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Transient Cortical Blindness After Coronary Angiography

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Transient cortical blindness is rarely encountered after angiography of native coronary arteries or bypass grafts. This paper reports a case of transient cortical blindness that occurred 72 h after coronary angiography in a 56-year old patient. This was the patient's fourth exposure to contrast medium. Neurological examination demonstrated cortical blindness and the absence of any focal neurological deficit. A non-contrast-enhanced computed tomographic scan of the brain revealed bilateral contrast enhancement in the occipital lobes and no evidence of cerebral haemorrhage, and magnetic resonance imaging of the brain showed no pathology. Sight returned spontaneously within 4 days and his vision gradually improved. A search of the current literature for reported cases of transient cortical blindness suggested that this is a rarely encountered complication of coronary angiography.

KEY WORDS: Coronary artery disease; Cortical blindness; Contrast agents; Coronary angiography

Introduction

Although transient cortical blindness is a documented complication associated with many kinds of angiography, it occurs only rarely after coronary angiography procedures.[1] Cortical blindness is better recognized as a complication of cerebral and vertebral angiography. Transient cortical blindness related to coronary angiography was first reported in 1970[2] and subsequently several cases have been reported.[2 – 10] The incidence of transient cortical blindness after coronary angiography is, however, unknown. This is a very rare entity, the physiopathology of which remains largely speculative. The outcome is generally favourable, with spontaneous return of sight within 24 – 48 h and no requirement for specific therapy.[1]

This paper reports a case of transient cortical blindness and a review of the literature on transient cortical blindness as a complication of coronary angiography.

Case report

A 56-year old man with hypertension and a history of smoking underwent control angiography 9 years after having coronary artery bypass grafting (CABG) and 3 years after stent-supported angioplasty of coronary stenoses. This was the patient's fourth exposure to contrast medium. Transient cortical blindness occurred after coronary angiography and angioplasty had

been performed.

His first coronary angiography was performed, 1 month before CABG in 1999, via the right femoral artery and revealed three tight lesions in the left anterior descending artery (LAD), in the first diagonal (D1) branch and in the first obtuse marginal (OM1) branch of the circumflex artery. The patient had then undergone a CABG procedure using the left internal mammary artery (LIMA) to the LAD, the right internal mammary artery (RIMA) to OM1 and a saphenous vein graft to the D1 branch. The patient required a second control coronary angiography for unstable angina pectoris 6 years after CABG and, 2 days after his second coronary angiography, an angioplasty and stent implantation procedures were performed using contrast media. This was the third exposure of the patient to contrast medium. His second coronary angiography revealed a new, progressed right coronary artery (RCA) lesion. Angioplasty was performed to the RCA and a drug-eluted stent (DES) was implanted in the stenotic RCA lesion. The procedure was performed without complications.

The third coronary angiography (fourth exposure to contrast medium) showed another tight RCA lesion together with non-critical in-stent stenosis of the DES-implanted RCA. The tight RCA lesion was treated with percutaneous angioplasty. The patient was pre-treated with clopidogrel, starvastatin, angiotensin-converting enzyme inhibitors, β-blockers and nitrates. Before the third coronary angiography, he received an oral bolus of clopidogrel 300 mg, which is standard practice in our catheterization laboratory. During the procedure, a total of 220 ml of non-ionic, low-osmolar contrast agent (iohexol 350 mg; Amersham Health, Cork, Ireland) and heparin 5000 IU were given. After the procedure, blood creatinine and blood urea nitrogen levels increased gradually from 1.4 to 2.2 mg/dl and from 19 to 40 mg/dl, respectively.

At 24 h after the procedure, all laboratory variables (blood count, creatine kinase, creatine kinase-MB isoenzyme, renal function, liver enzymes, cholesterol level, electrolytes, and markers of collagen tissue disorders) were within the normal range and, at 72 h, the patient complained of severely blurred vision. The patient was awake but unable to see and this quickly progressed to complete bilateral amaurosis.

