The varied clinical and radiological manifestations of contrast-induced encephalopathy following coronary angiography

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ABSTRACT

Contrast-induced encephalopathy (CIE) is a rare complication of imaging using ionidated contrast media. Its pathogenesis remains unknown, and its clinical presentation is variable. We present two cases of CIE following coronary angiography (CAG) that underscore the multitude of clinical manifestations and imaging findings associated with the disorder. In patients 1, CIE manifested during the CAG with agitation and decreased consciousness, followed by left hemiparesis and visual neglect. Native computed tomography (CT) of the head was unremarkable but CT perfusion (CTP) showed extensive hypoperfusion of the right hemisphere with corresponding slow-wave activity in the electroencephalogram (EEG). These findings were more pronounced the next day. Magnetic Resonance Imaging (MRI) revealed multiple small dot-like ischemic lesions across the brain. By day six she had fully recovered. Patient 2 developed transient expressive aphasia during the CAG followed by migraineous symptoms. Native head CT showed a large area of parenchymal edema, sulcal effacement and variable subarachnoid hyperdensity in the right hemisphere. He developed mild left side hemiparesis, spontaneous gaze deviation and inattention. Brain MRI showed small dot-like acute ischemic lesions across the brain. The next morning, he had a generalized tonic-clonic seizure (GTCS) after which native head CT was normal, but the EEG showed a post-ictal finding covering the right hemisphere. His hemiparesis resolved within two months. The diversity in clinical and radiographic presentations suggest that CIE involve many pathophysiological processes.

KEY WORDS: Contrast-induced encephalopathy, coronary angiography, neurotoxicity

Iodinated contrast media (CM) are necessary for visualization during angiographic procedures. Although chemical refinement has decreased their toxicity, adverse reactions still occur with the brain being the second most often affected organ [1]. Their exact pathophysiological mechanism remains unknown but high osmolarity has been suggested to be important, although other intrinsic properties of contrast agents also seem to contribute [1]. Indeed, ionic, non-ionic, low-osmolarity, iso-osmolar and high osmolarity contrast media can induce contrast-induced encephalopathy [2].

Clinical presentations of CIE following coronary angiography (CAG) vary widely. Cortical blindness is the most common CIE manifestation following CAG (in 58% of reported cases) [1]. Possible clinical manifestations also include altered mental status (24%), limb paralysis or weakness (7%), headache (7%), seizures (5%), spinal myoclonus (1%) and coma (1%) [1]. Symptoms typically occur within six hours after CM administration in CAG although a delay of even over a week has been reported [1]. Typically, CIE has a good prognosis even though some cases with persistent deficits and even death have been reported. Management is supportive, but anticonvulsive drugs, mannitol and steroid hormones can be used if necessary [2].

The presentation of contrast-induced encephalopathy following coronary angiography is varied, as illustrated by these cases. Interestingly, CIE occurred already during the CAG in both our patients which appears to be very unusual and neither developed cortical blindness. There are also electroencephalogram (EEG) and computed tomography (CT) perfusion data included which is infrequent.

CASE PRESENTATIONS

Patient 1 was an 85-year-old woman with hypertension, insulin-treated type 2 diabetes (but normal renal function) and atrial fibrillation. She had suffered shortness of breath for the last 6 months. An elective CAG, during which she was given enoxaparin 3000 IU intravenously and 120 ml of iodinated CM Iomeron (350mg iodine/ml), revealed notable coronary artery plaque disease.

During the procedure she became agitated, and her level of consciousness decreased. Stroke was suspected and she was transferred to the emergency room where her blood pressure was 202/100 and heart rate 77 with normal serum glucose. Neurological examination revealed left hemiparesis, left visual neglect and gaze preference to the right yielding a National Institutes of Health Stroke scale (NIHSS) score of 14.

Non-contrast CT of the brain showed extensive hyperdensity and cortical enhancement of the right hemisphere (Fig. 1a). Dual energy CT revealed no intracranial hemorrhage and CT angiography (CTA) was unremarkable save for minor narrowing in small arteries of the right hemisphere, judged mild and equivocal (Fig. 1b). On CT perfusion (CTP) there was extensive hypoperfusion of the right hemisphere on Time to Drain (TTD) map and milder hypoperfusion on Mean Transit Time (MTT), Cerebral blood flow (CBF) and Cerebral blood volume (CBV) maps (Fig. 1c). An EEG was performed 3.5 hours after the CT scan, showing slow-wave activity in the right hemisphere without epileptiform discharges.

