LETTER TO THE EDITOR

To The Editor

CT Perfusion and EEG Patterns in Contrast-Induced Encephalopathy Stroke Mimic

Keywords: Contrast-induced encephalopathy, Stroke mimic, CT perfusion, EEG

Contrast-induced encephalopathy (CIE) is a very rare (incidence: 0.06%) complication of coronary angiography (CAG)[1] reported with any types of contrast media, including ionic, non-ionic, low osmolarity, iso-osmolar and high osmolarity.[2]

CIE is a transient, self-limiting (within 72 h) condition characterised by a heterogeneous clinical manifestation that includes focal neurological deficits, seizures and transient cortical blindness.[1] The syndrome emerges within minutes to hours after contrast administration. Hypertension, advanced age, male gender, renal disease, injection of large volumes of contrast media and previous adverse reaction to contrast are the main risk factors of CIE. Its broad clinical spectrum requires the support of imaging to exclude hemorrhagic and thromboembolic complications of CAG. Cerebral oedema, cortical enhancement and hyperdensity in the subarachnoid space similar to subarachnoid haemorrhage may occasionally be found among the radiological features.[2]

This case report describes an aphasic patient presenting with CIE stroke mimic assessed in the acute phase by multiparametric CT, including CT perfusion (CTP) and electroencephalography (EEG). We compared neuroimaging, EEG patterns and clinical findings with ischaemic stroke-related isolated aphasia and proposed differential diagnosis based on these patterns.

We reported a Caucasian 64-year-old man, with a history of ischaemic cardiopathy, dyslipidaemia, obesity, smoke, Crohn's disease, OSAS and mild cognitive impairment, who was admitted to the Cardiology Unit for an acute coronary syndrome.

The patient had already experienced acute transient confusion associated with complete mutacism twice: the first time following a thunderclap headache investigated through angiography; the second time after an acute STEMI treated with a CAG and a stent implantation. In this second episode, he underwent brain non-enhanced CT (NECT), CT angiography and brain magnetic resonance imaging (MRI), all resulted negative.

The day after the admission to our Cardiology Unit, the patient underwent CAG and a percutaneous coronary intervention with stent implantation in the anterior descending artery. A total of 150 ml of iomeprol, a low osmolar non-ionic iodinated contrast agent, was administered during the procedure. Local anaesthetic and IV diazepam were administered prior to CAG and standard 5000 + 6000 IU heparin intra-arterially during CAG.

Ten minutes after the procedures, he presented sudden confusion associated with speech alteration that developed in a complete mutacism. The intervention of a neurologist was requested due to suspected acute procedural ischaemic stroke. At initial neurological examination, the patient presented global aphasia and inability to perform basic tasks but no other neurological deficits (NIHSS: 9). Vital signs and serum glucose were normal. The patient underwent brain-CT, angio-CT of epiaortic and intracranial vessel and CTP scan, showing no abnormalities (Figure 1A). The patient was transferred to the Stroke Unit and underwent urgent standard 19-channels EEG, highlighting symmetric bilateral delta slow waves without epileptiform discharges. He was treated with intravenous fluids and recovered spontaneously in 24 h with no confusion or residual neurological deficits (NIHSS: 0). The final diagnosis was recurrent CIE following CAG. The patient had no recollection of the event. The 24-h follow-up NECT showed no acute lesion, and 24-h follow-up EEG showed an increase in alpha frequencies and a reduction of bilateral symmetric slow waves (Figure 1A). Laboratory investigations excluded infection, renal function and the other haematic parameters were normal. Telemetric monitoring highlighted no rhythm alteration. The patient was prescribed acetylsalicylic acid 100 mg/d, Clopidogrel 75 mg/d and other home therapy drugs. At 3 months, the patient was asymptomatic (NIHSS: 0; mRS: 0).

CIE is a rare cause of stroke mimic, which can present with a wide range of possible clinical presentations, thus posing a difficult differential diagnosis, especially in the hyperacute phase.

This case report highlights the observed multiparametric CT-EEG CIE pattern that may support the differential diagnosis of this specific type of stroke mimic. In particular, our patient was characterised by a history of previous transient neurological deficit (acute confusion associated with complete mutacism) after CAG. NECT did not present any early ischaemic signs (ASPECT score = 10), CTA showed no vessel occlusion and CTP maps did not present any hypo- or hyperperfusion areas. EEG recordings showed bilateral predominance of slow waves with no asymmetry or sharp waves. Unfortunately, brain MRI was not performed in the third stereotyped episode. In the second episode, the patient developed transient mutacism after an acute STEMI treated with CAG and stent implantation. As previously mentioned, in the second episode, MRI was negative, thus excluding small cortical infarct or thalamic infarct.

