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Review

Neuroimaging evaluation in headache patients who have suffered a stroke or traumatic brain injury

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Abstract

In a medical emergency, the most urgent patients at significant risk of death are those with a cerebrovascular accident and those with traumatic brain injury. Many are admitted with diminished conscience status (coma) and focal neurological deficits. In the evaluation of these patients, neuroimaging is indispensable in order to identify the type of lesion and the location of the brain where it is located.

In the case of stroke, we can subdivide it into hemorrhagic and ischemic. Among hemorrhagic hemorrhages, we can mention (1) spontaneous intracerebral hematomas and (2) hemorrhages due to rupture of an intracranial aneurysm, with subarachnoid hemorrhage leading.

Patients with head trauma are critical; even those who arrive at the hospital alert and oriented can decrease their level of consciousness in a few hours due to an intracranial hematoma, edema, or cerebral contusion.

Thus, the availability of performing neuroimaging evaluations, using computed tomography and magnetic resonance imaging, or even digital angiography, is vital for continuous supervision of this type of patient. The exams often require repetition several times due to the rate of evolution of vascular lesions and after head trauma.

A warning sign in these types of patients is headache. In the intracranial aneurysmal rupture, we classically have the thunderclap headache, an explosive, sudden pain mentioned as the worst pain the individual has suffered in his or her life. The pericranium and some intracranial structures are sensitive to nociceptive stimuli, such as the dura mater, large arteries, and venous sinuses. The brain is relatively insensitive to painful stimuli.

This narrative review aims to inform the importance of neuroimaging assessment of patients with stroke and traumatic brain injury in an emergency department. In conclusion, a neuroimaging evaluation is paramount in addition to a neurological and physical examination of the critically ill patient with cerebrovascular disease or who has suffered a traumatic brain injury.

Keywords:
Stroke
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RMI
Computed tomography
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Introduction

In a medical emergency, the most critical patients at significant risk of death are those who have suffered a cerebrovascular accident and those with traumatic brain injury.[1-3] Many are admitted with diminished conscience status (coma) and focal neurological deficits. In the evaluation of these patients, neuroimaging is essential in order to identify the type of lesion and the location of the brain where it is located.[4,5]

In the case of stroke, we can subdivide it into hemorrhagic and ischemic. Among hemorrhagic hemorrhages, we find (1) spontaneous intracerebral hematomas[6-8] and (2) hemorrhages due to rupture of an intracranial aneurysm, with subarachnoid hemorrhage leading[9,10].

Patients with head trauma are critical; even those who arrive at the hospital alert and oriented can decrease their level of consciousness in a few hours due to an intracranial hematoma, edema, or cerebral contusion.[11,12]

Thus, the availability of performing neuroimaging evaluations, using computed tomography and magnetic resonance imaging, or even digital angiography, is vital for continuous surveillance of this type of patient. The exam often needs to be repeated several times due to the quality of evolution of vascular lesions and after head trauma.

A warning sign in these patients is headache.[13,14] In the intracranial aneurysmal rupture, we classically have the thunderclap headache, an explosive, sudden pain mentioned as the worst pain the individual has suffered in his or her life.[15,16] The pericranium and some intracranial structures are sensitive to nociceptive stimuli, such as the dura mater, large arteries, and venous sinuses. The brain is relatively insensitive to painful stimuli.

This narrative review aims to inform the importance of neuroimaging assessment of patients with stroke and traumatic brain injury.

Traumatic Brain Injury

Head trauma can affect the soft parts (scalp, pericranium, and bone), causing a localized or diffuse headache for a few days. In more severe cases, trauma can damage the brain parenchyma, causing tissue damage (contusion) and even the formation of hematomas (Figure 1),which leads to more intense and lasting headaches.[17-19]

