

CASE REPORT

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Case report and literature review on contrast-induced encephalopathy

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Contrast-induced encephalopathy (CIE) is a rare neurological complication following the administration of injectable intravascular contrast media. Patients with CIE present a wide spectrum of symptoms such as headache, transient cortical blindness, seizure and focal neurological deficits. The diagnosis of CIE requires a high index of suspicion. Its early recognition is of paramount importance in instituting the appropriate supportive treatment in the form of intravenous fluids and also in avoiding unnecessary potentially harmful treatment such as intravenous thrombolysis for suspected ischemic stroke. Here, we report the case of a 62-year-old male patient with a typical presentation of CIE immediately following coronary angiography. We then continue to briefly review the relevant literature on CIE to date.

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Contrast-induced encephalopathy (CIE) is a rare condition that manifests with variable neurological symptoms and signs that occur secondary to the toxic effects of injectable intravascular contrast media. The manifestations are predominantly transient. It is mostly a benign phenomenon but causes significant symptoms that may mimic serious intracranial events such as intracranial hemorrhage and/or embolic events. The exact underlying mechanism is not well understood, however, disruption of the blood–brain barrier by the neurotoxic effect of contrast media has been postulated [1]. We present a case of a patient with a typical presentation of CIE.

Case

A 62-year-old male was electively admitted for coronary angiography due to a history of stable angina. He was known to previously have had percutaneous coronary angioplasty with a drug-eluting stent to the left circumflex artery following non-ST elevation myocardial infarction 6 months prior to presentation. Other background history included hypertension. He was a nonsmoker. At the time of admission, the patient was completely asymptomatic. He had been on dual antiplatelet therapy with aspirin 75 mg and clopidogrel 75 mg once-daily in addition to β -blockers, ACE inhibitors and statin therapy.

The patient had coronary angiography via the right radial artery using a 6-French sheath and 6-French catheters. The left coronary system showed mild coronary disease with a patent stent. The right coronary artery was very difficult to engage and therefore required different catheters to attempt and in process required more contrast (200 ml) than the usual dose for routine diagnostic coronary angiography (70–100 ml). The contrast medium used was Omnipaque 300 (Iohexol).

KEYWORDS

• cardiac catheterization
• contrast-induced encephalopathy • contrast neuropathy • coronary angiography • stroke

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Subsequently, the angiogram demonstrated only mild coronary disease and a patent pre-existing stent. A TR Band® was used for hemostasis.

Immediately following the procedure (in the recovery room), the patient complained of difficulty seeing objects on his right side. He had no headache, no limb weakness or speech difficulty. He did complain of tingling in the right arm. On clinical examination, blood pressure was 145/90 mmHg and heart rate was 90 bpm, regular and of good volume. Cardiovascular, respiratory and abdominal examinations were normal. Neurological examination showed right-sided homonymous hemianopia, otherwise normal tone, power, reflexes, sensations and gait in all four limbs.

An emergency CT brain scan was requested to rule out an intracranial bleed and the acute stroke pathway was activated with possibility of need for thrombolysis in mind. The CT scan demonstrated a slight enhancement of the venous sinuses and cerebral arteries, however, was otherwise normal (**Figure 1**).

Because there was no objective evidence to suggest an evolving stroke and based on a low National Institutes of Health Stroke Scale (NIHSS) score, thrombolysis was deferred but the patient was transferred to the stroke unit for further monitoring and observation. Based on the CT brain scan, the presumed diagnosis was contrast-related encephalopathy. The patient was only prescribed supportive therapy in the form of intravenous fluids (normal saline) in addition to his conventional secondary prevention therapy. The patient went on to have a brain MRI, which came back normal.

Within the following 48 h, symptoms improved remarkably to complete resolution and

the final diagnosis as supported by the consultant stroke physician was CIE. CIE is considered a diagnosis of exclusion after considering a full differential diagnosis.

