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Case Report

Rare Cases of Contrast-Induced Encephalopathies

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Abstract

Cortical blindness (CB) due to contrast-induced encephalopathy is a rare complication in endovascular procedure. Although exact mechanism is not known, disruption of blood–brain barrier (BBB) by contrast agent is supposed to be caused. We report two cases of contrast-induced encephalopathies after coil embolization of unruptured aneurysm. A 68-year-old woman with unruptured basilar artery aneurysm was treated with endovascular stent-assisted coil embolization. The procedure was successfully accomplished within 172 min using about 160 ml of contrast medium (iopamidol). However, she manifested with CB 3 h after the procedure and seizure on the next day. Immediate computed tomography revealed the cortical enhancement in both occipital lobes. Diffusion-weighted imaging–magnetic resonance imaging and fluid-attenuated inversion recovery sequence 1 day after the procedure revealed edema in both occipital lobes with no findings of ischemia or hyperperfusion. Electroencephalography showed sharp and slow waves in both occipital lobes. She required endotracheal intubation on day 2 to maintain airways and breathing. Her sensorium improved 4 days after the procedure with administration of steroid and anticonvulsant. She was extubated on day 4 after the procedure. She was discharged with persisting CB as a sequel.

Keywords: *Cerebral angiogram, computed tomography angiogram, contrast-induced encephalopathy, cortical blindness*

Introduction

Contrast-induced encephalopathy (CIE) is a rare complication of endovascular interventions. The presentations may include cortical blindness (CB), hemiparesis, seizure, and coma. In most reported cases, the symptoms are self-limiting but may become fatal.[1] Here, we document a case of permanent CB in CIE after digital subtraction angiography for aneurysmal coiling using iopamidol, which is a type of nonionic monomer low-osmolar contrast agent. Another case of CIE became fatal.

Case Reports

Case report 1

A 68-year-old woman presented to us with unruptured basilar artery aneurysm. She had undergone clipping of internal carotid artery (ICA) aneurysm 8 years back. The size of basilar artery to aneurysm was 5 mm 8 years back. The patient was on regular clinical and radiological follow-up with us. Recent imaging showed an increase in size of aneurysm from 5 to 8 mm. Therefore, coiling of basilar top aneurysm was planned. On admission, her neurological examination was normal. Her medical history included hypertension on medical management.

Cerebral angiogram revealed an 8-mm size unruptured basilar top aneurysm [Figure 1a]. She underwent endovascular procedure with contrast iodinated agent for basilar tip aneurysm. She received 260 ml of iopamidol for angiogram and stent-assisted coiling. The procedural time was 172 min. (We used 6-Fr guiding catheter, 4.2-Fr microcatheter, and target 360 coil.) The procedure was uneventful. The neurological examination was normal at the end of the procedure.

The cerebral angiogram showed complete obliteration of basilar tip aneurysmal sac with no coil migration [Figure 1b].

The patient complained of decreased vision in both eyes 3 h after the procedure. Computed tomography (CT) brain [Figure 2] was performed which showed subarachnoid contrast enhancement in bilateral occipital lobe sulci with loss of gray-white differentiation and sulcal effacement.

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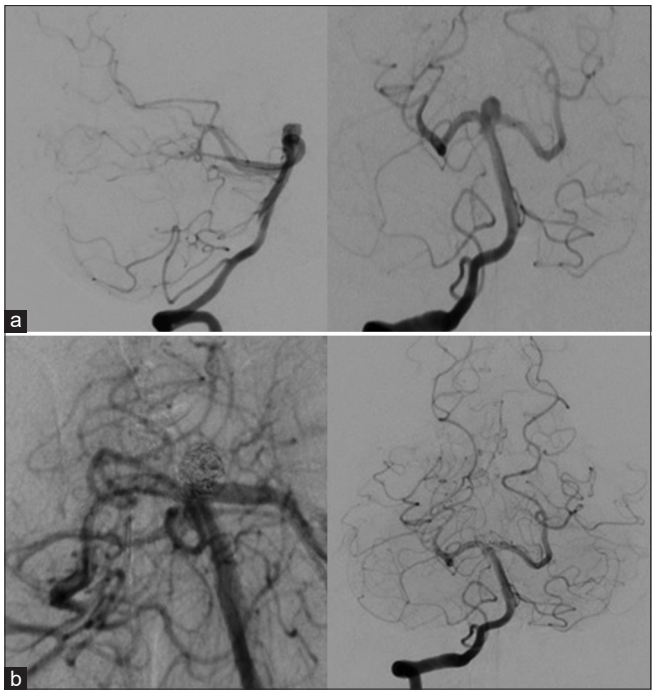

Figure 1: (a) Cerebral angiogram showing basilar tip aneurysm before coiling. (b) Cerebral angiogram showing obliteration of basilar tip aneurysm after coiling

There was no intracerebral hemorrhage. She was treated with aspirin 100 mg/day, clopidogrel 75 mg/day, and argatroban.

