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Basilar artery occlusion: Prognostic signs of severity on computed tomography

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ABSTRACT

Purpose: To determine the computed tomography (CT) signs that are predictive of the clinical outcome of basilar artery occlusion (BAO).
Materials and methods: The study population consisted in 37 patients (14 women, 23 men, mean age: 63 years), admitted with onset of neurological deficit, starting 1–72 h prior to admission, who were diagnosed with BAO on the basis of a CT examination with intravenous contrast agent. The following signs were collected on CT scans performed on admission: clot density on noncontrast images, clot length, and clot location, as well as the presence of acute ischemic lesions. The results were compared against the modified Rankin Scale (mRS) score of patients at 3 months, favorable clinical outcome being defined as a mRS score ≤ 3.
Results: The clinical outcome was favorable in 13 (35%) of the 37 patients and unfavorable in 24 (65%). Signs of acute ischemia were visible in 13 of the 24 patients with unfavorable outcome but in none of the 13 patients with favorable outcome ($p < 0.001$). None of the other CT signs analyzed were significantly correlated with clinical prognosis.
Conclusion: Of all the CT signs analyzed, only the presence of signs of acute ischemia on the admission CT of patients with BAO was associated with poor prognosis.

1. Introduction

Basilar artery occlusion (BAO) is a rare pathology that accounts for around 1% of all strokes [1] and that may have disastrous neurological consequences, including locked-in syndrome. Computed tomography (CT) is considered to be the best imaging modality for diagnosing BAO [2]. However, the role of CT signs in predicting the clinical outcome of patients is the subject of controversy. One study [3] has suggested that the only CT criterion that is predictive of survival is distal clot location, whereas "noncontrast brain CT findings did not predict survival or neurologic outcome." In contrast, other studies have suggested that signs of acute ischemia (early ischemic changes) were predictive of poor outcome [4–6]. Some authors have also suggested that basilar artery hyperdensity on native images may be a factor of poor prognosis [7].

This study's goal was to analyze the value of all these radiological signs on admission CT scans for predicting poor outcome in patients admitted to our institution for BAO.

2. Materials and methods

2.1. Patient selection

Patient selection for our study was performed by keyword search in an electronic database of consecutive radiological reports. A diagnosis of BAO was established in 48 patients. Of these, 11 were excluded from the study because there was no information on their clinical outcome ($n = 8$) or because there were no series of contrast CT scans ($n = 3$). The CT examinations of the 37 patients who

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constituted our study sample involved a series of unenhanced CT scans followed by another series of scans (1.25 mm thickness every 0.6 mm) taken after intravenous (i.v.) administration of 100 ml of an iodine contrast agent (Iohexol 350 mgI/ml) in the arterial phase (angio-CT). The examinations of these patients were performed using a Philips 16-row Mx8000 scanner (Philips Medical Systems, Best, the Netherlands).

Radiological image analysis was carried out by means of consensus reading by two emergency radiologists (attendings of the emergency radiology unit) who had 15 and 17 years of experience, respectively.

The following radiological signs were analyzed.

Unenhanced scans: the presence of acute parenchymal lesions (Fig. 1), which were defined as hypoattenuated regions with poorly defined contours in a vascular territory of the basilar artery [6].

If the clot was visible without contrast (Fig. 2), its maximum density in Hounsfield Unit (HU) was measured [8].

Scans after the administration of contrast agent (arterial phase): clot length (mm) and clot location in the distal basilar artery as opposed to another location in the vertebrobasilar system (Fig. 3). The following locations were taken in account: the proximal and mid portions of the basilar artery (between the vertebrobasilar junction and the superior cerebellar artery), and the distal portion of the basilar artery (between the superior cerebellar artery and the origin of the posterior cerebral arteries) [1]. For those patients with an acute hypodense parenchyma lesion in the posterior circulation, the ASPECT score was calculated using a 10 points grading system, according to the methodology reported in prior series as "pc-ASPECTS" [9]. Following the methodology advocated by the latter international cooperative study, the ASPECT score was dichotomized at $\geq$8 or versus <8 [9].

Once the images had been analyzed, the neurological clinical outcome score on the modified Rankin Scale (mRS) at 3 months after the acute episode of BAO was found for each patient and was taken as the standard reference in the subsequent statistical analyses. Favorable outcome was defined as a mRS score $\leq$3 (the patient requires daily help but can walk without assistance). A poor outcome was defined as a mRS score >3 (the patient is unable to walk without assistance) or as BAO-related death [10].

For each patient, the NIHSS (National Institute of Heath Stroke Scale) at admission [11] was retrieved from the admission file, as well as the time elapsed from the symptoms onset to the CT.

