

Diffusion-weighted MR Neurography of Extremity Nerves and the Initial Clinical Applications

lian xin zhao¹, guang bin wang¹, Queenie Chan², and wei bo chen²

¹Shandong Medical Imaging Research Institute, Shandong University, jinan, shandong, China, People's Republic of; ²Philips Healthcare

Purpose: To demonstrate the feasibility of diffusion-weighted (DW) magnetic resonance (MR) neurography of extremity nerves and evaluate the potential clinical applications.

Materials and Methods: This study was approved by local institutional review board, and informed consent was obtained. Total forty-seven healthy volunteers and eight patients underwent DW MR neurography of extremity nerves at a 3.0-T magnetic resonance system. Twenty-one volunteers underwent DW MR neurography of the upper limb, with 7 volunteers each at the level of upper arm, elbow and forearm. Nine volunteers were examined at the level of thigh, eight volunteers at the level of knee, and nine volunteers at the level of calf. DW MR neurography images of volunteers were displayed using a three-dimensional (3D) maximum intensity projection and blindly evaluated by two radiologists in consensus using a four-point grading scale (1 = poor [the nerve was partially visible]; 2 = moderate [the entire nerve was visible and of moderate signal intensity]; 3 = good [the entire nerve was visible and of good signal intensity]; 4 = excellent [the entire nerve was visible and of excellent signal intensity]). In patients, the depiction of nerves and lesions, and the anatomic relationship between them were evaluated on the axial source and reformatted 3D volume DW MR neurography images.

Results: The long trajectory of extremity nerves, including radial, median, ulnar, sciatic, tibial, and common peroneal nerves, could be visualized on reformatted 3D volume DW MR neurography images. In volunteers, the total mean score (\pm S.D.) of all nerves was 3.68 ± 0.73 . Image quality of radial and median nerves at the level of upper arm, median nerve at the level of forearm, bilateral sciatic nerves at the level of thigh, and tibial and common peroneal nerves at the level of knee was all graded as excellent. The mean scores (\pm S.D.) of radial and median nerves at the level of upper arm, ulnar nerve at the level of upper arm, elbow and forearm, and tibial nerve at the level of calf were 3.86 ± 0.38 , 3.57 ± 0.79 , 3.43 ± 0.79 , 3.57 ± 0.79 , 3.43 ± 0.98 , and 2.56 ± 1.13 , respectively. All tumors in the eight patients, including schwannomas, neurofibromas and aggressive fibroma, were clearly depicted on DW MR neurography. In the four patients with schwannoma, the well-demarcated oval shape of all tumors and the original nerve were clearly displayed. The type, number, size and distribution of tumors in extremities were clearly depicted on DW MR neurographic images in the three patients with neurofibromatosis. In the patient with aggressive fibroma, the irregular tumor with hyperintensity was seen immediately adjacent to the tortuous left sciatic nerve but only displaced it as a distinct boundary between them could be visualized. In follow-up examination of 2 patients after surgery, no recurrent tumor was found and nerves were visualized in a relatively normal course.

Conclusion: DW MR neurography is feasible for providing three-dimensional visualization of major extremity nerves, including radial, median, ulnar, sciatic, tibial, and common peroneal nerves. Our preliminary results suggest that the use of DW MR neurography, as complementary to conventional MR imaging, will improve depiction and evaluation of nerve anatomy and pathology, and their anatomic relationship with a comprehensive overview.

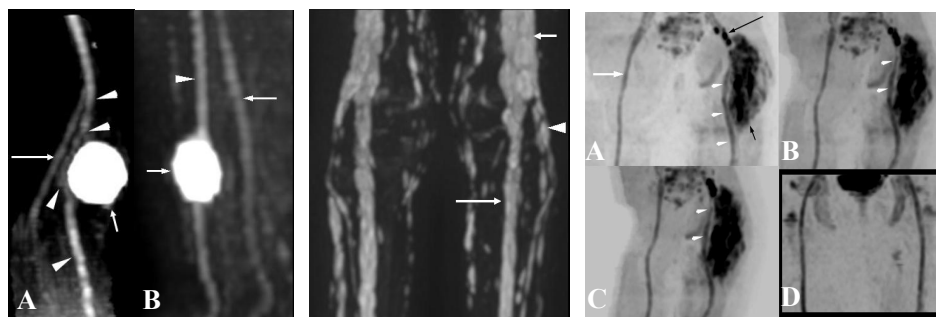


Figure 1

Figure 2

Figure 3

Figure 1. 3D volume DW MR neurographic images of pathologically proved schwannoma in two patients, a 31-year-old man (A) and a 36-year-old woman (B). A: This image shows that the tumor (short arrow) originates from right tibial nerve (arrowheads) in the popliteal fossa. The right common peroneal nerve (long arrow) is normal. B: This image shows an oval-shaped schwannoma (short arrow) encompassing the left median nerve (arrowhead) at the lower third of the forearm. The left ulnar nerve (long arrow) is normal.

Figure 2. A 20-year-old girl with neurofibromatosis types 1. DW MR neurographic image shows the diffuse fusiform enlargement of bilateral sciatic (short arrow), tibial (long arrow), and common peroneal (arrowhead) nerves throughout their courses.

Figure 3. 3D volume DW MR neurographic images with gray-scale inversion obtained before (A-C) and 5 months after (D) surgery of aggressive fibroma in a 6-year-old boy. A-C: The irregular tumor (short black arrow), displayed in three projections, is seen immediately adjacent to the tortuous left sciatic nerve (arrowheads) but only displaces it. A distinct boundary between them is visualized. Lymph nodes (long black arrow) accompanying the sciatic nerve are displayed. The right sciatic nerve is normal (white arrow). D: No recurrent tumor is found and the left sciatic nerve is visualized in a normal course.