On postprocedure day 1, she developed generalized convulsions. She was treated with levetiracetam 1 g/day, phenobarbital 750 mg/day, and methylprednisolone 500 mg/day to control seizure. Magnetic resonance imaging (MRI) brain and electroencephalogram (EEG) were performed.

EEG showed slow and sharp waves in bilateral occipital lobes [Figure 3].

MRI showed hyperintensities in fluid-attenuated inversion recovery sequence. There was no restriction in diffusion-weighted imaging (DWI) sequence of MRI brain [Figure 4].

CT brain done after 48 h showed resolution of contrast enhancement [Figure 5].

The patient became drowsy on postprocedure day 2 and hence intubated. Her sensorium gradually improved on day 4, and subsequently, she was extubated. Her sensorium completely improved on day 6 after the procedure. There were no further seizure episodes. CT brain done on day 5 [Figure 6] showed no bleed or infarct with persistence of hypodensities in both occipital lobes.

She was discharged from hospital with persisting CB on the 7th postprocedural day.

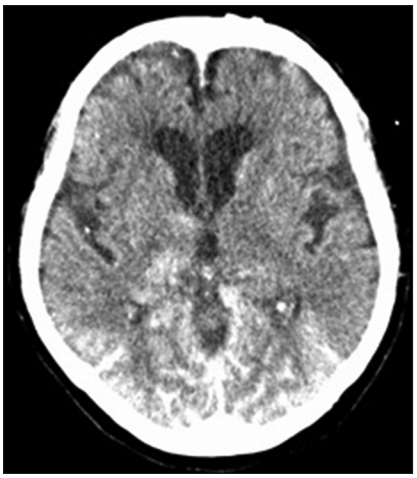

Figure 2: Computed tomography brain after the procedure

Case report 2

Here, we discuss a 62-year-old woman with no comorbidities presented to our hospital with unruptured right cavernous ICA aneurysm. Coiling of the right cavernous aneurysm was planned after cerebral angiogram findings [Figure 7].

Stent-assisted coiling was performed for cavernous ICA aneurysm. Coil migration was noted into the distal ICA during the procedure. Migrated coil was extracted with stent retrieval device [Figure 8].

Stent-assisted coiling was performed. The figure shows obliteration of aneurysmal sac by coils, and luminal patency of ICA is maintained by the stent at the end of the procedure.

Her neurological examination was normal at the end of the procedure (Glasgow Coma Scale [GCS]-15).

A CT scan [Figure 9] was performed at the end of coiling, which showed blood and contrast extravasation in the right frontoparietal area. Her GCS was 15 without any neurological deficits.

She developed left hemiparesis and became drowsy 3 h after the procedure. Her right pupil was dilated. A CT scan brain [Figure 10] showed a redistribution of sulcal hyperdensities in both hemispheres (right > left).

Her sensorium deteriorated rapidly 14 h after the procedure. GCS was 4. CT brain [Figure 11] showed hydrocephalus. She was intubated to maintain airway and electively ventilated. An external ventricular drainage was inserted for hydrocephalus [Figure 12].

CT scan brain on day 2 [Figure 13] and day 3 [Figure 14] showed persistent hyperdensities with severe edema and mass effect. The patient was treated with anticonvulsants, steroids, and anti-edema measures. The patient died 3 days after the procedure.

