www.jkns.or.kr 10.3340/jkns.2011.50.1.45
Print ISSN 2005-3711 On-line ISSN 1598-7876
J Korean Neurosurg Soc 50 : 45-47, 2011

Case Report

Serious Blood-Brain Barrier Disruption after Coil Embolization of Unruptured Intracranial Aneurysm : Report of Two Cases and Role of Immediate Postembolization CT Scan

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Abnormal contrast enhancement on brain computed tomography (CT) scan after diagnostic or interventional angiography is not rare, and has known to be induced by temporary blood-brain barrier (BBB) disruption from contrast media. Furthermore, it has been regarded as clinically subtle, but reported to have no symptom or mild transient symptoms. However, we recently experienced two cases of serious BBB disruption during the acute period after coiling of an unruptured intracranial aneurysm. One patient presented with an unruptured paraclinoid internal carotid artery (ICA) aneurysm on the right and the other with an unruptured right supraclinoid ICA aneurysm. Both patients showed similar findings on immediate postembolization CT scan and clinical courses after coiling. Typical radiological, clinical characteristics of BBB disruption were described. In addition, the role of immediate postembolization CT scan are also discussed.

Key Words : Aneurysm · Blood-brain barrier · Coil · Embolization.

INTRODUCTION

Nonionic iodinated contrast media (CM) are generally used for diagnostic and interventional cerebral angiography. Several cases with minor complications resulting from nonionic CM have been reported[5-7,9]. Regarding the adverse events of CM, abnormal contrast enhancement on brain computed tomography (CT) scan is most common event and it is reported to be encountered up to 43% in clinical practices[2]. Appearance of these patterns on CT scans can be various such as cortical, subarachnoid, intraventricular, and striatal enhancement[2,3]. Temporary disruption of blood-brain barrier (BBB) permeability has been the primary explanation for the abnormal CT findings[2,7,8]. Such abnormal enhancement after angiography had mostly reported no symptoms, or only mild transient symptoms. However, we recently experienced two patients of life-threatening BBB disruption who revealed typical radiological findings in immediate postembolization CT scan and simultaneously showed serious neurological deterioration, particularly after coiling of an unruptured cerebral aneurysm.

• Received : August 10, 2010 • Revised : December 13, 2010
• Accepted : July 1, 2011
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CASE REPORT

Case 1

A 58-year-old female was admitted for coiling of an unruptured paraclinoid internal carotid artery (ICA) aneurysm on the right. The aneurysm was incidentally found on the screening magnetic resonance imaging (MRI) for evaluating nonspecific headache. She had no past medical history. The coiling procedure was uneventful (Fig. 1A, B) under systemic heparinization which was administered as a 3000-IU bolus intravenously, and its duration was 80 minutes; the patient's body weight was 56 kg, therefore, 3.45 cm^3/kg of nonionic water-soluble iodinated contrast material (Visipaque 320; Amersham Health, Oslo, Norway) was used. The immediate postembolization CT scan showed diffuse cortical hyperintensity and some gyral swelling in the right frontoparietal lobe, which were suggestive of CM induced BBB disruption (Fig. 1C, D). However, the patient was neurologically stable without headache. At four hours following the procedure, she deteriorated neurologically to GCS 12 with left hemiparesis (4/5). MRI showed multiple small high signals on diffusion

weighted image (DWI) in the right, which appeared to be caused by microcatheter manipulation (Fig. 1E). She subsequently worsened neurologically to GCS 9 with left hemiparesis (2/5). Digital subtraction angiography (DSA) showed diffuse narrowing of cortical branches of the MCA and decrease of blood flow velocity were demonstrated (Fig. 1F). Among the several aforementioned clues, we presumed that the patient's deterioration originated from CM induced BBB disruption rather than other findings in the MRI and DSA, since the microinfarctions seemed not too severe to depress level of consciousness and the diffuse narrowing of cortical branches of the MCA might be caused by frontoparietal cortical swelling. Therefore, we decided conservative care on the basis that CM washout generally occurred within two days[7]. We just lowered systolic BP below 120 mmHg and monitored the patient carefully. The next day CT scan revealed no cortical hyperintensity with decreased gyral swelling. The patient showed neurological improvement at four days after coiling and had recovered without neurologic deficit upon at discharge.