Neurological examination, computed tomography (CT) and magnetic resonance imaging (MRI) of the brain were performed to confirm the diagnosis. The neurological examination revealed bilateral visual field defects that progressed rapidly to total blindness. Cranial nerve, peripheral motor and sensory examinations were normal. Ophthalmological examination revealed that extraocular movements were preserved. Pupillary reflexes were normal. Examination of the fundi showed bilateral grade II hypertensive retinopathy. The patient was diagnosed as having bilateral cortical blindness with no focal neurological deficits. The non-contrast-enhanced cranial CT scan performed immediately after loss of vision to look for suspected ischaemic or haemorrhagic complications showed marked bilateral contrast enhancement in the occipital lobes and no evidence of cerebral haemorrhage. The non-contrast CT scan demonstrated marked bilateral contrast enhancement in the occipital lobes, increased attenuation in the cortex, mild loss of sulci in both frontal lobes and the posterior mesial occipital lobes, and no evidence of cerebral haemorrhage. The MRI of the cranium revealed no evidence of haemorrhage the day after the onset of

symptoms. On diffusion-weighted imaging, which can detect very small focal areas of ischaemia in the brain, there were no lesions in the occipital lobes.

The patient's vision then spontaneously gradually started to improve and had recovered completely within 96 h of the third coronary angiography procedure. All visual symptoms disappeared after 4 days of the start of recovery of vision and CT scanning was repeated after his sight had recovered, showing clearing of the contrast media with no focal lesions in the brain. The patient's subsequent hospital stay was uneventful and he was discharged with no residual blindness. The patient was well at his 6-month and 1-year follow-up visits.

Discussion

The incidence of cerebrovascular complications in diagnostic cardiac catheterization and coronary angiography is low,[3] and transient cortical blindness is a rare complication of coronary angiography. This complication has been encountered in only one case among 142 252 angiographic procedures at our institution since 1985. It is more frequent after cerebral angiography (0.3 – 2.6%), particularly when the vertebral artery is studied.[11] The rate can be as high as 4% when hyperosmolar iodinated contrast agents are used.[12,13] The highest incidence of cortical blindness was detected after vertebral angiography. The National Institutes of Health (Bethesda, MD, USA) reported a rate of 0.03% and a report from the British Cardiac Society, based on 34 041 patients, gave an incidence of 0.06%.[14,15]

Blindness usually progresses rapidly after onset. Symptoms may even begin while the procedure is in progress, or develop within 8 – 10 min after it is completed. Scanning of the brain by CT and/or MRI are indicated to confirm the diagnosis. Return of vision may begin within a few hours.[16] In most cases, vision returns gradually, starting with light and motion perception followed by the return of colour vision.[12] Recurrence has never been reported.

In the literature, 22 cases of transient cortical blindness were reported after angiography of the native coronary vessels and angiography of coronary artery bypass grafts.[2 – 14,16 – 23] Most cases of transient cortical blindness are reported after control coronary angiography of bypass grafts. Patient outcomes are generally favourable, with vision returning within 24 – 48 h. Associated symptoms included severe headache, vomiting, loss of co-ordination or limb weakness, aphasia and confusion. Most patients have chronic hypertension, although the details of pressure changes during angiography are not usually reported. There is no specific measure to be taken for protection against this unusual and alarming complication. Differential diagnosis with ischaemic complications in the acute phase is more difficult, although the lack of focal neurological defects could be helpful.[17] Generally, visual symptoms are resolved within 3 days. For the present case, transient cortical blindness occurred 72 h after the angiographic procedure and the visual symptoms had disappeared completely after 4 days. We found only one report of rechallenge with radiocontrast medium and there was no recurrence of cortical blindness.[3]

The possibility of a shower of microemboli into the brain while the right subclavian artery and/or the brachiocephalic trunk is being crossed must be taken into account, especially when an upper extremity approach is used.[24,25] Although cerebral infarction is rare, microembolization has been reported in up to 5% of patients undergoing cardiac catheterization through

the transbrachial approach; however, this frequency compares favourably with observations made during a femoral approach.[17,25] Such events are not associated with cortical contrast enhancement in the acute phase and are normally silent or associated with focal neurological signs. Alternatively, diffusion-weighted MRI could be a very useful way to detect even very small focal areas of brain ischaemia in this setting.[17]

The mechanism whereby cerebral injury causes cortical blindness remains speculative. All contrast agents may be associated with this complication, which does not seem to be volume-dependent.[17] Cortical blindness after angiography may appear when as little as 12 ml of radiocontrast agent is used.[18] The higher risk of cortical blindness with non-ionic contrast agents supports this hypothesis.