She was transferred to the neurology ward and became confused and slightly agitated. She was treated conservatively with intravenous fluids. On the next day her EEG findings remained unchanged but hypoperfusion of the right hemisphere on CTP had deepened. The neurologic examination revealed confusion, left hemiparesis, left sensory and visual neglect. Magnetic Resonance Imaging (MRI) of the brain was performed four days after CAG, revealing multiple small (2-3mm) dot-like ischemic lesions in both parietal lobes, in the right frontal lobe, in both occipital lobes and in the right cerebellum (Fig. 1d). MR angiogram was normal. She gradually recovered, and her neurological signs and symptoms had completely resolved by day six.

Patient 2 was a male in his sixties with a history of hypertension, hypercholesterolemia and type 2 diabetes. He was admitted because of dyspnea with elevated serum troponin and given enoxaparin 8000 IU x 2 s.c. on admission. The next day, a diagnostic CAG showed no significant stenoses. Perioperatively he received enoxaparin 8000 IU, acetylsalicylic acid 100 mg and a total of 220 ml of iodinated contrast agent Iomeron (350mg iodine/ml). During the procedure he developed expressive aphasia that resolved within minutes. He also developed a positive visual aura on the right visual field and headache, similar to his previous occasional migraines. Head CT approximately 2.5 hours after the CAG showed a large area of parenchymal edema, sulcal effacement and variable subarachnoid hyperdensity in the right hemisphere (Fig. 1e-g). CTA of head and neck were unremarkable.

Clinical examination after the CT revealed mild left side hemiparesis, spontaneous gaze deviation slightly to the right but no gaze paresis. Later that day the patient also developed left side inattention. Brain MRI (without CM) was done six hours after the CT and showed small dot-like acute ischemic lesions on the right frontal cortex and in deep white matter and on the left parietal cortex but no edema. MR angiogram was normal.

The next morning, he had a generalized tonic-clonic seizure (GTCS). A new non-contrast head CT was normal. EEG showed a post-ictal finding covering the right hemisphere. Clinical examination revealed no gaze deviation or neglect but there was left hemiparesis that resolved within 2 months. Atrial fibrillation was subsequently detected.

DISCUSSION

CIE is a rare stroke mimic associated with CAG and neurological endovascular procedures [1, 3-5], and a variable presentation: the current case 1 mimicked a right middle cerebral artery syndrome while case 2 had more diverse symptoms including a GTCS. Interestingly, neither

developed cortical blindness which is the most common CIE manifestation following CAG [1]. Our patients also appear to be quite unusual in that CIE developed already during CAG in both [1].

Male gender, hypertension, diabetes mellitus, impaired renal function, impaired cerebral autoregulation and transient ischemic attack are known risk factors for CIE [2]. Ionic, non-ionic, low-osmolarity, iso-osmolar and high osmolarity CM can induce CIE [2]. While toxicity potential is dose-dependent, CIE has also been associated with low CM volumes [2]. Indeed, CIE may be an idiosyncratic reaction [5]. The exact pathophysiological mechanism remains unknown, but arterial vasospasm, disruption of microcirculation and CM epileptogenicity have been suggested [1, 4, 6]. These suggestions also fit the clinical and imaging findings of our cases.

Although brain imaging can be normal [1], typical CT imaging findings in CAG-associated CIE include abnormal cortical and subcortical contrast enhancement, enhanced cerebral sulci, cerebral oedema, focal hyperdense lesions and subarachnoid contrast enhancement [3]. Both our patients had some of these typical findings. On MRI, increased T2 and flair signal changes with facilitated diffusion and punctate foci of restricted diffusion without T2 signal change are associated CIE [4], although seldom in CIE following CAG [1,3]. Both our patients had these lesions.

There are few previous reports concerning CTP findings in CIE. Although resembling the current case 1, the previously reported CIE case with aberrant CTP findings occurred after a cerebral angiogram, not a CAG [4]. Unfortunately, no EEG data were reported [4]. The previously reported case with normal CTP had undergone CAG followed by CIE milder than that in our case 1 but with similar EEG findings [7]. These diverging electrophysiological and imaging findings suggest that CIE may be associated with several mechanisms.

