

Research article

Incidental discovery of chronic lacunar infarction in the head of the caudate nucleus: pathophysiological considerations and retroactive etiologic diagnosis of a depressive syndrome.

Case presentation

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Abstract: Introduction. Neuroimaging studies demonstrated the complex caudate nucleus' interrelationships within topographically organized cortical networks and its strategic role in emotional balance.

Case presentation. The clinical case depicts a 71-year-old female patient with chronic depressive syndrome, orthostatic hypotension, hyperlipidemia, and arthritis. CT cerebral imagery incidentally revealed an old lacunar infarction in the right caudate nucleus with a diameter of about 6 mm.

Written informed consent was obtained from the patient for the inclusion and use of materials related to the case, respecting the confidentiality of her identity data. The presentation of this clinical case has the approval of the ethics commission of TEHBA (no. 40205/01.09.2023).

Discussion. The authors hypothesized that the old lacuna was incriminated as the organic substrate for chronic neuropsychiatric illness in an older woman with risk factors for cerebral small vessel disease.

The etiopathological assumption was contextualized in a selective literature review that focused on relevant data from recent publications and emphasized the caudate's strategic role in emotional balance and dysthymia.

Unilateral or bilateral small lacunae in the caudate nuclei are associated with a high risk of developing psychiatric complications but not motor deficits after stroke.

Keywords: caudate nucleus; lacunar stroke; incidentaloma; depressive syndrome; case report

1. Introduction

The striatum has a modular topographic anatomical-physiological structure based on hierarchical models of cortico-striatal neurocircuitry for appropriate goal-directed behaviors toward significant objectives: motivation (ventral striatum), planning and cognition aimed at appropriate specific actions (caudate), and sensorimotor coordination (putamen). [1, 2]

The neuronal connections between the neocortex and the caudate nucleus (CN) are systematically interconnected in cortical-specific areas and functional domains to

integrate territories, networks, and information across reward, cognition, and motor functions. [1-4]

Cortical inputs to the striatum are topographically integrated and organized into the human default mode network (DMN). [5, 6]

The CN is intricately linked to executive functions, cognitive operational control, motor processes, and affective implications. [1-10]

The CN is involved in several non-motor functions: motivation, learning, and reward processing. Lesions in this area were also associated with neuropsychiatric symptoms such as depression, apathy, anxiety, and anhedonia.

The CN may regulate the stress response, and lesions in this area may lead to increased susceptibility to stress and subsequent development of depression.

A possible mechanism for this association is that the CN regulates reward processing and motivation, and lesions in this area may lead to a decreased ability to experience pleasure and reward, which are key symptoms of depression.

Case presentation. A 71-year-old right-handed female with a medical history of depressive syndrome (in the past 12 years), postural hypotension, and arthritic disease was admitted to our rehabilitation department. Her complaints included generalized joint pain and dizziness when leaving the bed.

The patient was semi-illiterate and hearing impaired, so her evaluation was difficult. However, no neurological pathological signs were found during the examination. BP was 90/60 mm Hg (left-right), and the heart rate was 90/min in sinus rhythm. The ECG had a regular appearance. Blood tests revealed mixed dyslipidemia with high serum triglyceride levels (241 mg/L) and moderate cholesterol levels (206 mg/L).

A native brain CT scan incidentally detected an old lacunar area (of a maximum of 6 mm in diameter) at the level of the right caudate nucleus (Fig.1).

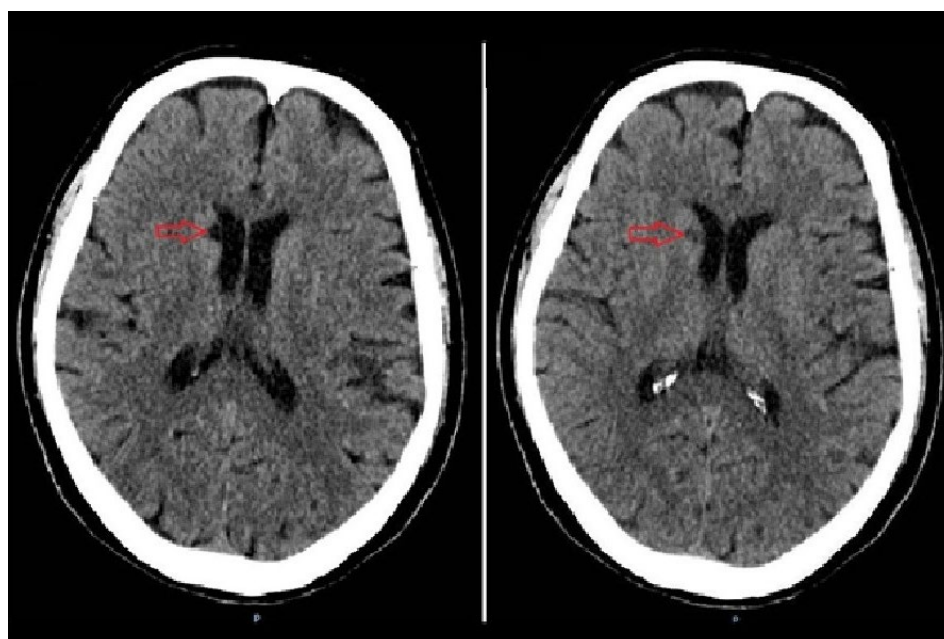


Fig.1 Brain CT scan: small chronic lacunar infarction in the head of the right caudate nucleus (red arrows).

