Programmable shunts and headphones: Are they safe together?

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**Abstract:**

OBJECT Programmable shunts have a valuable role in the treatment of patients with hydrocephalus, but because a magnet is used to change valve settings, interactions with external magnets may reprogram these shunts. Previous studies have demonstrated the ability of magnetic toys and iPads to erroneously reprogram shunts. Headphones are even more ubiquitous, and they contain an electromagnet for sound projection that sits on the head very close to the shunt valve. This study is the first to look at the magnetic field emissions of headphones and their effect on reprogrammable shunt valves to ascertain whether headphones are safe for patients with these shunts to wear.

METHODS In this in vitro study of the magnetic properties of headphones and their interactions with 3 different programmable shunts, the authors evaluated Apple earbuds, Beats by Dr. Dre, and Bose QuietComfort Acoustic Noise Cancelling headphones. Each headphone was tested for electromagnetic field emissions using a direct current gaussmeter. The following valves were evaluated: Codman Hakim programmable valve, Medtronic Strata II valve, and Aesculap proGAV. Each valve was tested at distances of 0 to 50 mm (in 5-mm increments) from each headphone. The exposure time at each distance was 1 minute, and 3 trials were performed to confirm results at each valve setting and distance.

RESULTS All 3 headphones generated magnetic fields greater than the respective shunt manufacturer's recommended strength of exposure, but these fields did not persist beyond 5 mm. By 2 cm, the fields levels were below 20 G, well below the Medtronic recommendation of 90 G and the Codman recommendation of 80 G. Because the mechanism for the proGAV is different, there is no recommended gauss level. There was no change in gauss-level emissions by the headphones with changes in frequency and amplitude. Both the Strata and Codman-Hakim valves were reprogrammed by direct contact (distance 0 mm) with the Bose headphones. When a rotation component was added, all 3 headphones reprogrammed the Strata and Codman-Hakim valves at 0 mm. At all distances above 0 mm, the headphones did not affect the shunts. The proGAV valve was not affected by headphones at any distance.

CONCLUSIONS Although all the headphones studied generated significant gauss fields at distances less than 5 mm, the programmable valve settings only changed at a distance of 0 mm (i.e., with direct contact). Given the subcutaneous location of the valve, the authors conclude that is highly unlikely that commercially available or customary headphones can contribute to the reprogramming of shunts.

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