Multiparametric CT (including CTP) and urgent EEG can easily differentiate CIE from acute ischaemic or haemorrhagic stroke, as well as focal seizure. Table 1 summarises clinical, radiological and EEG data related to the CIE patient and to further 27 isolated aphasia acute ischaemic stroke patients.[3] The ischaemic stroke often showed ASPECT ≤ 10 and intra/extracranial occlusion or significant stenosis. Normal blood flow values were observed in the CIE by perfusion imaging (Figure 1A), whereas decreased flow restricted in dependent vascular territories was observed in the ischaemic stroke (Figure 1B). Diffused slow delta activity was observed in the CIE (Figure 1A), while a more focal slow-wave pattern was observed in the ischaemic stroke (Figure 1B), as discussed in our previous study.[3] At a clinical level, we observed confusion and psychomotor agitation in the CIE, while being infrequent (8%) in the ischaemic aphasia cases.[4] In addition, the observed CIE patient CTP-EEG pattern was different from that reported in seizure-related stroke mimics with isolated aphasia. The latter showed focal hyperperfusion on CTP and sharp EEG waves.[3]

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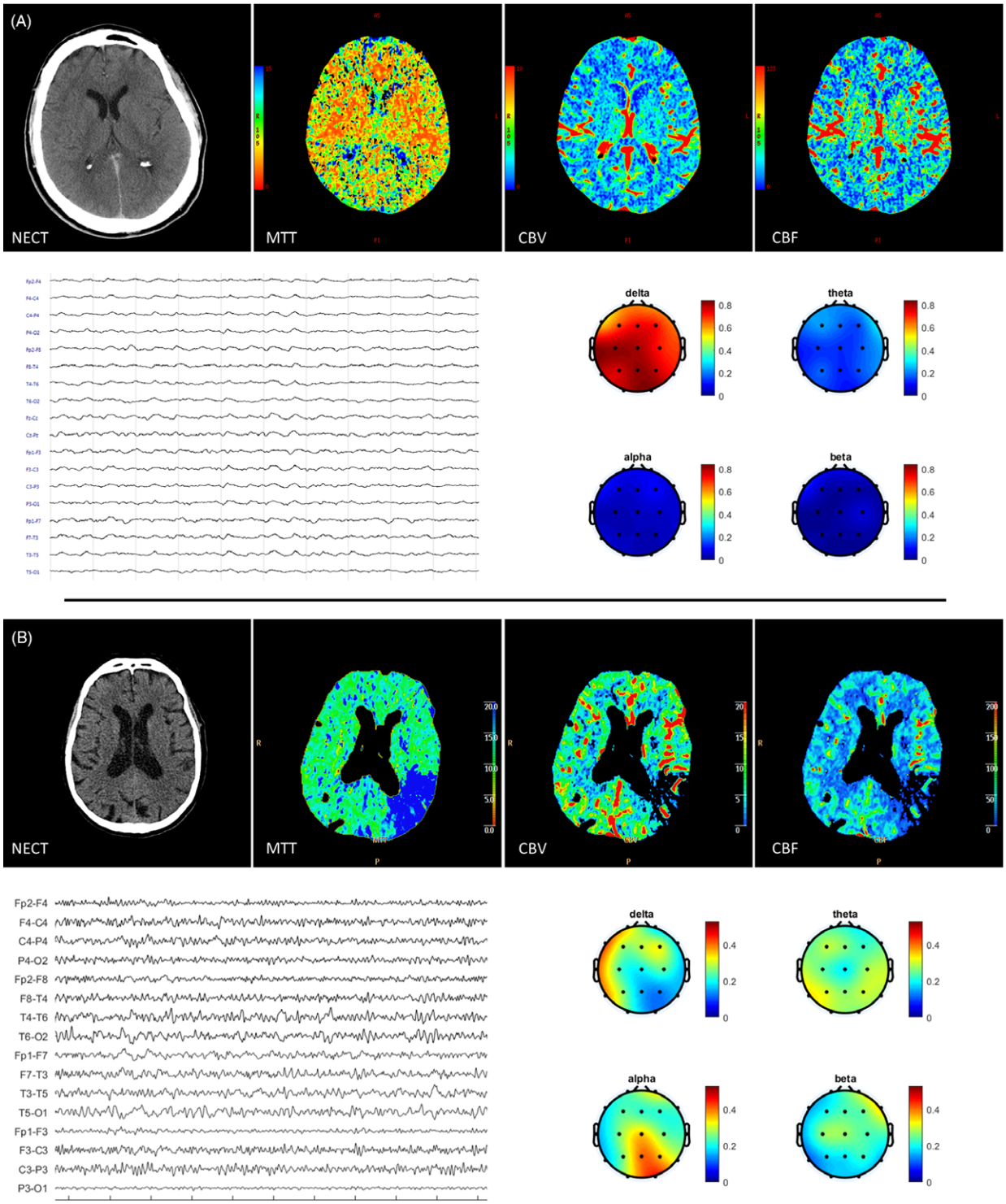

