BRANCH ATHEROMATOUS DISEASE:
Narrative review of clinical and neuroimaging features

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1. BACKGROUND

Intracranial branch atheromatous disease (BAD) was originally described as the occlusion or stenosis at the origin of a deep penetrating artery due to large parent arterial disease or by microatheroma of the proximal portion of a perforator [1]. The term BAD is currently used to label imaging features supposedly associated with the proximal occlusion of a penetrating artery.

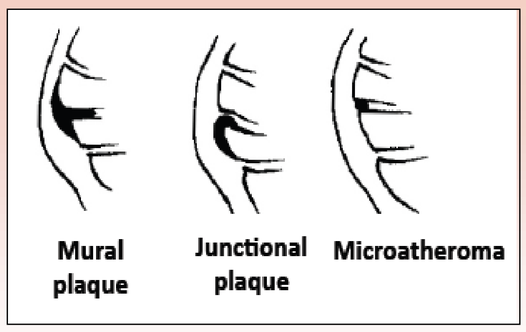

Figure 1: Sites of BAD [1]

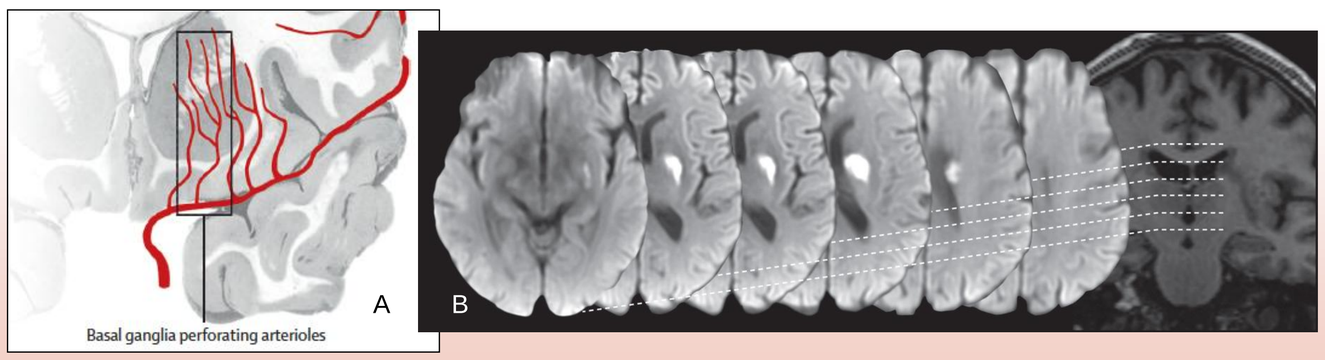

Figure 2: BAD-related infarct in the basal ganglia perforating arterioles (A): the infarct follows the line of a perforating arteriole (B) [2]

We review the definition of BAD, as well as the associated clinical and imaging features.

2. METHODS

Search terms:
'*branch atheromatous disease*'
'*intracranial branch atheromatous disease*'
'*cerebral branch atheromatous disease*'
combined with '*stroke*'