There may be a relationship between cortical blindness and hypertensive encephalopathy, a clinical syndrome that can include visual disturbances.[12] Previous studies have suggested that cortical blindness may be related to contrast-induced hypotension during the angiographic procedure, to the presence of hypertensive vascular disease, or to the osmolality and total amount of contrast material injected.[2] Hypertensive encephalopathy is thought to result from a sudden increase in systemic blood pressure that exceeds the autoregulatory capacity of the cerebral vessels, thereby producing regions of vasodilatation and vasoconstriction, with breakdown of the blood–brain barrier and focal transudation of fluid.[12,13] The vertebrobasilar system seems to be more fragile in the setting of hypertension, and this may favour transient cortical blindness.[16] The occipital cortex is probably more vulnerable to penetration because of reduced sympathetic innervation of the vertebrobasilar arterial system and the relative lack of protective sympathetic-mediated arteriolar vasoconstriction.[19] Oedema secondary to disturbance of autoregulation of the posterior cerebral vessels is another possible mechanism for transient cortical blindness.[12]

The most likely mechanism appears to be local disruption of the blood–brain barrier by the contrast agent, possibly favoured by predisposing factors, which may have a direct neurotoxic effect.[17,20,26] The blood–brain barrier is not permeable to contrast agents. The mechanism responsible for transient cortical blindness probably involves a toxic reaction as the contrast agent penetrates into the brain parenchyma as a result of acute disruption of the blood–brain barrier.[21] Importantly, the breakdown of the blood–brain barrier appears to be sporadic because re-exposure to contrast medium does not seem to reproduce the clinical effects of the previous exposure.[3,10] The self-limiting course of the clinical symptoms, the contrast extravasations seen on CT, and the lack of significant residual lesions on MRI implicate disruption of the blood–brain barrier in the pathophysiology.[11] Bilateral occipital enhancement is described in the literature.[22] When the contrast medium has been excreted, normal vision returns as the normal protective function of the blood–brain barrier returns. Direct idiosyncratic neurotoxicity still appears the most plausible explanation, although the exact mechanism remains unknown. Some patients are more prone than others to idiosyncratic reactions after injection of contrast medium.[2] Transient vasculopathy with disruption of the blood–brain barrier as the cause of transient cortical blindness after angiography has been confirmed by MRI.[11]

It is likely that direct injection into the vertebral artery occurs during angiography of the internal mammary artery conduit.[12] The patients' prolonged supine posture might also play a role in the intracranial enhancement of the contrast solution in the occipital region.

There is limited experience of rechallenge in patients with a history of cortical blindness, but Rama *et al*.[3] found that re-exposure to contrast media during coronary angiography in three patients who had developed transient cortical blindness at a previous angiography did not lead to cortical blindness.

Blood–brain barrier injury during the use of contrast medium has been reported before, especially in patients with uncontrolled hypertension.[12] The lack of protective arterial vasoconstriction during hypertension could, therefore, act as a trigger for the breakdown of the blood–brain barrier mediated by the contrast medium.[17] A direct toxic effect has also been postulated.[26]

A possible mechanism for disruption of the blood–brain barrier is hypoventilation. Hypoventilation induces hypercarbia, which may cause breaching of the blood–brain barrier with penetration of normally impermeable matter into the brain parenchyma.[10]

Immunological mechanisms have been suggested to be associated with radiocontrast-associated cortical blindness.[23] The endothelins, ET-1, ET-2 and ET-3, are a family of peptides that have been implicated in the pathophysiology of disorders associated with posterior leucoencephalopathy and have been shown to increase the permeability of human brain endothelial cells.[27,28] They are potent, long-acting vasoconstrictors that are released by endothelial cells as well as non-vascular tissues, including kidney, lung, and astrocytes and neurons in the brain. Administration of large volumes of radiocontrast medium is associated with elevated endothelin levels in animals and humans.[11] Other reported risk factors for blood–brain barrier injury include renal insufficiency, eclampsia and immuno-suppressive drug abuse.[12]

Cerebral CT scans have demonstrated pronounced intracerebral enhancement in the occipital lobes bilaterally in most published cases. The CT images in acute transient cortical blindness could be interpreted as subarachnoid haemorrhage rather than contrast extravasations; however, in the setting of a coronary intervention this interpretation could be detrimental to the success of the intervention.[20] MRI can distinguish blood from contrast medium in this setting and can be used to guide therapy.

In conclusion, the transient cortical blindness observed after coronary angiography in the patient reported here might have been a result of breakdown of the blood–brain barrier with direct contrast neurotoxicity to the occipital cortex. The MRI findings supported the mechanism of transient vasculopathy and correlated with the reversible CT findings of contrast extravasation indicating that there was no cerebral ischaemia or haemorrhage, implying a reversible clinical cerebral dysfunction with disruption of the blood–brain barrier.

Conflicts of interest

The authors had no conflicts of interest to declare in relation to this article.

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