The psychological examination revealed severe anxiety-depressive disorders with psychosomatic manifestations, moderate cognitive decline, attention deficits, and immediate and short-term memory impairment.

The Mini-Cog test for a brief psychological assessment to help detect dementia in its early stages was preferred because it contains little language and allows a brief cognitive evaluation. The 3-item recall component score was 1, and the clock drawing test noted 1.

The HARD total score was 58 (H mood: 12/18; anxiety: 18/18; retardation: 15/18; danger: 13/18), indicating a moderate level of emergency.

The patient received a hypolipidemic diet and symptomatic and pathogenic medication. She received rosuvastatin 10 mg, aspirin 75 mg, non-steroidal anti-inflammatory drugs, and gastroprotection.

The daily combination of anxiolytic and antidepressant medications (tianeptine 12.5 mg and lorazepam 1 mg) had a good therapeutic effect. No adverse events were observed.

The ad functionem prognosis was good at discharge. The patient was self-sufficient in both basic and instrumental daily living activities.

The ad vitam prognosis depends on the future evolution of her cardio-cerebrovascular condition.

The patient was discharged with instructions for medical follow-up at the territorial Polyclinic.

Methods. Only 20 relevant publications (1984–2022) to support the clinical case were located via an advanced PubMed search that targeted the syntax ((caudate nucleus) AND (stroke) AND (depression)).

However, within the same frame of time, a staggering number of papers were discovered, utilizing the associated terms (stroke) AND (depression), (Fig.2).

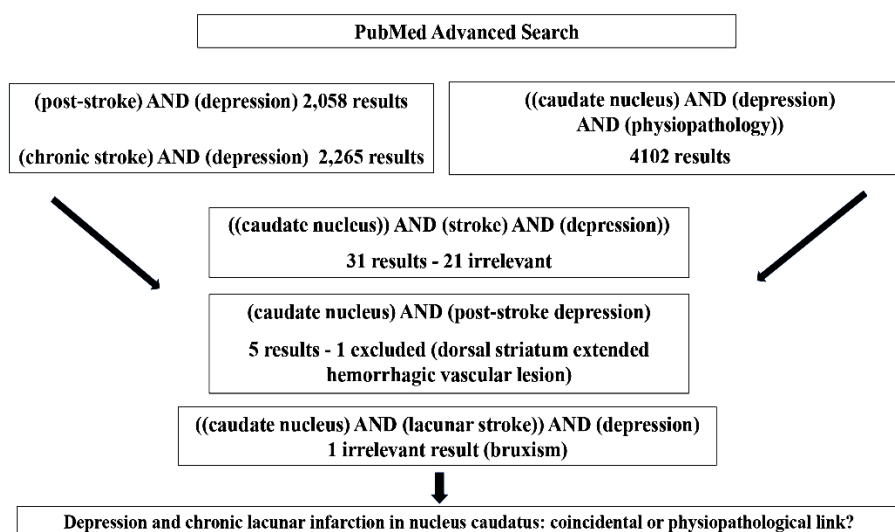


Fig.2 An advanced PubMed search that targeted the syntax ((caudate nucleus) AND (stroke) AND (depression)) yielded few relevant publications (1984-2022) to support the clinical case.

Discussion. Neuroimaging studies emphasized the complex CN's interrelationships within topographically organized cortical networks and its strategic role in emotional balance.

Neuroimaging studies have demonstrated the strategic importance of the CN in maintaining emotional balance and its complex interactions within topographically structured cortical networks.

The paper completes the information regarding the pathophysiological aspects related to lacunar stroke and the CN with recent data from the literature.

Brain CT imaging unexpectedly revealed a small lacuna in the head of the right caudate nucleus (CN) in a 71-year-old woman with associated risk factors for cerebral small artery disease, depressive chronic disorders, and no apparent neurological dysfunction.

The authors hypothesized that the CN lacuna probably represented the organic substrate for chronic neuropsychiatric complications in an older woman with risk factors for cerebral small vessel disease. The etiopathological assumption was contextualized in a selective literature review focused on relevant data from recent publications.

