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Case Report

Image Analysis with the Brain Easy Analysis Tool (BEAT) Method in Cases of Encephalomalacia Following Shaken Baby Syndrome

George Imataka[1], Yoshiyuki Watabe[1], Keiko Tsukada[1], Shigeko Kuwashima[2], Teisuke Hashimoto[2] and Osamu Arisaka[1]

Department of Pediatrics[1] and Rediology[2], Dokkyo Medical University School of Medicine

SUMMARY

Brain easy analysis tool (BEAT) is newly released software to calculate composite images both MRI and SPECT on computer graphics. At first, we herein report two cases with shaken baby syndrome associated with multicystic encephalomalasia diagnosed based on MRI. Next, we created fusion MRI-SPECT images using BEAT. The result of composited images was not only well recognized in anatomical visually but also easy to explain data to patients. This report is the second case report with this software called BEAT.

Key Words : Shaken baby syndrome, brain easy analysis tool, encephalomalacia, fusion image

INTRODUCTION

Shaken baby syndrome (SBS) is a battered child syndrome that occurs due to the shaking of the head of an infant. Because it occurs in the daily lives of children, society has become aware of the importance of its prevention. Shaking causes intracranial hemorrhaging, which is complicated by fundal hemorrhaging at a high rate. In many cases, shaking of the brain results in secondary destructive changes detected in brain MRI examinations, leaving severe neurological sequelae[1～4].

This article presents two cases that exhibited secondary encephalomalacia in brain MRI examinations following SBS. Furthermore, we herein report that we attempted fusion image analysis of brain MRI images and 99m-Tc ECD SPECT for SBS using the computer software called Brain Easy Analysis Tool (BEAT), which was newly developed recently[5].

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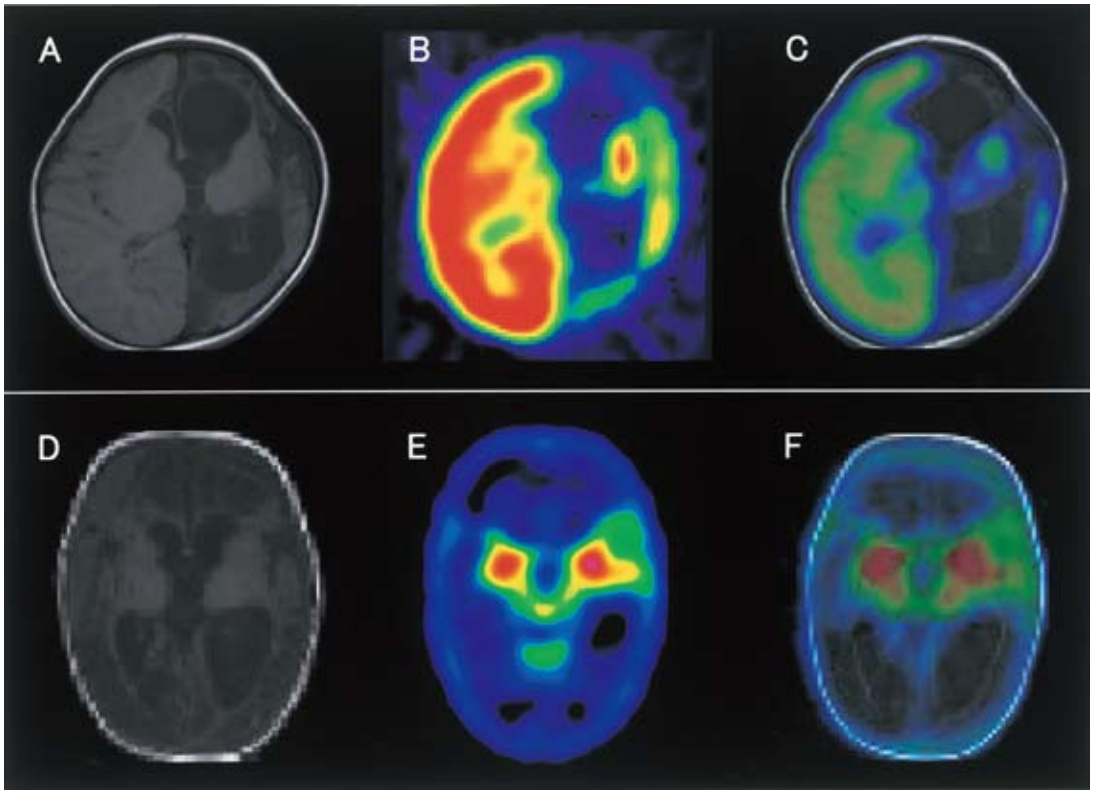
Reprint requests to : George Imataka, MD.
Department of Pediatrics, Dokkyo Medical University School of Medicine, Mibu, Tochigi 321-0293 Japan

