Letter to the Editor: Cerebral Hemorrhage following Chiropractic Activator Treatment–Case Report and Review of Literature

Michael A.K. Liebschner[1] Bruce L. Ehni[2]

[1] Department of Neurosurgery, Baylor College of Medicine, Houston, Texas, United States
[2] Neurosurgery Service Line, Michael E. DeBakey VA Medical Center, Houston, United States

Address for correspondence Michael Liebschner, PhD, Department of Neurosurgery, Baylor College of Medicine, 7200 Cambridge Suite 9A, Houston, TX 77030-3411, United States (e-mail: Liebschner@bcm.edu).

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We took an interest in the above-published case study, a well-written article providing a detailed overview of the medical history, diagnostic procedures, treatment outcomes, and surrounding factors related to the surprising occurrence of a small cerebral hemorrhage in a 75-year-old woman admitted to the hospital of the author following a chiropractic treatment. The main topic of the article was around a causation analysis, a mechanical impulse device attributed to the cause of a small parenchymal or local subdural hemorrhage. However, any biomechanical engineer familiar with the energy output of devices such as the one mentioned above would contend that the patient could not have sustained a cerebral hemorrhage from the application of this instrument to the lateral occiput. The output of the activator device does not generate enough energy to injure intracranial blood vessels of normal strength and integrity, but more importantly, the type of mechanical output such devices generate is not consistent with the mechanism of blood vessel injury.[1]

Activator devices used in chiropractic treatments employ an energy level designed merely for neuromodulation and sensory fiber stimulation. An engineering analysis is required to determine the existence of a mechanism to cause this tissue injury, in addition to the author's temporal analysis, which seems to implicate the device. The mentioned chiropractic instruments, Activator and Impulse, are mechanical impulse devices that generate a mechanical shockwave in the order of 0.3 J of energy or less.[2] Mechanical shockwaves are pressure waves similar to acoustic waves, travel nearly unchanged through fluids, such as water ripples, and are reflected, refracted, transmitted, or dissipated on encountering a change in acoustic impedance along their path. Any change in the mechanical properties of tissue results in the release of a part of the shockwave energy, which in turn generates compression and shear loads on the surface of the material with the higher impedance (such as soft tissue/skull interface). Further, the impulse is a radial pressure wave, for which the maximum pressure decreases proportional to the square of the distance from the contact point of the device.[3] In other words, blood vessels in closer proximity to the contact point of the device (e.g., right under it) would have ruptured first, were the device responsible, due to higher pressure gradients near the source. A local contusion might have been produced,[4] which generally resolve 24 to 48 hours after the treatment.[5] The only such reported complications followed treatment with much more powerful devices; extracorporeal shockwave therapy, such as lithotripsy, confined to subcutaneous hemorrhage and pain near the application site. Even in these cases, it has not been resolved conclusively if these complications were a result of the shockwaves or the device being pressed against the tissue during the application. It has been hypothesized that cavitation near the application site may have been the cause.[6]

The peak pressure amplitude of radial shockwave generators used for extracorporeal shockwave therapy (ESWT, lithotripsy) is approximately 20 times higher than the output of chiropractic instruments.[3] In addition, ESWT generally requires between 1,000 and 4,000 impulses per treatment while the Activator devices are limited to just one impulse per treatment site. Although ESWT is not used on the head, blood vessels are constructed of similar tissue across the body.

When performing a causational investigation, one has to think beyond a temporal relationship and determine if the mechanism of injury is consistent with the event believed to result in injury. Blood vessels are exposed to dynamic blood

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pressure from the inside and lower static pressure from the outside; they are therefore susceptible to circumferential and longitudinal stresses. Related to the exposure to pressure waves, blood vessels seem to be very resilient. Experiments on cavitation generated inside blood vessels have not caused these blood vessels to burst, even though the energy level to generate cavitation is approximately 100 times higher than the capabilities of chiropractic instruments. Pressure waves generated by chiropractic instruments are simply unable to damage blood vessels.

In conclusion, the device can be ruled out as a cause of this injury by virtue of an engineering approach to its energy output and injury mechanism. Other mechanisms must be at play, such as a startled reflexive movement, age, and disease altering the patient's mechanical properties. Obtaining patient-specific biomechanical properties of the relevant tissue is not feasible currently.

References

1 Liebschner MA, Chun K, Kim N, Ehni B. In vitro biomechanical evaluation of single impulse and repetitive mechanical shockwave devices utilized for spinal manipulative therapy. Ann Biomed Eng 2014;42(12):2524–2536
2 Fuhr AW, Smith DB. Accuracy of piezoelectric accelerometers measuring displacement of a spinal adjusting instrument. J Manipulative PhysiolTher 1986;9(01):15–21
3 McClure SR, Merritt DK. Extracorporeal shock-wave therapy for equine musculoskeletal disorders. Compend Contin EducPract Vet 2003;25:68–75
4 Haupt G. Use of extracorporeal shock waves in the treatment of pseudarthrosis, tendinopathy and other orthopedic diseases. J Urol 1997;158(01):4–11
5 Aksoy Y, Yapanoğlu T, Özbey İ. The efficacy and safety of extracorporeal shock wave lithotripsy in children. Eurasian J Med 2009;41(02):120–125
6 Bruemmer F, Braeuner T, Huelser DF. Biological effects of shock waves. World J Urol 1990;8:224–232