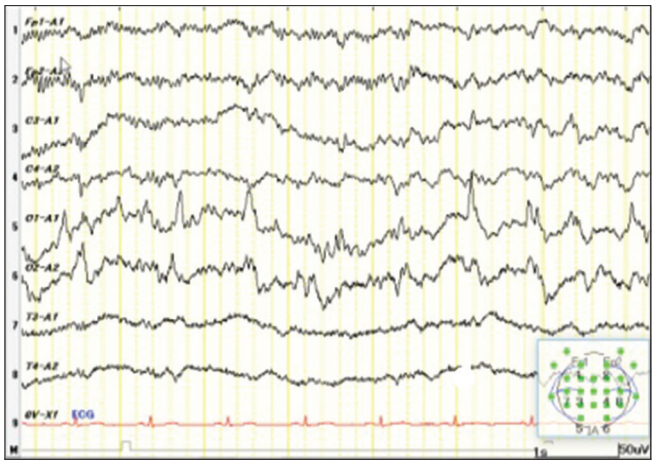

Figure 3: EEG showing sharp and slow waves in bilateral occipital lobes

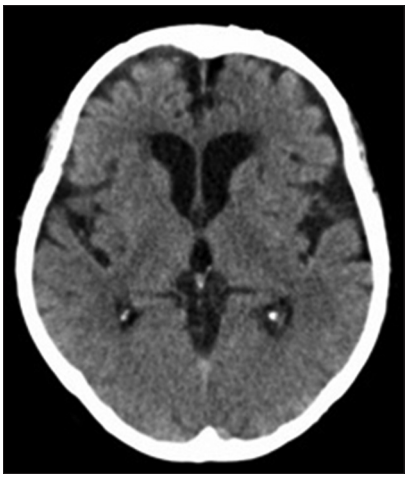

Figure 5: Computed tomography brain after 48 h

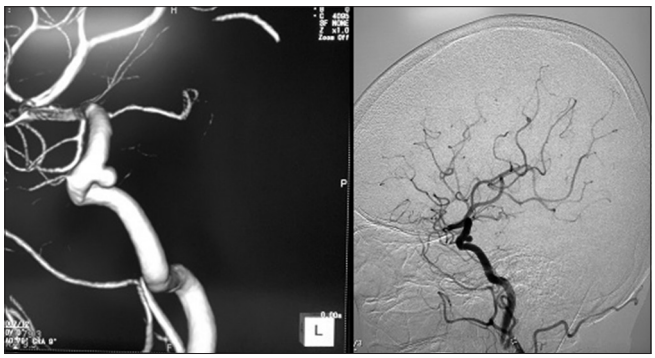

Figure 7: Angiogram showing right cavernous internal carotid artery aneurysm

Discussion

We reviewed literature on CIE by 16 authors comprising 27 cases (including 2 from our series) [Table 1].

CIE affected all age groups. The youngest reported in the study was 17 years old and the eldest was 82 years old. Both sexes were affected (male: 10, female: 1). Females were more involved than male population.