In conclusion, CIE is a rare complication of angiographic procedures. Both its presentation and findings are diverse, possibly reflecting varied underlying pathophysiological processes.

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FIGURE LEGENDS

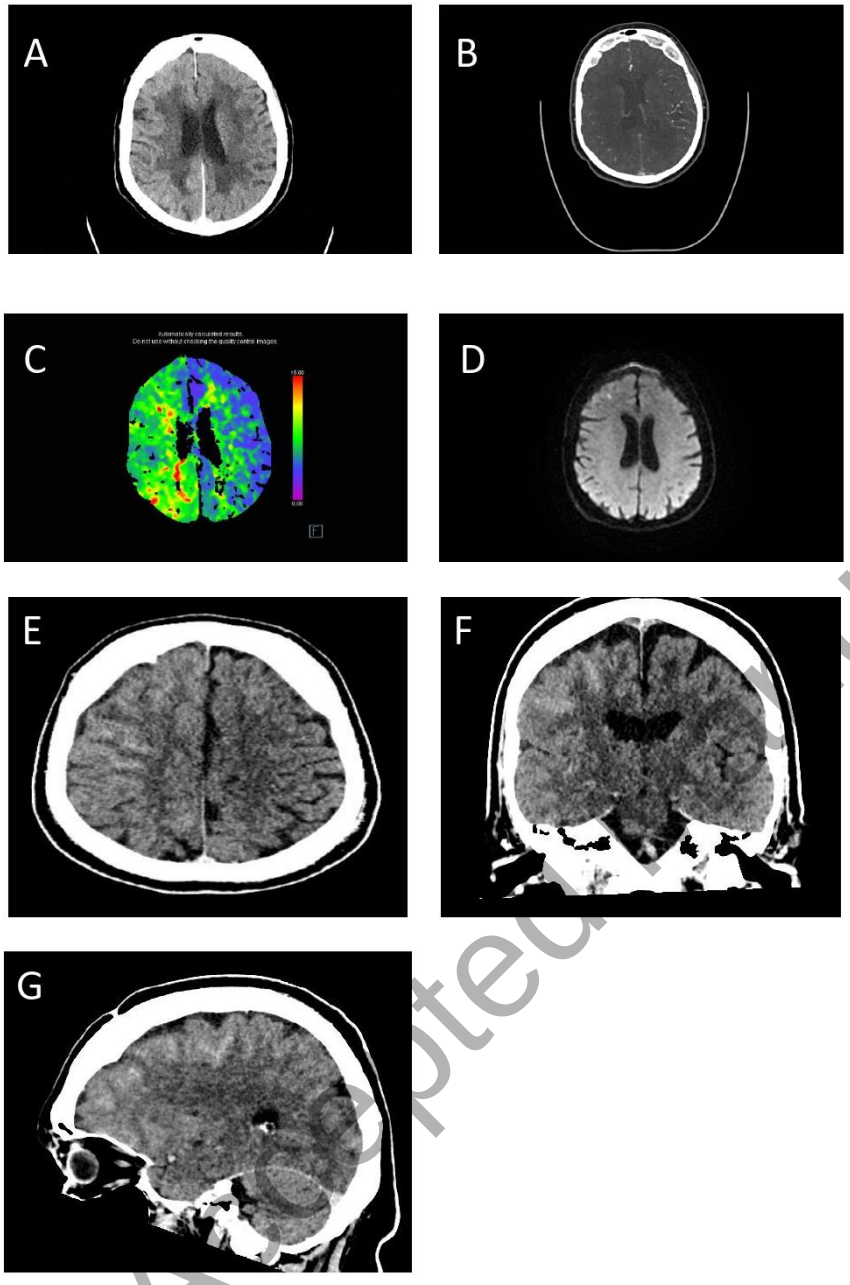

Figure 1.

Fig. 1a: Non-contrast computed tomography of the brain showed extensive hyperdensity and cortical enhancement of the right hemisphere.

Fig.1b: CT angiography showed minor narrowing in small arteries of the right hemisphere.

Fig 1c: Hypoperfusion of the right hemisphere on Time to Drain (TTD) map.

Fig. 1d: MRI of the brain revealed multiple small dot-like ischemic lesions in both parietal lobes, in the right frontal lobe, in both occipital lobes and in the right cerebellum.

Fig. 1e-g: Head CT showed a large area of parenchymal edema, sulcal effacement and variable subarachnoid hyperdensity in the right hemisphere.