CASE REPORTS

Case 1

A 2-month-old male infant visited the emergency outpatient unit due to eye deviation and local convulsion of the limbs. According to our inquiry of the parents, the patient exhibited repeated stereotyped movements of moving the limbs up and down for half a day. There was no obvious trigger for the occurrence of these movements. The child had no trauma on the body surface. Palpation revealed that the limbs had become stiff, and the eyes were displaced downward and immobilized. The anterior fontanelle exhibited bulging. We diagnosed the child with local convulsive status. In funduscopy, periretinal hemorrhaging was found. In a brain CT examination, subdural hemorrhaging was found. Subsequently, the child quickly developed respiratory failure and underwent artificial respiratory management. The patient entered the ICU and under-



Case 1：
A：MRI T1-weighted image (spin echo；TR＝545.0, TE＝15.0) showed multicyctic encephalomalasia. **B**：99m-Tc ECD SPECT qualitative analysis showed hypo-perfusion area consisted with images of MRI. **C**：Fusion images using BEAT with 30％ composite image exhibited characteristic both MRI and SPECT images.
Case 2：
D：Brain MRI T1-weighted image (spin echo；TR＝545.0, TE＝15.0) of axial image revealed multicyctic encephalomalasia. E：99m-Tc ECD SPECT qualitative analysis suggested hypo-perfusion area consisted with catastrophic images of MRI. F：Fusion images employing BEAT with 30％ composite image showed characteristic both MRI and SPECT images.

went mild brain hypothermia therapy and steroid pulse therapy.

Several days later, we heard from the parents that they had shaken the child hard, and we clinically diagnosed the patient with SBS. A brain MRI (Fig. A) examination conducted two months after onset showed subdural hemorrhaging, atrophic images of the cerebrum in the right frontotemporal region, and contralateral cystic encephalomalacia. 99m-Tc ECD SPECT qualitative analysis (Fig. B) showed extensive images of inadequate blood flow.

Two years after onset, the patient still has disorders of the visual field and visual acuity as well as talipes equinus with spastic paralysis, and he is undergoing rehabilitation.

Case 2

A 3-month-old female child visited the emergency outpatient unit due to local convulsion of the hands. The child had been born at 28 weeks gestation with a weight below 1,000g. According to our inquiry of the parents, the child became inactive after excessive shaking when cradling her at home. Subsequently, local convulsion of the eyes and hands were expressed. In a brain CT examination, subdural hemorrhaging was found. The ocular fundus had hemorrhaged. From these two findings and the clinical course, we diagnosed the patient with SBS. Steroid pulse therapy and continuous anticonvulsant infusion was performed. However, severe sequelae remained. An MRI examination (Fig. D) conducted 6 months after onset showed

bilateral encephalomalacia. Moreover, in 99 m-Tc ECD SPECT qualitative analysis (Fig. E), inadequate blood flow images matching the MRI findings were found.

BEAT analysis

MR images were analysis to the computer system from the server as DICOM data. Format fusion images was obtained employing the DICOM viewer software licensed by Fujifilm RI farma Co. Ltd[5].

SPECT was performedusing a triple-head system (Toshiba GCA-9300A/HG®) equipped with ultra-high-resolution fanbeam collimators and interfaced to a dedicated computer. Data were collected for continuous 5 rotations (3 minutes for one rotation) in a 128 × 128-matrix. Acquired data were reconstructed using 3-dimensional Butterworth-Wiener filter (order, 8.0 ; cutoff frequency, 0.13 cycle per pixel) after applying a Shepp & Logan back projection filter. For both cases, we created fusion images of MRI from DICOM data and qualitative analysis SPECT images obtained around the same time using the BEAT method, and these images are presented herein (Fig. C/F).

DISCUSSION

In cases involving dynamic reductions in the reflux area in cerebral blood flow images, it is necessary to consider the anatomical changes based on MRI images to interpret SPECT images. Conventionally, in such cases, visual examination has been the mainstream method of interpreting and evaluating cerebral blood flow SPECT images. However, recently, a method has been developed for MRI in which image statistical analysis software is used and a simple fusion technique for MR and SPECT images is used. BEAT, which we used, is a new tool that combines MRI and SPECT images on a computer screen, and it has been clinically applied in only a few cases but exhibits great potential[5]. Moreover, when explaining the results of the imaging tests to the parents, we have visually received a uniformly good impression. Therefore, BEAT is highly useful in situation of counseling of neuroradiological-imaging data for patients and parents.

The two cases presented herein both involved extensive cerebral cortical disorder due to encephalomalacia in the MRI images. In such cases, the fusion images using BEAT were very useful for visually understanding structural abnormalities in MRI and abnormal blood flow in SPECT. This software provides not only a technique for creating fusion images using MRI and SPECT but also functions for superimposing a difference image, which displays a difference (amount of change or rate of change) between two SPECT images from the same patient, over an MRI image to display the image. In the future, we would like to test MRI and SPECT images of the two cases presented herein over time and examine the fusion of difference images and MRI images as well.

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