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Case Report

Endovascular therapy for cardiocerebral infarction associated with atrial fibrillation: A case report and literature review

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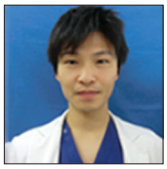

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ABSTRACT

Background: Cardiocerebral infarction (CCI) is a rare entity that refers to the simultaneous occurrence of acute myocardial infarction and acute ischemic stroke. The management of CCI patients remains unclear.

Case Description: An 86-year-old woman with a medical history of paroxysmal atrial fibrillation presented with a sudden onset of consciousness disturbance and right hemiplegia. Computed tomography of the head revealed no intracranial hemorrhage but the left hyperdense middle cerebral artery sign, associated with ST-segment elevation in II, III, and aVF noted on a routine 12-lead electrocardiogram at admission. The patient was immediately brought to the catheterization laboratory and percutaneous coronary intervention (PCI) was performed first, followed by mechanical thrombectomy, resulting in successful revascularization of the both diseases.

Conclusion: Although the treatment strategy of CCI may depend on the condition of coronary and cerebral ischemia, it may be appropriate to prioritize coronary angiography and PCI if not acute ischemic stroke is critical.

Keywords: Atrial fibrillation, Cardiac embolism, Cardiocerebral infarction, Mechanical thrombectomy, Percutaneous coronary intervention

INTRODUCTION

Cardiocerebral infarction (CCI) is a rare entity described by Omar *et al.* in 2010, which is defined as the simultaneous occurrence of acute myocardial infarction (AMI) and acute ischemic stroke (AIS).[10] Although the incidence of CCI is reportedly 0.009% of AIS,[15] CCI patients requiring both percutaneous coronary intervention (PCI) and mechanical thrombectomy (MT) are increasing due to an expansion of the indications for MT for AIS.[11,12] However, the management of CCI patients remains unclear and there is no clinical study that addressed the proper management of CCI.[1,9] The authors report a case of CCI due to atrial fibrillation (AF) who was treated by PCI first, followed by MT.

CASE PRESENTATION

An 86-year-old woman was rushed to our hospital because of a sudden onset of disturbance of consciousness and right hemiplegia. The patient had a medical history of hypertension and paroxysmal AF, the latter of which had not been treated with anticoagulants due to her advanced age. On admission, her blood pressure was 112/62 mmHg and similar between the right and left limbs, and an irregular pulse of 55 beats/min was measured. Neurological examinations revealed global aphasia and conjugate eye deviation to the left and right hemiplegia with a score of 30 points according to the National Institutes of Health Stroke Scale (NIHSS). Computed tomography (CT) of the head revealed no intracranial hemorrhage but the left hyperdense middle cerebral artery (MCA) sign [Figure 1a]: the Alberta Stroke Program Early CT Score was 10 points. In addition, admission 12-lead electrocardiogram (ECG) showed ST-segment elevation in II, III, and aVF, leading to the diagnosis of CCI [Figure 1b]. Because the exact time of the CCI onset was unknown and there was a possible need of dual antiplatelet medication for PCI, recombinant tissue-type plasminogen activator (rt-PA) was not administered. Because of the narrow therapeutic time window for CCI, the patient was immediately brought to the catheterization laboratory. Although her blood pressure and other circulatory parameters were stable, PCI was preceded considering the possibility of sudden changes in vital signs including cardiac arrest due to AMI. Coronary angiography revealed occlusion of the right coronary artery, which was treated with PCI using a thrombosuction catheter to retrieve a red clot, resulting in thrombolysis in myocardial infarction Grade 3 recanalization [Figures 2a and b]. Subsequently, cerebral angiography was performed to show the left M1 occlusion followed by MT using a stent retriever which retrieved a red clot and accomplished thrombolysis in cerebral infarction Grade 2b recanalization [Figures 2c and d]. Her neurological symptoms improved mildly, but aphasia and right hemiparesis (manual muscle test, 3/5) persisted. Postoperative brain magnetic resonance imaging and angiography showed the almost patent left MCA but with extensive left MCA territory infarction [Figures 3a and b]. In addition, she fell into heart failure, which improved with the administration of diuretics. On postoperative day 6, edoxaban (30 mg/day) was prescribed and rehabilitation started. The patient was transferred to a rehabilitation hospital with the modified Rankin scale 4 on the 34th postoperative day.

