area receiving 1000 pulses. Two rats received ECSWT over the ONJ area once weekly at weeks 9, 10 &11. One rat received ECSWT over the ONJ area at weeks 9&10 only. Another rat was retained as an untreated control. At week 12, the initial control rat was treated with ECSWT over lung, brain and dental pulp areas. All rats were then sacrificed, specimen areas dissected and submitted for microscopic pathologic analysis.

Results:

1. Upon macroscopic examination, the lung tissue demonstrated significant hemorrhage, while all other areas appeared normal.
2. Microscopically, dental pulp tissue appeared normal.
3. The rat that received shockwave treatment directly to its cranial vault displayed subduced activity for two days following the treatment, but then recovered normally. Macroscopically the brain tissue appeared normal with no evidence of intracranial hemorrhage.
4. Despite following a validated protocol to induce ONJ, no evidence of ONJ was observed microscopically in the ECSWT groups. In the ECSWT groups, compared to the untreated groups, significant osseous healing was noted with a profusion of woven bone.

Conclusions

1. Extracorporeal shockwave therapy appears safe for oral use with no adverse effects on oral or pulpal tissues and may have a positive effect on osseous healing.
2. Effects on cognition and brain tissues merit further study.
3. ECSWT of lung tissues is contraindicated
4. Further study is needed to assess the effects of ECSWT on ONJ tissues.

Discussion:

The findings of this pilot study suggest the possibility that ONJ may be safely and effectively treated using ECSWT. However due to its very small group size much additional research is needed. The biggest question raised from this trial was the validity of the Barba-Recreo model for inducing ONJ. Although empty lacunae were seen in the histologic specimens of the treated control, suggesting the model is effective, one rat seems inadequate to be sure we actually induced ONJ. No empty lacunae were seen in the SANUWAVE-treated rats. This seems to indicate the efficacy of SANUWAVE in treating ONJ. However, in the paper published by Barba-Recreo, they only achieved ONJ in 80% of treated rats. And because the ONJ can only be detected histologically with this model, there is no means to ensure the presence of ONJ prior to ECSWT. The development of a model that could be detected visually (such as non-healing tooth extraction sockets) would facilitate more concrete analysis.

The fact that the pulp appears unaffected by ECSWT is an important finding. After treatment with ECSWT to the brain, our rat appeared stunned or dazed for several hours. Additional testing of brain function and histology subsequent to ECSWT will be needed. The finding of severe lung hemorrhage subsequent to ECSWT is an important lesson, demonstrating the effects of ECSWT at tissue-air interfaces. Consequently, it is imperative to avoid ECSWT exposure to lung tissues.

Conclusions:

1. ECSWT appears safe for oral use with no adverse effects on oral or pulpal tissues
2. ECSWT may have a positive effect on osseous healing.
3. Effects of ECSWT on cognition and brain tissues merit further study.
4. ECSWT of lung tissues is contraindicated
5. Further study is needed to better assess the effects of ECSWT on ONJ tissues.

References: