Apparent Diffusion Coefficient of Subcutaneous Epidermal Cysts in the Head and Neck:

Comparison With Intracranial Epidermoid Cysts[1]

Chiori Suzuki, MD, Masayuki Maeda, MD, Akihiko Matsumine, MD, Toshio Matsubara, MD, Waro Taki, MD
Stephan E. Maier, MD, PhD, Kan Takeda, MD

Rationale and Objectives. Subcutaneous epidermal cysts and intracranial epidermoid cysts are pathologically identical. Although diffusion-weighted imaging (DWI) studies of intracranial epidermoid cysts have been numerously reported, those of subcutaneous epidermal cysts have not been sufficiently investigated. Our hypothesis for this study is that the apparent diffusion coefficient (ADC) values of subcutaneous epidermal cysts and intracranial epidermoid cysts are not different. This study was intended to evaluate the ADC of subcutaneous epidermal cysts of the head and neck in comparison with that of intracranial epidermoid cysts.

Materials and Methods. The MR studies were performed in 14 patients with head and neck subcutaneous epidermal cysts and 10 patients with intracranial epidermoid cysts using line scan DWI (LSDWI). The ADC was measured and compared between the two types of cyst.

Results. The ADC values (mean ± SD) were $0.81 \pm 0.14 \times 10^{-3}$ mm^2/s in subcutaneous epidermal cysts and $1.06 \pm 0.12 \times 10^{-3}$ mm^2/s in intracranial epidermoid cysts. A significant difference was found in ADC values between the two types ($P = .0019$).

Conclusion. Our preliminary study has shown that the ADC provides useful information regarding tissue characterization of subcutaneous epidermal cysts. However, the ADC of subcutaneous epidermal cysts was significantly lower than that of intracranial epidermoid cysts.

Key Words. Cyst; epidermoid; epidermal; magnetic resonance imaging; diffusion-weighted imaging; apparent diffusion coefficient.

Epidermal cysts are common, benign masses that occur in the skin. The lesions commonly involve the scalp, face, neck, trunk, and back (1). However, only a few reports regarding MR imaging findings have been issued on subcutaneous epidermal cysts (2–8). Typical MR imaging findings of subcutaneous epidermal cysts include a well-circumscribed margin, iso-, or slightly high signal intensity relative to adjacent muscles on T1-weighted images, and very high signal intensity on T2-weighted images (7, 8). Usually, no apparent enhancement is visible inside the cyst if unruptured (8).

Subcutaneous epidermal cysts and intracranial epidermoid cysts are pathologically identical: cysts filled with keratin debris and bounded by a wall of the stratified squamous epithelium (9). Unlike subcutaneous epidermal cysts, numerous MR imaging reports have described intracranial epidermoid cysts (10–17). Several studies of

Acad Radiol 2007; 14:1020–1028

[1] From the Departments of Radiology (C.S., M.M., K.T.), Orthopedic Surgery (A.M.), and Neurosurgery (T.M., W.T.), Mie University School of Medicine, 2-174 Edobashi, Tsu, Mie 514-8507, Japan; and the Department of Radiology, Brigham and Women's Hospital, Boston, MA (S.E.M.). Received March 24, 2007; accepted May 15, 2007. **Address correspondence to:** M.M. e-mail: mmaeda@clin.medic.mie-u.ac.jp

doi:10.1016/j.acra.2007.05.014

diffusion-weighted imaging (DWI) and apparent diffusion coefficient (ADC) have had particular impact on the diagnosis of the intracranial epidermoid cysts (12–17). However, reports on DWI and ADC of subcutaneous epidermal cysts are insufficient. We hypothesize that ADC values of subcutaneous epidermal cysts and intracranial epidermoid cysts are not different because they are pathologically identical. This study was intended to evaluate the ADC of subcutaneous epidermal cysts of the head and neck in comparison with that of intracranial epidermoid cysts.