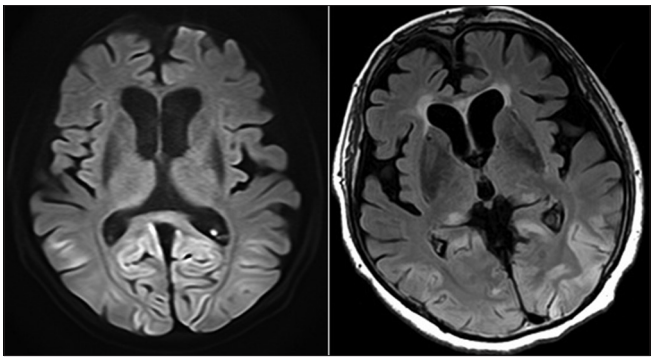

Figure 4: Magnetic resonance imaging brain on day 2

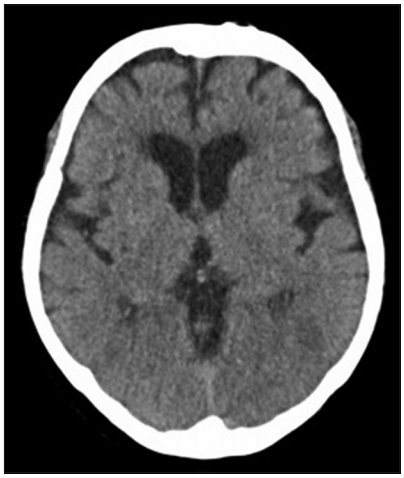

Figure 6: Computed tomography brain on postoperative day 5

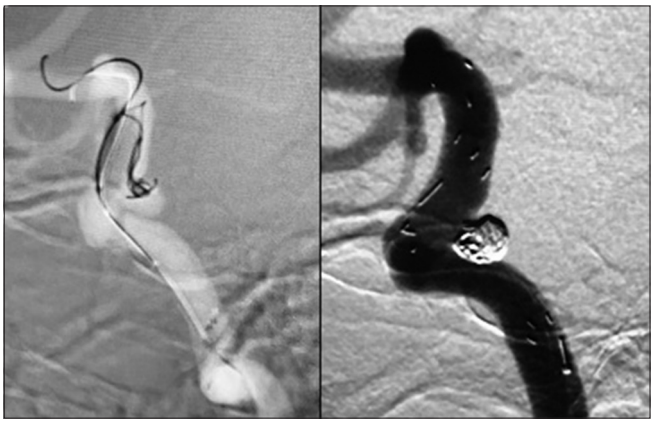

Figure 8: Angiogram showing coil migration

Most of the symptoms were noticed within few 12 h after the procedure. Three patients had symptoms during intervention, 9 occurred immediately after completion of intervention, 5 happened within 1 h of intervention, 3 occurred within 3 h of intervention, and 6 occurred within 6–12 h after intervention.

CB, altered sensorium, and hemiparesis were the most common neurological findings noticed after CIE [Table 2].

