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The emerging role of brain Magnetic Resonance Imaging in decision-making for comatose type A acute aortic dissection.

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Abstract

Type A dissection complicated by cerebral malperfusion and coma may pose decision-making challenges. We describe the case of a patient who presented coma in the context of acute type A aortic dissection, without cardiac tamponade. Brain MRI was performed 4 hours after the onset of symptoms to evaluate the brain perfusion and viability. We discuss the potential role of the currently available emergency brain MRI as an additional tool in the workup of aortic dissection, and its potential to discriminate between irreversible brain injury and brain viability.

The emerging role of brain Magnetic Resonance Imaging in decision-making for comatose type A acute aortic dissection.

Running head : Brain MRI in acute dissection

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Abstract

Type A dissection complicated by cerebral malperfusion and coma may pose decision-making challenges. We describe the case of a patient who presented coma in the context of acute type A aortic dissection, without cardiac tamponade. Brain MRI was performed 4 hours after the onset of symptoms to evaluate the brain perfusion and viability. We discuss the potential role of the currently available emergency brain MRI as an additional tool in the workup of aortic dissection, and its potential to discriminate between irreversible brain injury and brain viability.

KEY WORDS: Aortic dissection; Stroke; Magnetic Resonance Imaging

Glossary

CPB Cardiopulmonary Bypass

CT-scan Computed Tomography scan

ECC Extracorporeal Circulation

HCA Hypothermic Circulatory Arrest

IRAD International Registry of Aortic Dissection

MRI Magnetic Resonance Imaging

NIRS Near Infrared Spectroscopy

TAAD Type A acute Aortic Dissection

Case Description:

A 73-year-old woman with history of chronic renal failure was taken to the emergency department for suspected acute aortic syndrome. During transfer, she suffered sudden neurological deterioration with a Glasgow Coma Score of 4. On arrival, and after orotracheal intubation, a contrast-enhanced total body computed tomography (CT-scan) confirmed the diagnosis of type A acute aortic dissection (TAAD) (Supplemental figure 1). Both carotid arteries were occluded without any antegrade flow (the vertebral arteries remained patent) (Figure 1, Central picture, Video 1) and the Near Infrared Spectroscopy (NIRS) indicated regional oxygen saturation around 20 in the prefrontal region bilaterally. This aggressive presentation raised the suspicion of massive ischemic stroke and questioned the benefits of TAAD surgical management. To guide decision-making, an emergency magnetic resonance imaging (MRI) was performed 4 hours after the onset of neurological symptoms. The patient was hemodynamically stable and transthoracic echocardiography showed minimal pericardial effusion. MRI revealed a small-sized, focal, recent cortical stroke in the right internal carotid territory (Figure 2). Brain viability in the remaining territories associated with a permeable Willis polygon with blood flow provided from vertebral arteries was demonstrated, allowing antegrade flow in both sylvian arteries (Supplemental figure 2) (Video 2). Surgical management was therefore performed. Surgery began 5 hours after the onset of neurological symptoms. After right axillary cannulation and institution of cardiopulmonary bypass (CPB), we observed an immediate and bilateral improvement in the NIRS score. The intimal tear was located at the medial part of the ascending aorta. Supracoronary ascending aortic replacement and hemiarch replacement under moderately hypothermic (25°C) circulatory arrest (HCA) and bilateral antegrade cerebral perfusion were performed. Disruption of the right coronary artery required a bypass graft, and the native aortic valve was repaired. The CPB time was four hours including forty-four minutes of HCA.

The neurological postoperative course was satisfactory, the patient awakened from anesthesia without any deficit and was extubated on day 3 due to respiratory failure. Later, she presented a confusion episode which recovered spontaneously. Postoperative renal failure required temporary dialysis. She was transferred to another hospital on postoperative day 14 and provided consent for use of data.

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Discussion :

Cerebral malperfusion occurs in 6 to 14% of TAAD patients (1,2). The benefit of emergency surgery in patients with comatose TAAD is controversial, as it may be futile if massive ischemic cerebral lesion has occurred. It also carries the risk of cerebral reperfusion oedema or hemorrhagic conversion. In the international registry of aortic dissection (IRAD), ischemic brain injury clearly influenced patient management. Surgery was not performed in 24.1% of patients with stroke and 33.3% of comatose patients, compared to 11% of patients without neurological symptoms (1). On the other hand, comatose patients medically managed have a 0% survival rate. Surgery appeared to be a protective factor, resulting in a 55.6% survival rate (1,2). Some authors established a decision-making algorithm considering the predictive factors of neurological recovery to orient the patient towards immediate, delayed or no surgical management (3).