MATERIALS AND METHODS

Subjects

We retrospectively studied 14 patients (five women and nine men; mean age, 52.1 years) with subcutaneous epidermal cysts in the head and neck and 10 patients (six women, four men; mean age, 50.6 years) with intracranial epidermoid cysts between July 2001 and April 2006. In all cases, the final diagnoses were made pathologically by surgery. Unruptured subcutaneous epidermal cysts were included in this study, but ruptured epidermal cysts were excluded because ruptured epidermal cysts contain exuberant foreign body reaction or hemorrhage inside the cyst.

Lesion locations included the neck ($n = 5$), scalp ($n = 5$), and face ($n = 4$) in patients with subcutaneous epidermal cysts, and cerebellopontine angle cistern ($n = 7$), quadrigeminal cistern ($n = 2$), and fourth ventricle ($n = 1$) in patients with intracranial epidermoid cysts. The mean maximum diameter (mean ± SD) of lesions was 25 ± 12 mm in subcutaneous epidermal cysts and 41 ± 11 mm in intracranial epidermoid cysts.

MR Imaging

For this study, MR imaging was performed using a 1.5-T superconducting system (Signa CV/i; GE Medical Systems, Milwaukee, WI). In patients with intracranial epidermoid cysts, MR imaging was achieved using a head coil. Conventional MR imaging studies consisted of a sagittal T1-weighted sequence (repetition time [TR]/echo time [TE]/excitation, 400/14/2), axial T1-weighted (300/9/1), axial fast spin echo T2-weighted (TR/TE_{eff}/excitation, 4000/100/2; echo-train length, 14) with or without fat suppression, and axial fast fluid-attenuated inversion recovery (FLAIR) (TR/TE_{eff}/inversion time, 8000/133/2000; 1 excitation) sequences. Other parameters included a section thickness of 5 mm with a 1-mm intersection gap, a 256 × 192 matrix, and a 20- to 22-cm field of view (FOV). Contrast-enhanced T1-weighted images were obtained for eight patients with intracranial epidermoid cysts. A three-dimensional (3D) heavily T2-weighted sequence was, in all patients, added to the conventional MR imaging for evaluation of the texture inside the cyst. The 3D heavily T2-weighted sequence was as follows: 6.3/1.8/2, a 24-cm FOV, a 512 × 224 matrix, and a 1-mm section thickness without a gap. In patients with subcutaneous epidermal cysts, MR imaging was acquired using a head coil or a neurovascular array coil. An axial and/or coronal T1-weighted sequence (300–466/9/2) and an axial and/or coronal fast spin echo T2-weighted sequence (3000–4000/96–103/2–3, echo train length 12–16) with or without fat suppression was used with a matrix size of 256 × 224, an FOV of 20–22 cm, and a section thickness of 3–5 mm with a 1-mm intersection gap. Contrast-enhanced T1-weighted images with or without fat suppression were obtained in nine patients with subcutaneous epidermal cysts.

The DWI was performed using line scan DWI (LSDWI). The LSDWI studies of patients were conducted within the guidelines of the research committees of our institution. Informed consent was obtained from patients or their authorized representatives. The LSDWI method has been described previously (18–21). Neither cardiac gating nor respiratory triggering was employed in LSDWI. No antisusceptibility devices on the neck were used to reduce susceptibility artifacts. The LSDWI images were acquired using the following scan parameters: TR = 3168–4048 ms, TE = 57.1–70.7 ms, one excitation, a FOV of 20–24 cm, matrix size of 128 × 128 columns, and bandwidth of 3.91–7.91 kHz. The effective section thickness was set to 3–5 mm with an inter-section gap of 1 mm. The LSDWI images were obtained with two different b values, with the maximum b value applied along three orthogonal directions: one with a low diffusion weighting (b factor) of 5 s/mm^2 and the other with a high (maximum) b factor of 1000 s/mm^2. The scan time per slice was 37–49 s: in all, 3–5 slices were obtained according to the lesion size. Isotropic diffusion images with a b factor of 1000 s/mm^2 were generated from the three diffusion directions assessed. Trace ADC maps were generated using the equation described by Stejskal and Tanner (22), $S = S_0 e^{-bADC}$, where b is the diffusion weighting factor, S is the signal intensity of the diffusion trace for