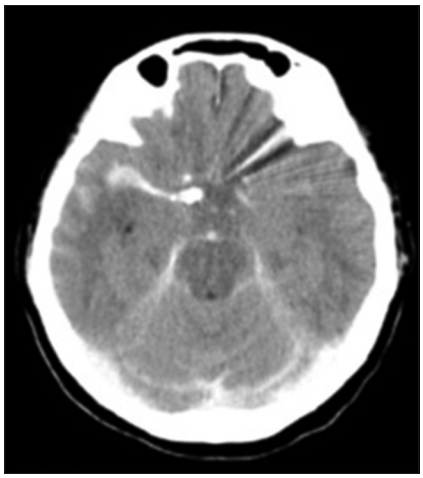

Figure 9: Computed tomography at the end of the procedure

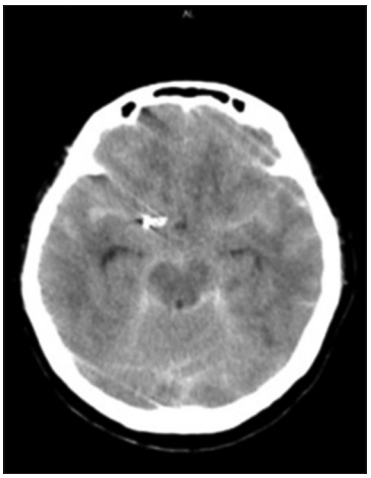

Figure 10: Computed tomography brain 3 h after the procedure

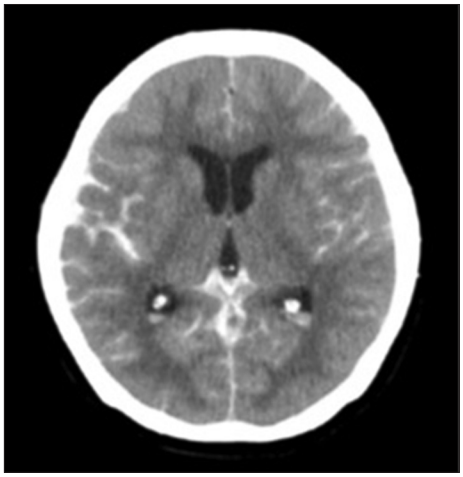

Figure 11: Computed tomography brain 14 h after the procedure

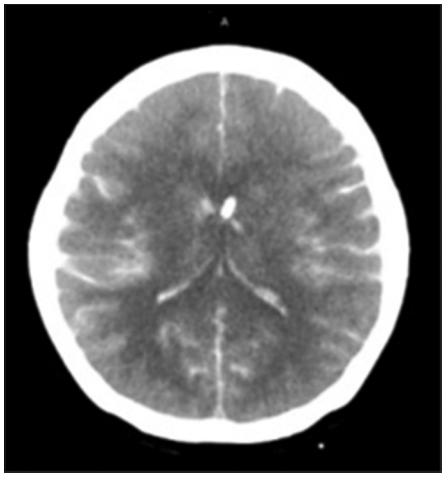

Figure 12: External ventricular drain for hydrocephalus

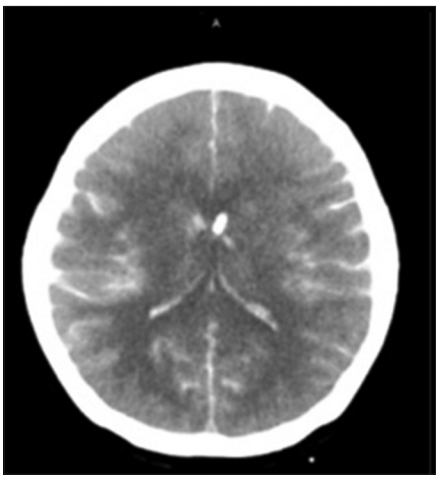

Figure 13: Computed tomography brain on day 2 after the procedure

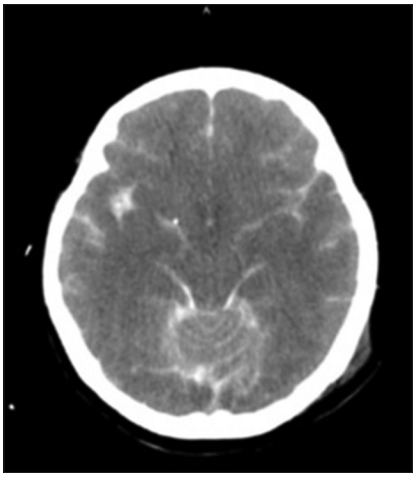

Figure 14: Computed tomography brain 3 days after the procedure

Cortical blindness

The incidence of CB was 1% with contrast cerebral angiography.[16] CB is characterized by partial or complete loss of perceived vision, normal fundi, normal pupillary reflexes, and unaltered extraocular movements. The onset of CB occurs from minutes up to 12 h after angiography. In most of the cases, blindness resolved, but in our case, CB persisted.

We reviewed these patients for the region of the brain involved. The literature showed an affinity of the occipital lobe in CIE [Table 3].

Table 1: Review of literature

Study detail	Age	Sex	Diagnosis	Symptoms after DAS	Time for onset of symptoms	Region involved in brain	Time for radiological resolution	Time for clinical resolution	Contrast agent	Dose of contrast	Recovery complete
Zhao *et al*.[1]	71	Female	ICA and MCA stenosis	coma	At completion				Iopamidol	110 ml	Died after 56 days
Current report	68	Female	Aneurysm coiling	Blindness	3 h	Bilateral occipital			Iopamidol	110 ml	Persisting blindness
	62	Female	Coiling of cavernous ICA	Left hemiparesis, altered sensorium	3 h	Bihemispheric (right more than left)	No	No	iopamidol	120 ml	Died after 2 days
Potsi *et al*., 2012[2]	71	Female	Carotid artery stenosis	Left hemiparesis, altered sensorium	During intervention	Right cerebral hemispheric sulci	1	4	Iopromide	25 ml	
Haussen *et al*., 2013[3]	89	Female	Diagnostic angiogram to rule out aneurysm	Left hemianopia, left hemisensory loss	6 hours after	Right occipital and parietal	1	1.5	Ionic contrast	18 cc	Yes
Guimaraens *et al*., 2010[4]	51	Male	Stent for aneurysm	Disorientation, left hemiparesis, visual disturbances	30 m	Right cerebral sulci	2	5	Iopromide nonionic	30 ml	
Roccatagliata *et al*., 2009[5]	65	Male	Tinnitus	Blindness, altered sensorium	During intervention	Bilateral occipital	48	1 year	Iohexol	Not available	Yes
Till *et al*., 2009[6]	17	Male	Feeders in hemangioblastoma	Blindness	During intervention	Bilateral occipital, right thalamus, cerebellum	5	2 m	Iopromide	44 ml	
Niimi *et al*., 2008[7]	41	Male	Aneurysm coiling	Blindness	3 h	Right parietal	1 m	Not available	Iopromide	297 ml	Left homonymous hemianopia
	46	Male	Aneurysm coiling	Right homonymous hemianopia	1 h	No abnormality	1 m	Not available	Iopromide	225	
	54	Female	Aneurysm coiling	Blindness	3 h	Bilateral occipital	1 m	1m	Iopromide	62 ml	
	47	Female	Aneurysm coiling	Right homonymous hemianopia, altered sensorium	1	Bilateral occipital	7	Not available	Iopromide	384 ml	
Shinoda *et al*., 2004[8]	62	Female	Aneurysm coiling VA-PICA	Blindness altered sensorium	During intervention	Bilateral occipital, left frontal, temporal	21	17	Ioversol	150 ml	Persistent left lower quadrantanopia
Saigal *et al*., 2004[9]	45	Female	SCA aneurysm	Blindness	12h	Bilateral occipital	16	Not available			
	74	Female	Investigating aneurysm basilar and carotid stenosis	Blindness altered sensorium	1h	Left parietal occipital	2	Not available	Iohexol nonionic	Not available	
	73	Female	Investigating aneurysm	Blindness altered sensorium	20 m	Bilateral occipital	5	Not available			