Literature review

CIE is rare and offers an initial diagnostic challenge due its close resemblance to acute stroke, a dreaded complication of coronary angiography. A high index of suspicion is crucial for making the diagnosis of CIE and for prompt institution of appropriate supportive therapy to avoid unnecessary complications. Cases of CIE after coronary angiography have been recognized from as far back as 1970 [2]. Contrast-mediated investigation and intervention of carotid arteries, vertebral circulation and coiling of intracranial aneurysms seem to be more frequently associated with CIE, albeit rare as well [3–5]. From our review of the literature, we found that all cases of reported CIE were associated with intra-arterial administration of contrast media. No cases have been reported on intravenous injections of dyes. This supports the concept that localized accumulation of iodinated contrast media has a localized neurotoxic effect on the blood–brain barrier that results in cerebral edema and also a chemotoxic effect of hyperosmolar media. Plasma hyperosmolality subsequently results in microvascular sludging and arterial spasm [1].

The presentation of CIE is highly variable, ranging from subtle symptoms such as headache to more extreme features such as coma or unresponsiveness. In most cases, it presents within hours of the procedure, however, more insidious disease courses have been reported [6]. Reported features in the literature include cortical blindness, hemiparesis, aphasia, a reduction in

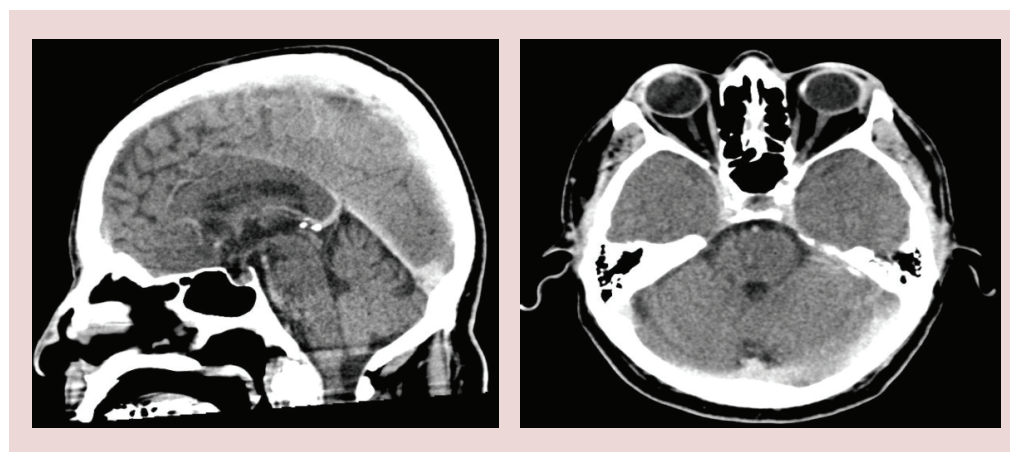


Figure 1. Patient CT scan depicting the sagittal (left) and axial (right) planes.

higher mental function such as agraphia, loss of coordination, confusion, seizures and coma [1–8]. In most reported cases, there was a noticeable correlation between symptomatology and radiological appearance on CT or MRI brain scans. Typically, symptoms resolve completely within days and the disease runs a benign course, however, there have been reports in the literature of cases with persistent neurological deficit [9–12] and even cases of fatal cerebral edema secondary to contrast injection [13,14]. Unsurprisingly, the mortalities were all related to the use of hyperosmolar contrast that clearly inflicts a more fulminant form of contrast-related complications and is therefore no longer used in practice.

As previously stated, the diagnosis of CIE requires a high index of suspicion. As a rule, all patients must have brain imaging in the form of CT scan or MRI primarily to rule out intracranial hemorrhage or thromboembolic events. CT imaging may show contrast enhancement in the cortical, subarachnoid or striatal spaces or cerebral edema [15]. Despite the wide spectrum of possible findings on CT imaging, high-intensity signals measuring 80–160 Hounsfield units have been described as pathognomonic of CIE, as opposed to ischemic or hemorrhagic pathology as a cause [1].

Given that stroke carries a detrimental effect on patients, careful neurological examination and meticulous monitoring are crucial. Most patients will be within the stroke thrombolysis window but this would not be the management of choice if symptoms are that of CIE rather than acute ischemic stroke. In fact, this will unnecessarily pose a significantly higher risk of hemorrhagic events. **Table 1** outlines the major differences between stroke and CIE.