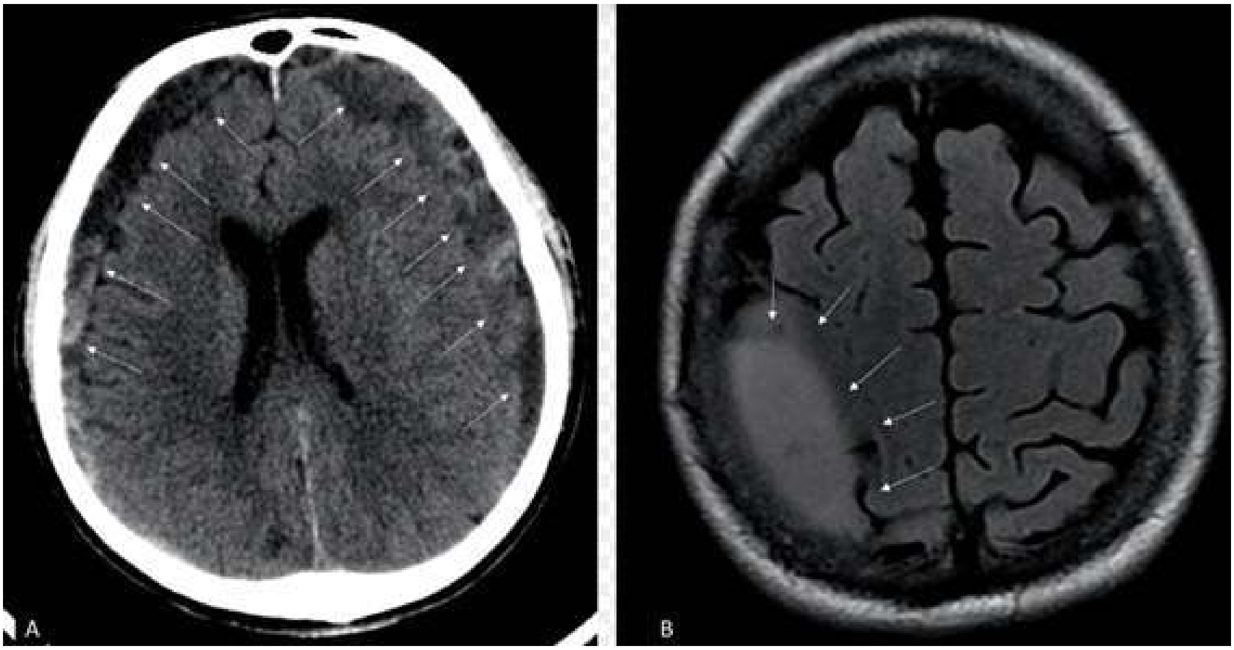

Figure 1. (A) Bilateral frontoparietal chronic subdural hematoma, and (B) right frontoparietal epidural hematoma. (A) Non-contrast computed tomography of the skull in the axial plane shows bilateral frontoparietal subdural hematomas (arrows), which are characterized by biconcave collections, with heterogeneous density because they present bleeding areas in several phases, suggesting that they are multiloculated (the more recent the bleeding areas, the greater the hyperdensity). It determines moderate compression on the surface of the cerebral hemispheres with effacement of the cortical sulci. (B) Magnetic resonance imaging of another patient, FLAIR axial sequence, showing a right frontoparietal epidural hematoma characterized by a hyperintense biconvex collection in this sequence, determining moderate compression over the right pre- and post-central gyri.

Vascular Headache

Intracranial Aneurysms

Occur in 1-2% of the population and account for about 80-85% of non-traumatic subarachnoid hemorrhages.[20] Intracranial aneurysms are sporadically acquired lesions; however, a rare familial form has been linked to conditions such as autosomal dominant polycystic kidney disease, Marfan syndrome, Ehlers-Danlos syndrome type IV, fibromuscular dysplasia, moyamoya disease, sickle cell disease, and arteriovenous malformations of the brain.[20] An important risk factor for an aneurysm is family history.[20]

Non-traumatic Subarachnoid Hemorrhage

Subarachnoid hemorrhage accounts for 5.5% to 15% of strokes, usually resulting from ruptured cranial aneurysms (Figure 2). Headache is sudden and severe, often accompanied by nausea, vomiting, and photophobia.[19, 21] It lasts between 2 and 3 weeks and is associated with a high mortality rate.

Figure 2. Subarachnoid hemorrhage due to rupture of intracranial aneurysm of the right posterior communicating artery. On the axial computed tomography image of the skull (A), subarachnoid hemorrhage is observed, located mainly in the suprasellar, perichiasmatic and ambient cisterns on the right, identifying hyperdensity of the acute bleeding (arrows) that is distributed through the cistern of the skull base (subarachnoid space), described above. The temporal horns (arrowhead) are well visualized as they are slightly enlarged, characterizing a discrete communicating hydrocephalus determined by subarachnoid bleeding. On digital angiography (B), saccular dilatation is observed at the origin of the right posterior communicating artery (arrow).

Arterial Dissection

Craniocervical arterial dissection is a leading cause of stroke in young and middle-aged adults, but it can occur at any age.[22]

The classic clinical history is headache or unilateral neck pain, accompanied by partial Horner syndrome and followed by cerebral ischemia hours or days later. It may be spontaneous or traumatic, and may result from mild trauma (cough, cervical chiropractic).[23]

The dissection results from the rupture of the intima with extravasation of blood into the vessel wall, creating a “false lumen”. The intramural hematoma can expand making the artery irregular and stenotic or even completely occluded. The formation of dissecting pseudoaneurysms is common.[24]

On non-contrast computed tomography, a hematoma on the vessel wall can be evidenced, characterized by a spontaneously hyperattenuating crescent-shaped area. On computed tomography angiography, an increase in the thickness of the dissected artery can be observed with an eccentric and narrow lumen surrounded by the mural thrombus and the intimal flap. On MRI, the T1 sequence with fat saturation is the best to characterize the dissection, in which the mural thrombus classically presents hypersignal. In angioresonance, we can see irregularities in the walls of the dissected vessel, reduction or absence of blood flow signal.[23]

Reversible Cerebral Vasoconstriction Syndrome

Reversible cerebral vasoconstriction syndrome, also called Call-Fleming syndrome and spasm-associated headache, is characterized by severe headache with or without neurological symptoms and vasospasms, determining a vascular appearance in a "necklace of beads". It is more frequent in women and can be precipitated by pregnancy, drug use, sexual intercourse, etc. Disappear spontaneously in 1-3 months. (Figure 3).[25,26]