DISCUSSION

The prognosis of CCI patients is unclear, but is presumed to be poor due to both AMI and AIS with high morbidities and mortalities as well as a short treatable time window. De Castillo *et al*. reported that the overall mortality of CCI was 45% (13/29 cases) and good functional outcome at 30-day post-CCI was 21% (6/29 cases).[4] There have been several reports of CCI that resulted in cardiac arrest and death before endovascular treatment.[6,14] The management of CCI patients remains controversial because of its rarity and pathophysiology: [9,14] more specifically, it is unclear whether or not rt-PA should be administered preceding PCI or MT, which should be done first, PCI or MT.[6]

To the best of our knowledge, there have been seven CCI patients including our case reported, who had no malignancy and were treated with both PCI and MT [Table 1].[2,7,8,15] CCI related to malignancy is considered to be another entity due to the further complexity of the pathophysiology. Among the seven reported patients, four patients had cardiovascular risk factors: two patients (Cases 1 and 6) received oral anticoagulants because of a left ventricular thrombus and AF, respectively, but the one (Case 6) showed poor compliance.[2,15] The possible causes of CCI were considered as follows: (1) most commonly, AF

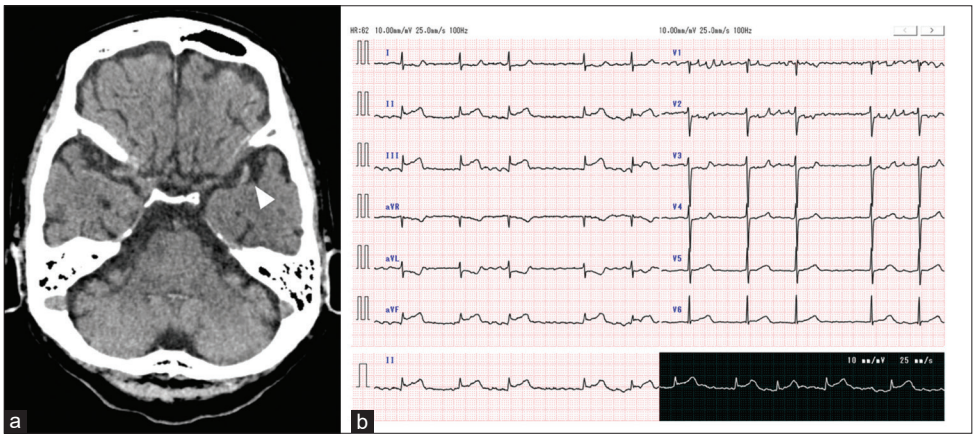

Figure 1: Computed tomography (CT) of the head and a routine 12-lead electrocardiogram (ECG) on admission. CT shows left hyperdense middle cerebral artery sign (*arrowhead*) (a). Twelve-lead ECG shows ST-segment elevation at II, III, and aVF (b).

caused both cardiac and cerebral embolization (Cases 2, 6, and the present case);[2,15] (2) AMI, especially in the anterior wall and apex, with weakened left ventricular contractility (decreased ejection fraction) and therefore intraventricular thrombi first occurred, resulting in cerebral embolization (Cases 1 and 3);[15] (3) severe hypotension due to AMI caused cerebrovascular hypoperfusion, leading to cerebral infarction;[3] and (4) an adrenergic or catecholamine surge associated with AIS-induced cardiac shock or Takotsubo syndrome.[5,14] Cases 4 and 5 had no obvious causes including findings suggestive of atherosclerosis, and thus, an embolic mechanism was suspected.[7,8] The diagnostic problem with CCI is that patients may not complain of chest pain due to impaired consciousness and/or aphasia caused by AIS: only two patients (Cases 1 and 6) complained of chest pain,[2,15] while in other patients including the present case, AMI was diagnosed based on a routine 12-lead ECG on admission.[7,8] It is, therefore, important to keep in mind the possibility of concurrent AMI when treating AIS patients, especially in those who cannot complain of chest pain.