Contd...

Table 1:Contd...

Study detail	Age	Sex	Diagnosis	Symptoms after DAS	Time for onset of symptoms	Region involved in brain	Time for radiological resolution	Time for clinical resolution	Contrast agent	Dose of contrast	Recovery complete
Lantos 1989[10]	49	Female		Blindness, nystagmus	During intervention	Right occipital, pons, both thalamus, midbrain	16 h	18 h	Diatrizoate meglumine (ionic)	30	
	64	Male	Dizziness	Blindness, altered sensorium	During intervention	Left parietal occipital	3	18 h	Iothalamate meglumine (ionic)	12	
	71	Male	Carotid artery atherosclerosis	Blindness altered sensorium	20 m	Bilateral occipital	10	Not available	Iohexol	38	
	68	Female	Investigating aneurysm	Blindness altered sensorium	Immediately after completion	Bilateral occipital	6	Few hours	Iohexol	24	
Leong and Fanning 2012[11]	51	Female	Aneurysm coiling	Right hemiparesis, hemisensory loss, hemineglect	Immediately after completion	Left frontoparietal	12 months	Gliosis	Iopromide	220ml	Persistent right limb spasticity, modified Rankin 2
Dangas *et al.*, 2001[12]	82	Male	Carotid artery stent	Left hemiparesis	Immediately	Right frontoparietal	2	2	Ioxaglate	50 ml	
Hsiu-Yu *et al.*[13]	80	Male	Carotid artery stent	Right hemiparesis	Immediately	Left frontoparietal	2	4	Iohexol	250 ml	
Numaguchi *et al.*, 1984[14]	53	Female	Investigating meningioma feeders	Left partial motor seizure	Immediately	Right temporofrontal	1	14	Diatrizoate meglumine	60 ml	
Kubota *et al.*[15]	66	Female	Left paraclinoid aneurysm coiling	Right hemiparesis, aphasia, altered sensorium, seizures	Immediately	Left temporoparietal	4	12m	Iomeprol	80 ml	Yes
T. Kawasaki *et al.*	75	Male	Right ICA aneurysm coiling	Left hemiparesis	Immediately	Right frontoparietal	1		?		
	65	Female	Left ICA aneurysm coiling	Right hemiparesis	Immediately	Left frontoparietal	1		?		

ICA – Internal carotid artery; MCA – middle cerebral artery; VA-PICA – Vertebral artery- Posterior inferior cerebellar artery; SCA – Superior cerebellar artery

Table 2: Clinical features

Symptoms	Number of patients (%)
CB	12 (46)
Hemiparesis	9 (33)
Altered sensorium	10 (38)
Visual deficit	4 (15)
Partial motor seizure	2 (7.6)

CB – Cortical blindness

Table 3: Regions of brain involved

Region	Number of patients (%)
Frontal	7 (26)
Parietal	8 (30)
Temporal	3 (11)
Occipital	12 (45)
Brainstem	2 (7.4)
Diffuse	1 (3.7)

Why occipital lobe and visual cortex?

BBB (blood brain barrier) is incomplete in the posterior cerebral circulation, hence, occipital lobes and visual cortex are more susceptible locations for contrast induced encephalopathies.[16,17]

Niimi *et al*.[7] reported four cases of CB due to endovascular procedure. They performed 137 intra-arterial treatment procedures for posterior circulation aneurysms & identified cortical blindness as complication in 4 patients. During the same time period, they treated 500 anterior cerebral circulation aneurysms without this complication.[7]

They identified four patients with cerebral vision loss complications. During the same time period, 500 aneurysms of the anterior cerebral circulation were treated without this complication. In his series, the visual field loss was unilateral in two and bilateral in two patients. Recovery was complete in three patients and almost normal in the fourth patient. The amount of contrast used and the duration of the procedure were similar among all patients. The four patients had no identified specific risk factors for developing procedure-associated occipital dysfunction.