To our knowledge, this is the first case description of emergency brain MRI used for decision-making in TAAD complicated by coma. Patients presenting with impaired consciousness and/or neurological deficits are usually assessed by contrast-enhanced CT-scan, promptly providing morphological information about the vessels, including the supra-aortic trunks. The role of cerebral MRI in this context is unknown. MRI not only can assess cerebral perfusion and the patency of the polygon of Willis, but also can discriminate since a very early phase from symptoms onset, between massive ischemic stroke and brain viability. Such assessment is rapidly reliable and prognostically valuable, since few hours after the onset of symptoms. MRI is also useful to exclude intracranial hemorrhage and predict hemorrhagic transformation through blood-brain barriers rupture (4).

Additionally, delayed neurological reassessment has also been proposed in patients affected by TAAD complicated by coma. Nonetheless, Tsukube et al. observed significantly different survival between comatose patients who underwent immediate repair and those who were initially administered medical treatment before later clinical reevaluation ($P = .0008$) (5). In this perspective, MRI could also allow gaining time by avoiding delayed reassessment and identifying eligible comatose patients to immediate surgery.

Conclusion:

Coma is a serious complication of TAAD, but it must not be considered as an absolute contraindication for surgery. As brain is prone to ischemic damage, minimizing the ischemic time is crucial to increase the chances of neurologic recovery, while avoiding futile interventions in patients with irreversible massive brain injury. We propose emergency brain MRI in hemodynamically stable patients as a tool to be introduced into management algorithms.

Data Availability Statement:

The data underlying this article are available in the article and in its online supplementary material.

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FIGURE LEGENDS

Figure 1: Arterial phase, contrast-enhanced CT scan (cervical axial sections) showing extension of the aortic dissection to the supra-aortic trunks. The right common carotid artery and the right internal carotid artery are not opacified. The left common artery is dissected and thrombosed with a left internal carotid artery opacified probably through retrograde collateral flow. Both vertebral arteries are patent.

Figure 2. Brain Magnetic Resonance Imaging, b1000 diffusion sequence signal revealing a limited recent cortical ischemic injury (white arrow) in the right internal carotid territory. The remaining brain parenchyma is viable.

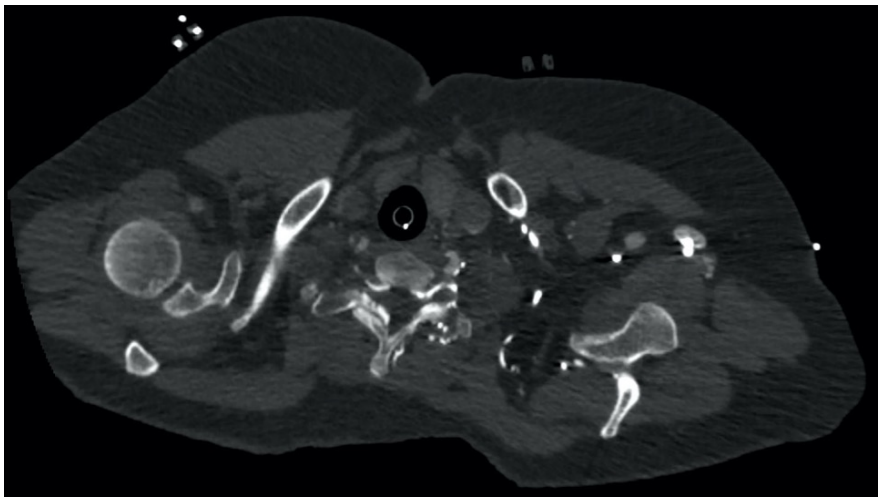
Figure 3. A) Contrast-enhanced CT scan showing type A acute aortic dissection. The right coronary artery arises from the false lumen with a dynamic obstruction of the left main stem. **B)** At the abdominal level, the splanchnic arteries arise from the true lumen with no sign of mesenteric ischemia.

Figure 4. A) Non-contrast enhanced MR Angiography (ARM 3D TOF) showing integrity of the polygon of Willis and its perfusion through **B)** the vertebral arteries, allowing the maintenance of an antegrade flow in both Sylvian arteries.

VIDEO LEGENDS

Video 1 . Contrast-enhanced CT scan from the abdominal aorta to the supra-aortic vessels showing type A aortic dissection and its extensions to the various arterial branches. The right common carotid and right internal carotid arteries are not opacified. The left common carotid artery is dissected and thrombosed. The left internal carotid artery is partially opacified retrogradely. Both vertebral axes are patent.

Video 2. 3D TOF Magnetic Resonance Imaging angiogram showing no visibility of the right carotid artery within the carotid canal. On the other hand, a complete anastomotic arterial circle of the base was identified, the blood flow towards its anterior portion being provided by vertebral arteries. The right middle cerebral artery was less intense in signal due to the underlying cervical involvement.



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