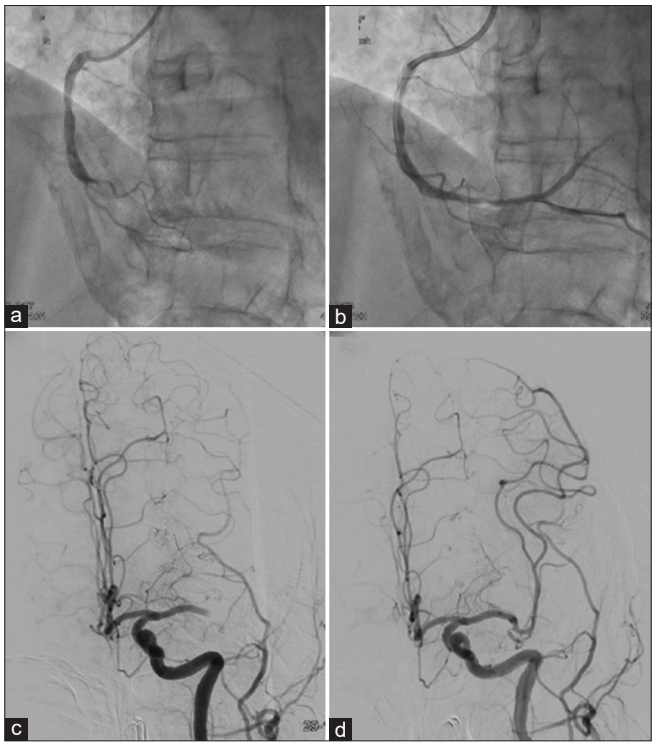

Figure 2: Percutaneous coronary intervention (PCI) and mechanical thrombectomy (MT). Coronary angiography shows occluded right coronary artery (a) and thrombolysis in myocardial infarction Grade 3 recanalization after PCI (b). Cerebral angiography shows the left M1 occlusion (c) and thrombolysis in cerebral infarction Grade 2b recanalization after MT (d).

As to the treatment of CCI, PCI was performed preceding MT in four patients (Cases 1, 2, 6, and our case):[2,15] the reasons were (1) unstable vital signs, hypotension, or refractory hypertension, respectively (Cases 1 and 2),[15] and (2) to avoid further output compromise and to reduce risks of potential ventricular tachycardia/fibrillation or bradycardia/hypotension during MT (Case 6 and our case).[2] In contrast, MT preceded PCI in three patients (Cases 3, 4, and 5).[7,8,15] The reasons for leading MT in Cases 3 and 4 were that they had non-ST-segment elevation myocardial infarction (NSTEMI) with stable vital signs, while they had severe neurological deficits (the NIHSS scores, 27 and 20, respectively).[7,15] In Case 5, although coronary angiography was performed first and a thrombus was detected in the left anterior descending artery, the coronary blood flow was slow but persistent; and thus, MT was preceded.[8] Ng *et al*. conducted a meta-analysis of 44 cases with CCI, focusing on AMI, and reported that the mortality was 22.7% (10/44 cases), of which 90% (9/10 cases) were cardiogenic: in the report, 11 of 16 cases with large cerebral vessel occlusion (LVO) underwent MT of a cerebral vessel, but no information was provided about the type or timing of acute cardiac interventions in these patients.[9] Taken together, the following treatment strategies seem appropriate: (1) if a patient has abnormal vital signs such as hypotension or lethal arrhythmia, PCI should be performed first to avoid possible cardiac arrest; (2) if a patient has less severe AMI such as NSTEMI and the neurological symptoms are severe,

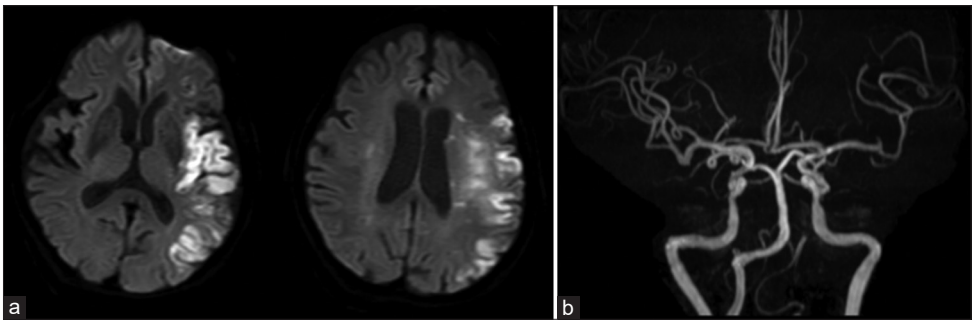

Figure 3: Postoperative magnetic resonance imaging (MRI) and magnetic resonance angiography (MRA) of the head. MRI shows the left middle cerebral artery territory cerebral infarction (a). MRA shows almost patent left middle cerebral artery (b).