In most of the cases, symptoms were self-resolving and less fatal. The time for radiological recovery ranged from 1 day to 12 months

Review of radiology findings in contrast-induced encephalopathy

The clinical features of CIE resemble neurological deficit due to embolism and hemorrhagic complications following angiography or endovascular interventions. Typical radiological findings include abnormal cortical contrast enhancement and edema, subarachnoid contrast enhancement, and striatal contrast enhancement – if the CT is performed soon after presentation. The enhancement resolves by 25 h in most of the cases. The diagnosis of contrast encephalopathy is, therefore, made by finding typical CT findings.[11]

The possible risk factors for contrast encephalopathy include hypertension and renal failure.[9] Roccatagliata *et al*.,[5] in their patients, obtained DWI sequence of MRI brain 3.5 h after symptom onset. It did not demonstrate any signal abnormality, thereby ruling out the presence of ischemic brain tissue within a time window useful for acute stroke management with thrombolysis. The complete absence of signal abnormality on initial DWI and a normal follow-up CT makes an embolic mechanism highly unlikely in our patient even if cases of falsely negative DWI studies have been reported.

Review of pathophysiology of contrast-induced encephalopathy

The mechanism of CIE is controversial. The disruption of the BBB after injection of the iodinated contrast agent is considered for this pathology.

Hyperosmolar contrast solutions cause water to diffuse out of the endothelial cells causing them to dehydrate and shrink in size. This decrease in size results in an opening of the tight junctions between the endothelial cells of the BBB allowing the iodinated materials to move into the neuronal tissues.[18] Thus, under the conditions of intravenous injection, contrast media with lower osmolality should possess fewer neurotoxic effects.

The neurotoxicity of contrast medium appears inversely related to the hydrophilicity of the agent. Wible *et al*.[19] performed animal experiments on a rat with ionic and nonionic contrast agents. They injected the contrast agent into cerebral cisterns of rat. Rats were monitored for seizures, dyspnea, blindness, and death. They reported that IOPROMIDE is lethal at small doses compared to other nonionic contrast material.

Iopromide is the most common contrast agent associated with this condition. 10 out of 26 were associated with this contrast (38%). All types of iodinated contrast agents can induce the development of neurotoxicity. Iopromide is a nonionic monomer low-osmolar contrast agent, which has been reported in cases of reversible CIE.[20,21]

The volume of contrast ranged from 12 cc of ionic contrast to 384 cc of nonionic contrast.

The time for clinical recovery was 12 h to 12 months. One patient died after 56 days. The patient in our study died after 48 h. One patient had recovered from hemiparesis but had spasticity in limbs even after a year.

Zhao *et al*.[1] reported death of a 71-year-old woman after cerebral angiogram during evaluation of tinnitus. The patient went into coma during the procedure and died 56 days after the procedure.[1]

Literature analysis showed CB as a manifestation of CIE in 12 patients. All have bilateral occipital lobe involvements on CT brain scan. All patients had clinical and radiological resolution within in weeks after the procedure with conservative treatment. In our case, CB persisted even after radiological resolution. Therefore, CB due to contrast cerebral angiogram may not resolve in all cases (even after radiological resolution).

In our second case report, the patient died on the 3rd day after the procedure. Only one case fatality due to CIE was reported in the literature.[1]

This observation and a review of the literature highlight that CIE may not always have a benign outcome and can cause permanent deficits. This potential harmful effect should be recognized by the angiographer and the interventionist.[11]

Conclusion

Although contrast-induced CB is self-resolving and associated with benign outcomes in previous studies, we present a case of permanent CB after DSA using iopamidol for aneurysmal coiling in the posterior circulation. Another case of CIE was fatal. Unfortunately, there is no effective treatment currently available for such a severe CIE. Further studies are needed to prevent the occurrence of severe complications and effective treatment.

Declaration of patient consent

The authors certify that they have obtained all appropriate patients consent forms. In the form the patients have given their consent for images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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