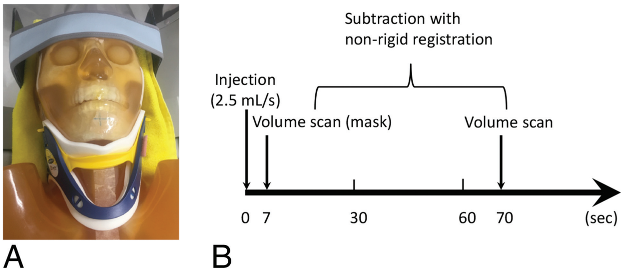
ON-LINE APPENDIX: MATERIALS AND METHODS

High-Resolution Deformable Registration Algorithm

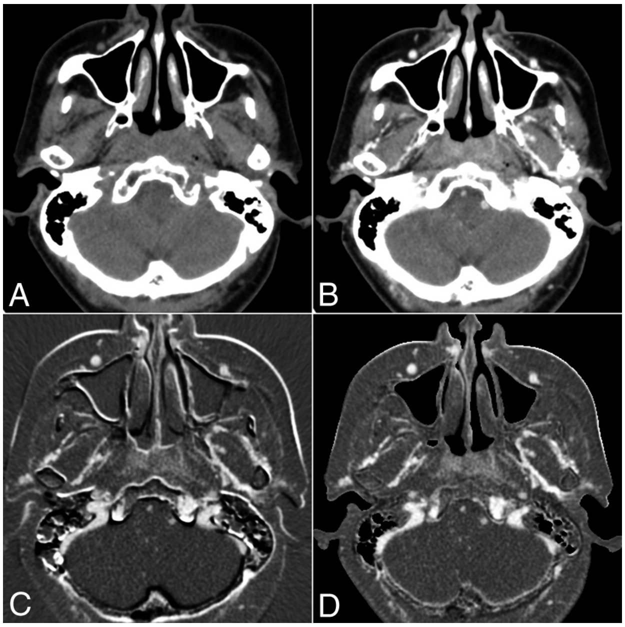
Two volume datasets (7- and 70-second CT) were reconstructed with a high-resolution deformable registration algorithm, and the mask volume was subtracted from the postcontrast volume using the ^{SURE}Subtraction application (Canon Medical Systems). With this software, by transforming the structure of an object that changes with time into "voxel units" instead of "volume units," we performed nonlinear registration by considering not only positional displacement but also expansion and contraction and twist (On-line Fig 2). The registration algorithm is based on mutual information, and the image is deformed so that the mutual information (correlation) is maximized for data with different time phases.[16] The time for generating a BSI image is about 30 seconds. The nonrigid registration algorithm was used to greatly constrain the search space, with only limited translation and rotation allowed, and no scaling. Skull base registration and subtraction are a simple algorithm, though slight movement of the neck can result in spatial mismatch of the skeleton between precontrast and postcontrast scans. Conventional volume scanning using wide area detector CT can reduce this mismatch because the wide coverage provided by a 160-mm-wide detector enables scanning of the head in 1 rotation, eliminating the need for helical scanning and moving the patient bed, which can reduce the moment of inertia or helical artifacts radically. Furthermore, an additional bone subtraction algorithm can be applied that uses the high-resolution deformable registration algorithm to ensure accurate subtraction of skeletal structures and calcified lesions.

MR Imaging Protocol for Standard of Reference

MR imaging of all patients was performed with a 3T scanner (Achieva or Ingenia; Philips Healthcare, Best, the Netherlands). Axial and coronal T1-weighted images (TR/TE, 675/13 ms; 560 × 560 matrix; 24-cm FOV; slice thickness, 3.0 mm; flip angle, 90°), axial and coronal T2-weighted images (TR/TE, 4868/90 ms; 560 × 560 matrix; 24-cm FOV; slice thickness, 3.0 mm; flip angle, 90°), and axial 3D T1-weighted Dixon gradient-echo in-phase images (TR/first TE/second TE, 4/1.5/2.5 ms; 320 × 320 matrix; 23-cm FOV; slice thickness, 1.0 mm; flip angle, 15°) were obtained using a head and neck coil. After administration of 0.1 mmol per kilogram of body weight of gadopentetate dimeglumine (Magnevist; Bayer HealthCare Pharmaceuticals, Wayne, New Jersey) or gadobutrol (Gadovist; Bayer Schering Pharma, Berlin, Germany), axial and coronal T1-weighted images with fat suppression (TE/TR, 139/3 ms; 512 × 512 matrix; slice thickness, 3.0 mm; flip angle, 70°) and 3D T1-weighted Dixon gradient-echo water images (TR/first TE/second TE, 4/1.5/2.5 ms; 320 × 320 matrix; slice thickness, 1.0 mm; flip angle, 15°) were obtained. Coronal pre- and postcontrast T1-weighted images (section thickness of 1.2 mm with 1.2-mm intersection gap, 60 sections) were reconstructed from 3D sequences.



ON-LINE FIG 1. Scan method for bone subtraction iodine imaging. *A*, Fixation of the head with a head band and neck collar. *B*, Two-volume scan archived at 7 and 70 seconds after contrast administration.



ON-LINE FIG 2. High-resolution deformable registration algorithm. Axial precontrast (mask) image (7 seconds) (*A*), axial postcontrast image (70 seconds) (*B*), bone subtraction image without ^{SURE}Subtraction application (*C*), and bone subtraction image with high-resolution deformable registration algorithm using the ^{SURE}Subtraction application (*D*).