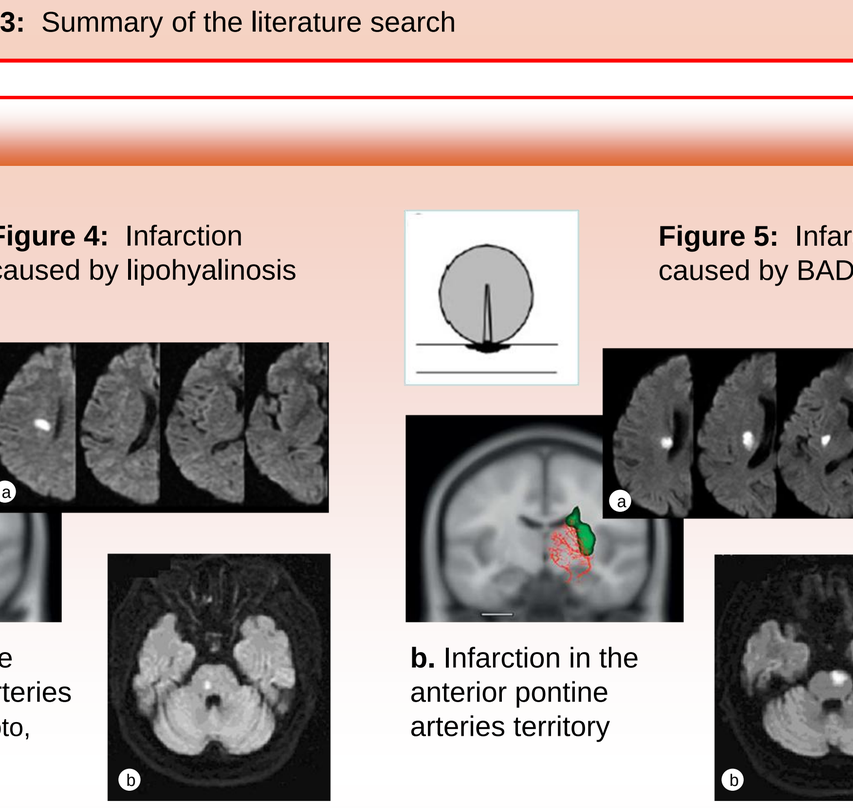

Figure 3: Summary of the literature search

3. SUMMARY

- We found a great heterogeneity in the criteria used to define BAD related stroke.
- There is a great variability of the clinical features reported in BAD related stroke patients, in particular a consistent association between BAD and any specific vascular risk factor profile has not been detected.
- Despite discrepant definitions, early neurological worsening is frequently observed in BAD related strokes, although no specific predictor or mechanism of progression has been identified [3].
- Traditional imaging techniques such as CT and conventional MRI can only show indirect features of parent artery disease, so BAD radiological diagnosis is mostly based on the features of the subcortical infarction, i.e. vascular territory, dimensions and/or shape of the acute ischemic lesion.

Figure 4: Infarction caused by lipohyalinosis

a. Infarction in the lenticulostriate arteries territory (Yamamoto, *J Neurol Sci* 2011)

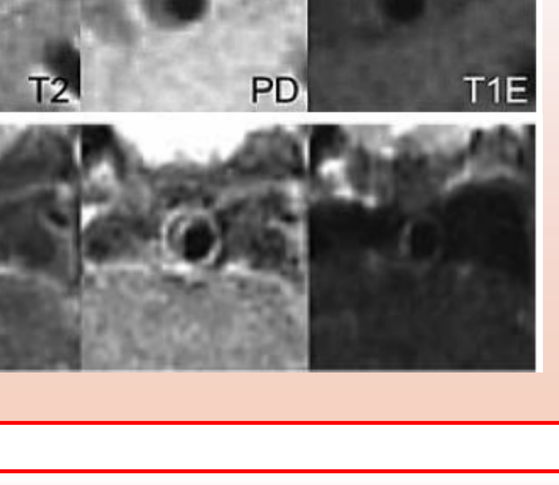

Figure 5: Infarction caused by BAD

b. Infarction in the anterior pontine arteries territory

- Recently, High-Resolution (HR) MRI proved to be capable of studying the morphology of intracranial artery vessels, including the presence of plaques involving parent arteries [4]. This could allow direct exploration of the atheromatous small vessel and parent vessel lesions that subtend to BAD.

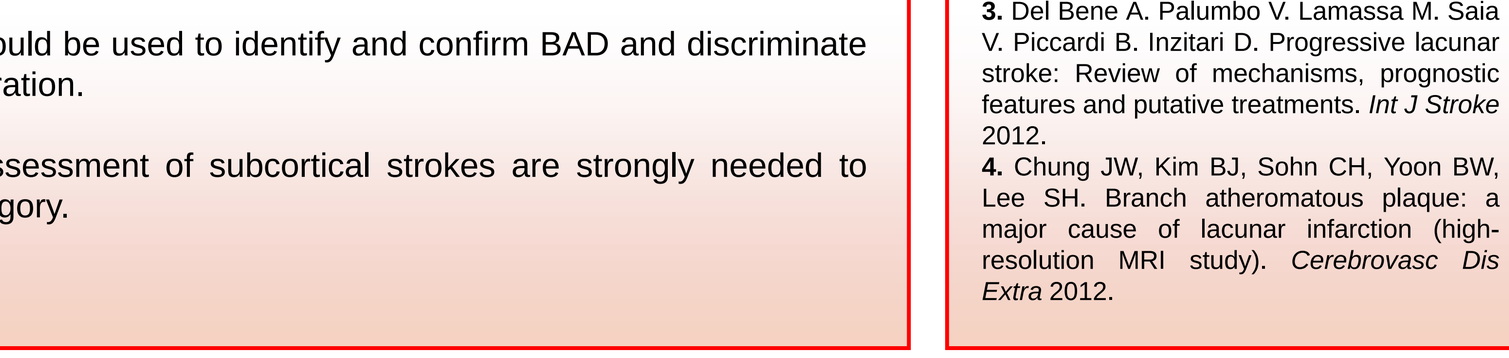

Figure 5: Imaging findings of BAD related infarct and branch atheromatous plaque in the middle cerebral artery (a) and in the basilar artery (b). Note the absence of lesions on MRA and the mild enhancement of the plaque on T1E images [4]

CONCLUSIONS

- Our literature search showed the lack of a unanimously accepted definition of BAD that is not consistently acknowledged as an aspect of either large or small vessel disease.
- One of the most consistent data emerging from our review is that BAD related stroke is at high risk of progression after stroke onset.
- High resolution arterial wall imaging, namely HR-MRI, should be used to identify and confirm BAD and discriminate it from subcortical infarctions due to lipohyalinotic degeneration.
- Prospective studies employing HR techniques in the assessment of subcortical strokes are strongly needed to better define the boundaries of BAD as a nosological category.

REFERENCES

1. Caplan LR. Intracranial branch atheromatous disease: a neglected, understudied, and underused concept. *Neurology* 1989.
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4. Chung JW, Kim BJ, Sohn CH, Yoon BW, Lee SH. Branch atheromatous plaque: a major cause of lacunar infarction (high-resolution MRI study). *Cerebrovasc Dis Extra* 2012.