It is difficult to predict the occurrence of CIE in patients who have not developed it before. Hypertension, impaired cerebral autoregulation, transient ischemic attack, impaired renal function and male gender seem to pose a higher risk for developing the condition [16–18]. The risk also proportionately rises with increasing amounts of contrast used [16]. There has been no defined amount of dye beyond which CIE is certain or more likely to occur.

The mainstay in the management of CIE is supportive treatment with intravenous hydration and anticonvulsants for control of seizures. There have been cases reporting the use of steroids [6] and mannitol [15] with favorable outcomes. In sporadic patients with renal insufficiency on dialysis who develop CIE, hemodialysis has proven beneficial [16]. A case report

Table 1. Table outlining the major differences between embolic/hemorrhagic injury (stroke) and chemotoxic injury of contrast-induced encephalopathy.

	Embolic/hemorrhagic injury	Chemotoxic injury
Symptoms	Limb weakness, headache, vertigo Sudden decrease in the level of consciousness	Headache, visual disturbance, coma or unresponsiveness, confusion, seizures, loss of coordination
Visual disturbance	Monocular or binocular visual loss Visual field defects, diplopia	Cortical blindness
Weakness	Hemiparesis, monoparesis or rarely quadriparesis Facial droop	Hemiparesis
Speech	Aphasia, dysarthria	Aphasia
Risk factors	HTN, DM, hypercholesterolemia, smoking, history of CAD, CABG or AF	HTN, male gender, TIA, impaired cerebral autoregulation and impaired renal function
Course	Less benign	Benign course
CT/MRI	Ischemic changes (artery occlusion) or hemorrhage	Cerebral edema Enhancement in the cortical, subarachnoid or striatal spaces
Management	Acute stroke management, for example, thrombolysis, conservative, interventional	Supportive treatment Anticonvulsants

AF: Atrial fibrillation; CABG: Coronary artery bypass graft; CAD: Coronary artery disease; DM: Diabetes mellitus; HTN: Hypertension; TIA: Transient ischemic attack.

by Pineda *et al.* [19] proposed craniotomy as a successful modality of treatment compared with conventional therapy in cases of severe cerebral edema to allow for expansion of brain parenchyma.

Although in the great majority of cases symptoms gradually resolve within days of onset, recovery may take a more prolonged course [6]. There have been cases of permanent residual deficits and this seems to be more likely among patients with ophthalmologic presentations [9,10]. Rarely, CIE may result in fatal cerebral edema as previously reported [15].

Spina *et al.* published an interesting review of 52 reported cases of CIE and this demonstrated the various presentations of this condition and showed that cortical blindness was, in fact, the most common presentation among the cases [20].

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Ethical conduct of research

The authors state that they have obtained appropriate institutional review board approval or have followed the principles outlined in the Declaration of Helsinki for all human or animal experimental investigations. In addition, for investigations involving human subjects, informed consent has been obtained from the participants involved.

EXECUTIVE SUMMARY

- With the growing use of vascular intervention as a diagnostic and a therapeutic means, complications are more likely to be encountered. Contrast-induced encephalopathy (CIE) is a rare complication of contrast-based procedures of arterial access.
- Recognition of this condition at an early stage is of paramount importance to exclude potentially more detrimental neurologic presentations and also to institute supportive treatment in the form of intravenous hydration at an early stage. Early recognition also prevents inappropriate administration of potentially harmful treatment such as thrombolysis.
- It is extremely important to have a high index of suspicion and be able to differentiate between the presentation of embolic and chemotoxic injury.
- Imaging in the form of CT or MRI scanning is essential to exclude ischemic or hemorrhagic events as a differential.
- Despite the good prognostic outcomes of CIE with only supportive therapy, close monitoring is important as a small entity of these patients may deteriorate to require high dependency level of care.
- Follow-up after discharge is important to assess for any residual neurological deficits. Predicting the occurrence of CIE is difficult but certain risk factors make it more likely. However, adhering to good practice with good preassessment checks in making sure patients' renal function is optimized; keeping them well hydrated and being conscious about amount of contrast used all reduce the risk.

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