Figure 1. *Panel (A) Contrast-induced encephalopathy stroke mimic. A Caucasian 64-year-old man presented with sudden confusion associated with speech alteration (NIHSS 9) 10 min after CAG. First row – neuroimaging assessment: NECT; mean transit time (MTT), cerebral blood volume (CBV), cerebral blood flow (CBF) CTP perfusion calculated maps. No abnormalities were detected. Second row – EEG raw data and calculated relative power for spectral bands: bilateral and symmetric delta waves are observed on raw EEG; strong predominance of delta was observed on topographic EEG power maps (mean relative powers: δ = 0.72; ϑ = 0.18; α = 0.06; β = 0.03). Panel (B) Acute ischaemic stroke. A 72-year-old man, with a history of dyslipidaemia and hypertension, was admitted with sudden onset of global aphasia (NIHSS 8). First row – Neuroimaging assessment: NECT; mean transit time (MTT), cerebral blood volume (CBV), cerebral blood flow (CBF) CTP perfusion calculated maps. ASPECT score was 9 at NECT. CT angiography observed left M3 occlusion. Marked hyporperfusion tissue identified by alteration of MTT, CBF, CBV maps indicating large core with small penumbra in temporoparietal area. Second row – EEG raw data and calculated relative power for spectral bands: bilateral and asymmetrical delta waves are observed on raw EEG, more enhanced in the left hemisphere; Delta power was observed on topographic EEG power maps, especially in the left side, with alpha power preservation on the contralateral side (mean relative powers: δ = 0.27; ϑ = 0.26; α = 0.27; β = 0.20).*

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Table 1. Key elements to distinguish acute ischaemic stroke from contrast-induced encephalopathy (CIE) stroke mimic

	Acute ischaemic stroke	Contrast-induced encephalopathy
History of previous stereotypical episodes	No	Yes
Confusion and psychomotor agitation	Rare	Frequent
NECT	ASPECT ≤ 10	ASPECT = 10
CTA vessel occlusion	Yes	No
CT perfusion abnormalities restricted in dependent vascular territories	Yes	No
EEG findings in affected hemisphere	Focal slow waves	Bilateral and symmetric slow waves
MTT	↑↑	→
CBF	↓↓	→
CBV	↑→ (penumbra) ↓↓ (core)	→

NECT = non-enhanced CT; CTA = CT angiography; CTP = CT perfusion; MTT = mean transit time; CBF = cerebral blood flow; CBV = cerebral blood volume.

Comparison of neurological examination, EEG and multiparametric CT hyperacute data.

CIE is a rare cause of stroke mimic, while seizures represent its most commonly identified cause. Indeed, post-ictal negative symptoms can be misdiagnosed as stroke. It is mandatory to differentiate acute ischaemic stroke from post-ictal negative phenomenon in terms of management and prognosis. In post-ictal negative phenomena, patient usually present history of epilepsy and brief post focal seizure neurological deficits.[5] EEG shows focal or more widespread slowing, focal epileptiform abnormalities or ictal pattern in case of persistent non-convusive seizure, while slow EEG activity corresponding to the site of the lesion in case of stroke is the most frequent finding. Neuroimaging investigation represents the most accurate way to discriminate between the two conditions. In acute ischaemic stroke, MRI with diffusion-weighted imaging (DWI) shows abnormalities following a vascular distribution, CT angiography may reveal large vessel occlusion, and CTP shows a hypoperfusion restricted in a vascular territory. In post-ictal negative phenomena, MRI with DWI is usually negative (or rarely with transient changes without vascular distribution), and CT angiography is negative.

New technologies with wireless amplifiers and EEG caps may allow the EEG assessment in emergency settings in spite of the complex hyper-acute patient management issues.[6,7] Acute EEG may support differential diagnosis,[3] monitor evolution of the brain ischaemia,[6] and predict functional and morphological outcomes.[7]

In conclusion, this case report supports the hypothesis that multiparametric CT (including CTP) combined with EEG and clinical assessment may be useful in the differential diagnosis between CIE and ischaemic events in the emergency setting.

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Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article. Figures are original and not previously published.

Statement of Authorship

Author contributions included conceptualisation and study design (GF, PM, MN, GB, and AZ), data collection or acquisition (GF, JR, and CV), signal and image processing and analysis (MA), interpretation of results (GF, PM, MA, MN, GB, and AZ) and writing of original draft (GF and MA). All authors reviewed the results and approved the final version of the manuscript.

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