The patients' treatment was also recorded. According to our local guidelines, patients with BAO usually undergo an immediate i.v. thrombolysis followed by either a mechanical thrombectomy (clot entrapment in a stent) or an intra-arterial thrombolysis. However, the standard treatment may vary according to

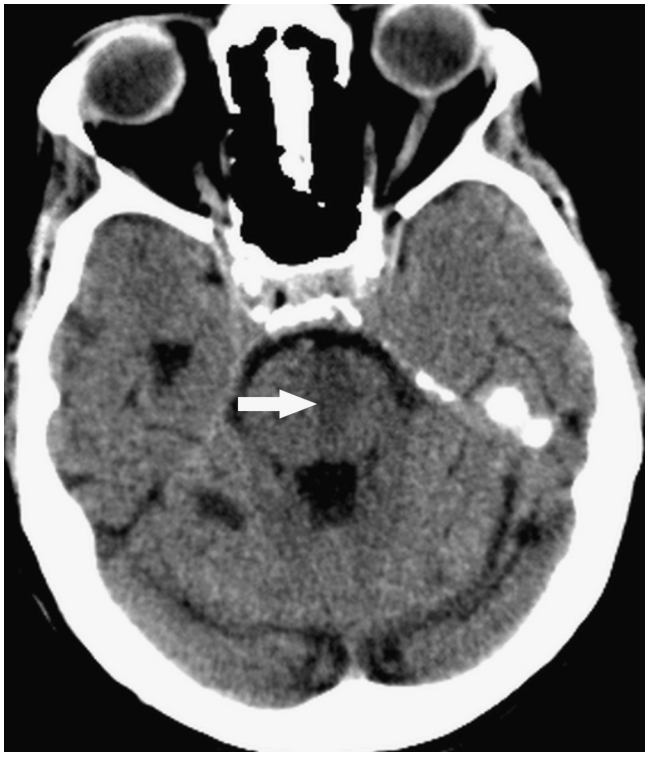

Fig. 1. Acute ischemic lesion associated to basilar artery occlusion. Axial nonenhanced CT image shows a ill defined hypodense area in the left aspect of the pons (arrow), consistent with an acute ischemia.

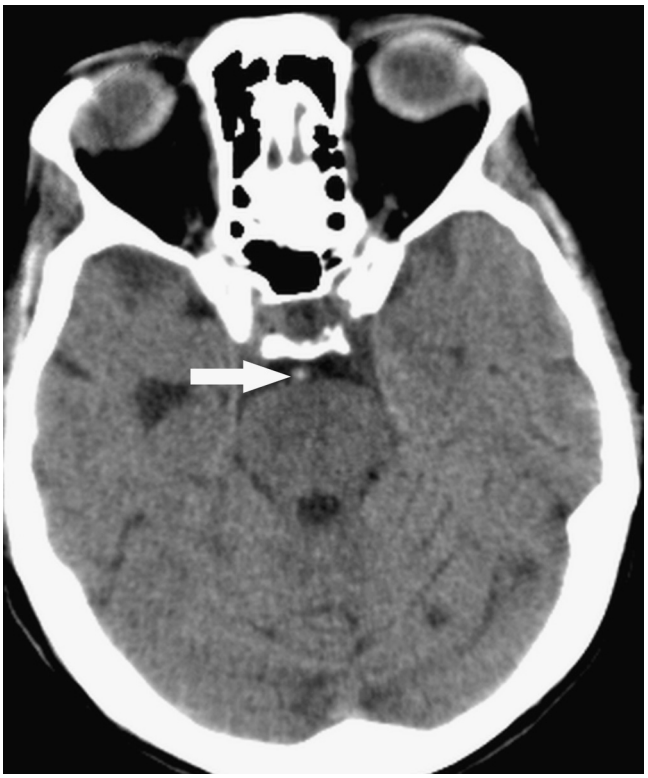

Fig. 2. Basilar artery occlusion. On this axial nonenhanced CT image, the basilar artery blood clot appears hyperdense (arrow) when compared to the surrounding structures.

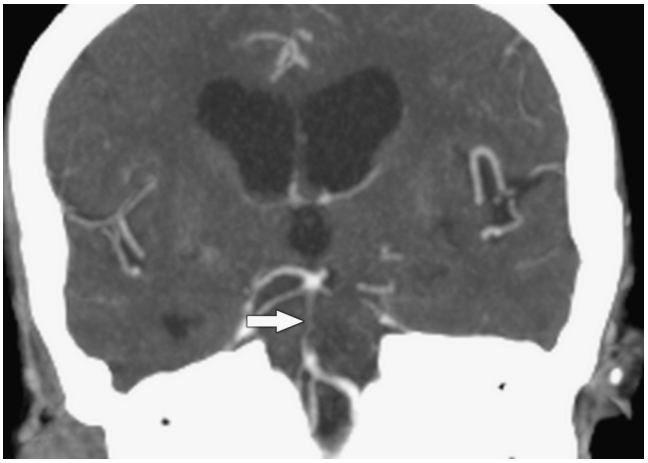

Fig. 3. Basilar artery occlusion. Coronal CT angiography shows a long thrombus (arrows), located in the proximal and middle segments of the basilar artery.