In recent neuroimaging, morphological, and functional studies, the significance of subcortical neural networks and their pathological structural changes in depressive syndrome has been emphasized [5-8] and demonstrated that the CN is an anatomical element integrated into the networks that regulate behavior [5-10]. It is joined into complex cortico-subcortical neural circuits as follows:

the nucleus accumbens, rostral putamen, the orbitofrontal and anterior cingulate cortices all project to the ventromedial region of the CN.

the ventromedial prefrontal cortex is connected to the medial portion of the CN and nucleus accumbens

the central CN (and, to a lesser extent, the putamen) are connected to the dorsal anterior region of the cingulate cortex.

the dorsolateral prefrontal cortex projects to the rostral central region of the CN. [12]

According to MRI morphometric investigations of depressed subjects, structural volumetric differences were noted in regional gray and white matter volumes between several cortical and subcortical anatomic structures in the bilateral CN, thalamus, hippocampus, amygdala, and anterior cingulate cortex. [9, 11-13]

Neuroimaging morphological investigations demonstrated that depressed individuals had reduced CN volume compared to healthy controls. [12, 13]

A decrease in gray matter volume in the anatomical structures of the DMN, as well as the disruption of the connectivity of the ventrolateral prefrontal cortex with the CN, was noted in patients with late-life depression and suicidal thoughts. [14]

Recent fMRI studies found an age-related reduction of the CN's morphologic integrity, topographic organization, and functional connectivity. [2, 13]

Significant cerebrovascular alterations and decreased amplitude of spontaneous hemodynamic response both in the CN and orbital frontal cortex were noticed in people with major depressive disorder compared to healthy controls. This disorder may be correlated to an unbalanced integration of emotional-related information noticed in depressed subjects. [8]

The CN's head has a particular anatomical situation that confers advantages when radiologically assessing small infarcts. Chronic lacunae appear as hypodense foci on CT scans and have a radiological appearance similar to cerebrospinal fluid. [15]

Small infarcts are mainly in the head of the CN and range in size from 2.1 to 8.6 mm and can affect the CN unilaterally (or bilaterally). A performative 7T-MRI study revealed multiple CN lacunae in a single patient. [16]

Caudate infarcts are caused by chronic, progressive small-artery cerebral disease in more than half of cases. [17-19]

The pathognomonic pathological and neuroimaging features that characterize cerebral small vessel disease consist of small lacunae (ranging from 1.5 to 15 mm in diameter). These are located in the cortical and/or subcortical areas of the brain, are (sometimes) confirmed by brain autopsy studies, and are detected (in most cases) by usual CT and/or 1.5 T-MRI scanning techniques.

In most elderly patients, lacunae and white matter degeneration are accidental findings on CT or MRI scans. These incidentalomas are referred to as "silent/subclinical/asymptomatic strokes". [19-20]

Neuropsychological and neuropsychiatric syndromes, like depression, apathy, and cognitive impairment, are frequent sequelae of stroke. [21-24]

A meta-analysis and comprehensive review of the prevalence of depression following a stroke found that, with an overall frequency of 27%, depression was the most common psychiatric disorder. Later depression (persisting after 3 to 12 months after the vascular event) was observed in 9% of subjects. [22]

Post-acute stroke depression is induced by dysfunction of the five defined frontostriatal circuits: cortico-striatal, pallido-thalamic, and cortical projections that modulate the cortical-thalamic-cortical pathway and their corresponding subcortical nuclei. [7, 8, 10, 14, 22]

Lesions in the ventral head of CN disrupt complex neurocircuits in the frontal-basal ganglia-thalamus-cortical networks. [2, 4, 10]

The volumes and pathomorphological changes of 15 subcortical regions were studied using 3T-MRI. People with early post-stroke depression (PSD) had smaller volumes of the accumbens nuclei, bilateral thalamus, and left pallidum than post-stroke non-depressed subjects. There was a significant statistical difference between the PSD group and both the major depressive patients and the healthy control participants. [8, 9]

PSD is frequently encountered in patients with CN and lenticular lesions. [12, 21-24]

A recent paper that examined the importance of CN in emotional processing was carried out on patients with a single ischemic stroke in the right hemisphere and investigated the role of CN in the processing of emotions. Eight patients (15.4%) had NC lesions, which are associated with a deficit in facial recognition of emotional happiness and sadness. [24]

The limitations of the clinical case are related to the absence of clear borderstones in the patient's medical history. It is impossible to establish the onset of an asymptomatic stroke based on an accidentally discovered cerebral lacuna.

The absence of a more thorough morpho-functional neuroimaging investigation in basic neuroscience is the cause of additional presentation limitations. These methods (mentioned in the discussion) could identify pathophysiological aspects of the complex neural structures that link and integrate NC within depressive-like behavior.

A brief review of recent relevant literature highlighted the link between depression and NC in lacunar infarct patients and supported the organic etiological theory. The retrospective diagnosis of the patient's depressive state was made based on the pathophysiological correlates of the CN.

The treatment management addressed lacunar stroke risk factors and secondary prevention and included antiplatelet therapy, neurotrophic agents, and dyslipidemia control in tandem with antidepressant medication.

Clinical, laboratory, and imagery follow-up was recommended in the territory.

Conclusions A targeted literature review highlighting the CN's strategic role in emotional balance and dysthymia supported the clinical case. The authors hypothesized that persistent psychiatric illness might have an organic substrate.

Unilateral or bilateral small lacunae in the CN are associated with a high risk of developing neuropsychiatric complications but not motor deficits after stroke.

Although evidence links CN lesions to depression, more study is required to comprehend these connections and the underlying mechanisms completely.

Abbreviations:

CN, caudate nucleus

CT, computerized tomography (scan)

fMRI, functional magnetic resonance imaging

1.5/3/7 T-MRI, Tesla MRI scanner

DMN, Default Mode Network

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