Table 1: Reports of CCI treated with both PCI and MT.

Author/year	No.	Age/ sex	Chief complaint	Premorbid medical status	NIHSS	Cerebral a. occlusion	Coronary a. occlusion	IV rt-PA	Treatment strategy	Outcome
Yeo *et al.*/ 2017[15]	1	45/M	Chest pain, visual neglect, and left hemiplegia	HF, HTN, and DLP	16	Right ICA	LAD	No	PCI (stenting) and then MT	Poor
	2	53/M	Aphasia and right hemiplegia	AF, DM, and DLP	23	Left M1p	LAD	No	PCI (stenting) and then MT	Poor
	3	71/F	Vomiting, impaired consciousness, and left hemiplegia	None	27	Right P1	LAD	No	MT and then PCI (stenting)	Poor
Nagao *et al.*/ 2019[7]	4	86/F	Aphasia and right hemiplegia	None	20	Left M2	LCx	Yes	MT and then PCI (stenting)	Poor
Nardai *et al.*/ 2021[8]	5	67/F	Global aphasia and conjugate eye deviation to the left and right hemiplegia	None	21	Left M1d	LAD	No	MT and then PCI (stenting)	Good
Chen *et al.*/ 2022[2]	6	76/M	Chest pain, slurred speech, and left hemiparesis	AF, HTN	18	Right ICA	LAD	Yes	PCI (thrombosuction) and then MT	Good
Present case	7	86/F	Global aphasia and conjugate eye deviation to the left and right hemiplegia	AF, HTN	30	Left M1d	RCA	No	PCI (thrombosuction) and then MT	Poor

CCI: Cardiocerebral infarction, PCI: Percutaneous coronary intervention, MT: Mechanical thrombectomy, A: Artery, AF: Atrial fibrillation, DLP: Dyslipidemia, DM: Diabetes mellitus, F: Female, Good: Modified Rankin scale 0–2, HF: Heart failure, HTN: Hypertension, ICA: Internal carotid artery, IV rt-PA: Intravenous tissue-type plasminogen activator, LAD: Left anterior descending artery, LCx: Left circumflex artery, M: Male, MT: Mechanical thrombectomy, M1d: Middle cerebral artery M1 distal segment, M1p: Middle cerebral artery M1 proximal segment, M2: Middle cerebral artery M2 segment, NIHSS: National Institutes of Health Stroke Scale, PCI: Percutaneous coronary intervention, Poor: Modified Rankin scale 3–6, P1: Posterior cerebral artery P1 segment, RCA: Right coronary artery

MT should be performed first; and (3) in cases that it is difficult to make a decision, coronary angiography should be performed first to evaluate the occluded vessels of AMI and then to decide which is the preferred procedure based on findings of the coronary angiography.

Finally, rt-PA was administered in two of the seven patients (Cases 4 and 6).[2,7] The reasons why not rt-PA was administered were already on anticoagulant therapy (Case 1),[15] refractory hypertension (Case 2),[15] delayed arrival from the onset (Case 3),[15] and unknown exact time of the onset (Case 5 and our case).[8] The 2018 American Heart Association and American Stroke Association guidelines, updated in 2019, recommended that in the setting of hyperacute simultaneous CCI, rt-PA treatment at the dose used for AIS followed by PCI is reasonable (Class IIa; level of evidence C).[12] It should be noted, however, that (1) the percentage of LVOs that recanalize with rt-PA is not high (4–21%);[13] (2) antithrombotic therapy is generally prohibited for 24 h after rt-PA administration; and (3) the risk of bleeding is very high if stenting is performed during PCI and dual antiplatelet therapy is initiated.[9,15]

CONCLUSION

CCI is very rare and has complex pathophysiology with poor prognosis. A routine 12-lead ECG is useful for ruling the possibility of concurrent AMI out because CCI

patients often have impaired consciousness or aphasia by AIS and, therefore, have difficulty in complaining of chest pain and other symptoms typical of AMI. Although the optimal treatment strategy of CCI is unclear, the findings of coronary angiography may be helpful to decide which should be preceded, PCI or MT, in difficult cases. Although rt-PA administration at a dose of AIS for hyperacute CCI is reasonable, it is noted that a risk of bleeding is increased and that the LVO recanalization rate by rt-PA is not as high.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Conflicts of interest

There are no conflicts of interest.

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