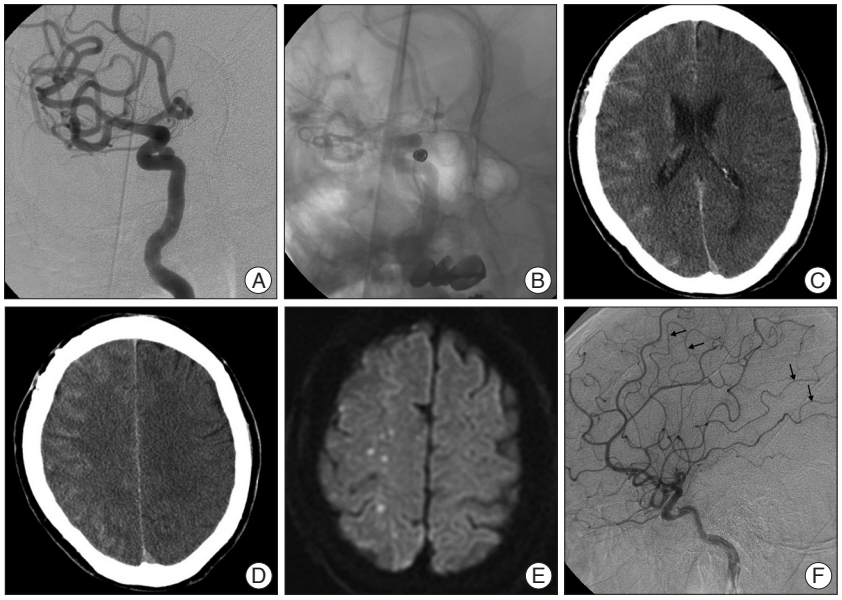

Fig. 1. A and B : Procedural angiographic images in case 1. C and D : Immediate postembolization noncontrast CT scan shows diffuse cortical hyperintensity and gyral swelling in the right frontoparietal lobe. E : DWI MRI shows multiple small high signals in the right frontoparietal lobe. F : Angiography revealing diffuse narrowing of frontoparietal cortical branches of the MCA (arrows). CT : computed tomography, DWI : diffusion weighted image, MRI : magnetic resonance imaging.

Case 2

A 61-year-old female was hospitalized for coiling of an unruptured supraclinoid ICA aneurysm on the right which was found on the coiling angiography at 2 months before. Then, the patient was presented with subarachnoid hemorrhage from rupture of basilar top aneurysm and treated with coil embolization. She had no previous medical history. The coiling procedure using a balloon assisted technique (4×10 mm HyperGlide, ev3, Plymouth, Minnesota, USA) was uneventful under 3000-IU-bolus of intravenous heparinization (Fig. 2A, B), and its duration was 70 minutes; the patient's body weight was 54 kg, therefore, 3.92 cm^3/kg of the same CM (Visipaque 320) was used. The immediate postembolization CT scan showed strong cortical hyperintensity on the right frontoparietal lobe, and high density in the right striatum (Fig. 2C, D). The CT scan was typically suggestive of CM induced BBB disruption, which seemed more serious than case 1. Despite she was neurologically stable without headache at the time, she was carefully monitored considering the CT findings. As expected, this patient also deteriorated neurologically to GCS 13 with left hemiparesis (4/5) at 6 hours from coiling. The neurologic deterioration peaked at GCS 8 with left hemiparesis (2/5) at approximately 24 hours after coiling. DWI in MRI showed within normal limit. With conservative care including lowering of the patient's systolic BP was continued and the patient showed neurological improvement at three days after coiling.