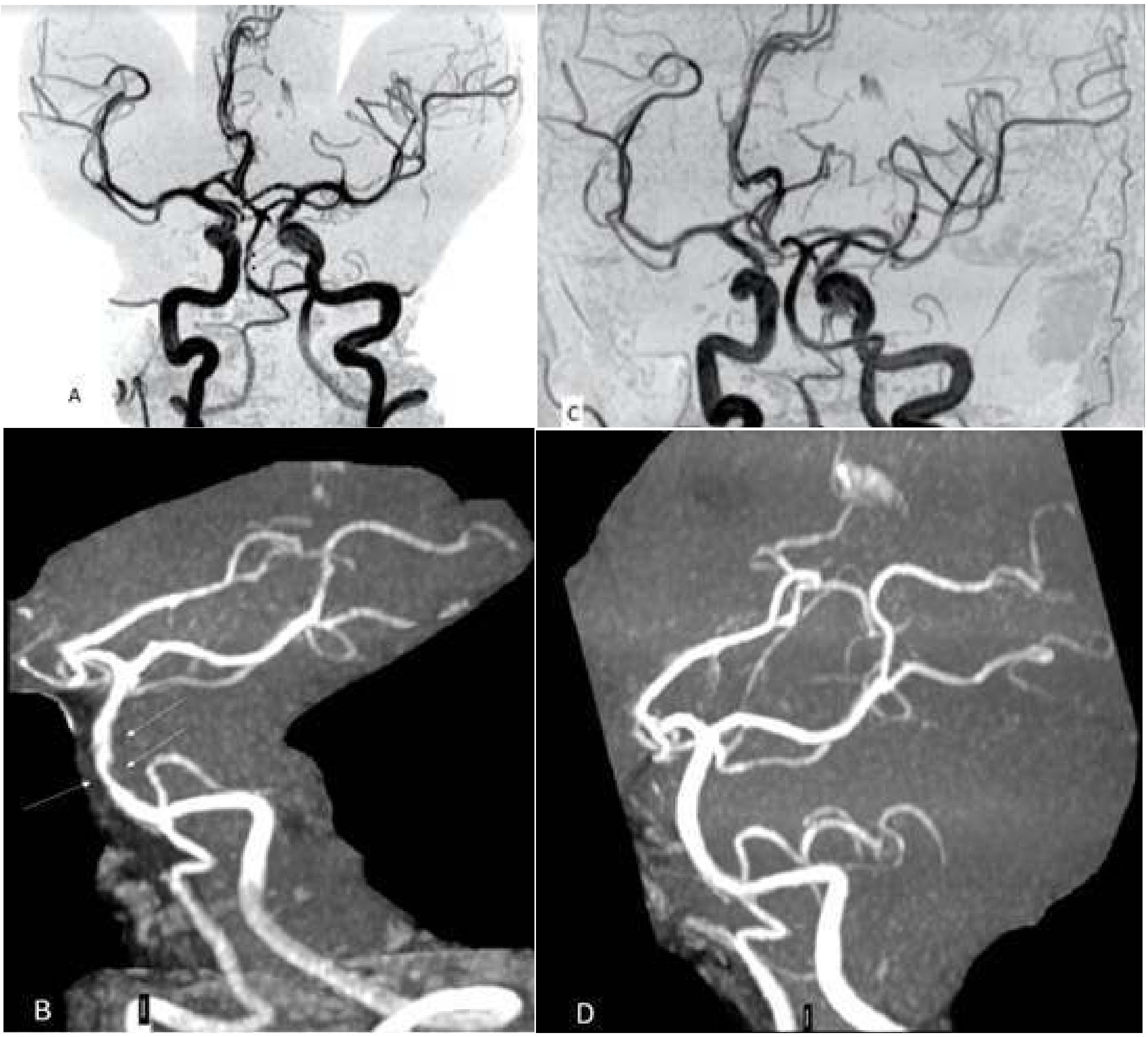

Figure 3. Vascular cause of headache, probable basilar artery dissection or vasospasm. Male patient reports onset of intense headache during sexual intercourse. Digital angiography (A) and magnetic resonance angiography with 3DTOF technique (B) showing moderate reduction in caliber and parietal irregularities in the middle and lower third of the basilar artery. There is dominance of the left vertebral artery and hypoplasia of the right (anatomical variation). Digital angiography (C) and magnetic resonance angiography with 3DTOF technique (D) control, two months later, showing that the basilar artery has normal caliber and contours, with complete resolution of the image and the patient's symptoms.

Conclusion

In conclusion, a neuroimaging evaluation is paramount in addition to a neurological and physical examination of the critically ill patient with cerebrovascular disease or who has suffered a traumatic brain injury.

No conflict of interest

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The work was financed with own resources.

Authors' contribution
MFVVA and LCA, wrote the article and the selection of the figures; MMV, the final edit of the manuscript.

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