DISCUSSION

Abnormal contrast enhancement on brain CT scan following diagnostic and interventional angiography is not rare, and transient disruption of BBB has

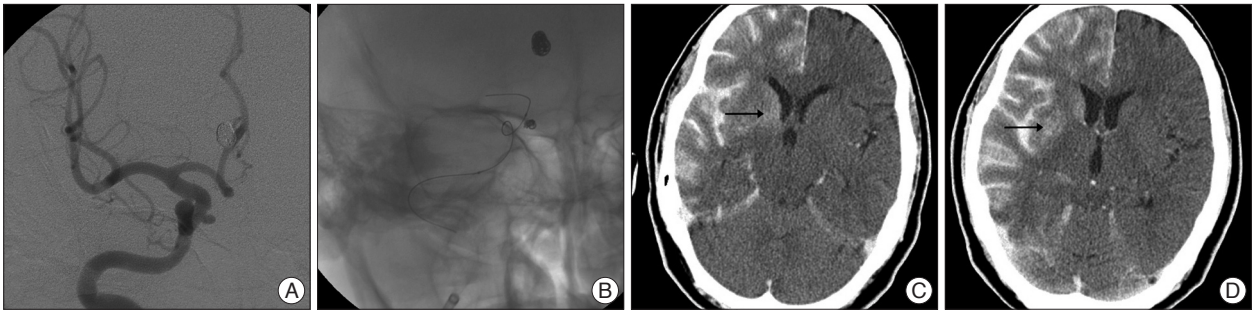

Fig. 2. A and B : Procedural angiographic images in case 2. C and D : Immediate post-embolization non-contrast CT scan showing strong cortical hyperintensity of the right frontoparietal lobe and high density in the right striatum (arrow). CT : computed tomography.

been the main explanation for the situation[2,4,5,7,8,10]. Various factors can induce temporary BBB disruption, including CM, balloon inflation during remodeling technique, advanced age, and hypertension[8]. Among these, iodinated CM has been regarded as the most constant and important factor influencing BBB permeability[4,9]. The CM used in these patients are Visipaque; dimeric, isosmolar, nonionic, water-soluble, radiographic CM and reported to be relatively safe and low side effect[1]. Besides, there have been several reports of BBB disruptioin from Iohexol (Omnipaque 300; Amersham Health, Cork, Ireland), Iopromide (Ultravist; Schering AG, Berlin, Germany), Ioversol (Optiray; Mallinckrodt Medical, St. Louis, USA), Iopamidol (Isovue 370; Bracco Diagnotics, Princeton, USA), and Iodixanol (Visipaque 320)[2,5-7,9]. However, in those reports, the mechanism of CM induced BBB disruption was not focused on the kind of CM, but the osmolarity, chemical structure, and speed of injection of CM[8]. Furthermore, it has been mostly reported as clinically subtle, even symptomatic, the cases are not considered to be serious no more than transient global amnesia, cortical blindness, and seizure[4,5]. However, this study presented two cases of life-threatening BBB disruption which could have been originated by the CM, particularly after coiling of unruptured intracranial aneurysm. To our knowledge, this is the first report of CM induced, serious BBB disruption after coiling of unruptured cerebral aneurysm.

Since January 2006, we have performed immediate post-embolization CT scan for early detection of procedural complications including BBB disruption. Based on our experiences, immediate postembolization CT scan played a role in detection of CM induced BBB disruption. In case 1, differential diagnosis of the patient's neurologic deterioration was difficult among several possible causative clues, including abnormal enhancement on postembolization CT scan, multiple microinfarctions on DWI, and diffuse narrowing of cortical branches of the MCA on follow-up DSA. On the contrary, in case 2, even though the patient was neurologically stable after coiling, we could predict the patient's deterioration based on immediate postembolization CT findings, which showed strong cortical hyperintensity on the right frontoparietal lobe and high density in the right striatum. Without immediate postembolization CT scan, we could not obtain the most important evidence for diagnosis of BBB disruption. According to previous report, iodine contents in cerebrospinal fluid showed rapid decrease to near zero within two days[7]. Both patients in this study showed either weak or no contrast enhancement on next morning CT scans, which were performed at 15 hours and 17 hours after coiling.

CONCLUSION

This study presents two cases of serious BBB disruption, which supposed to be caused by CM, particularly after coiling of unruptured intracranial aneurysm. Based on these cases, CM induced BBB disruption could be a possible cause of a patient's neurologic deterioration during the acute period after coil embolization. In addition, immediate postembolization CT scan may play a role in terms of early detection of CM induced BBB disruption.

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