Basal Ganglia Calcification. Characteristics of CT Scans and Clinical Findings*

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Calcium deposits in the basal ganglia have been known as a pathological entity for more than a century (17). They occur in tuberous sclerosis, toxoplasmosis, Fahr's disease, or in cytomegalic inclusion diseases. Furthermore, it has been generally accepted that most of them are caused by a disorder of calcium metabolism (6), including idiopathic or postoperative hypoparathyroidism, pseudohypoparathyroidism, or even hyperparathyroidism (4, 9). Cases of bilateral basal ganglia calcification are sometimes familial, usually autosomal dominant, but also autosomal recessive (5). Some of these calcifications are labelled "idiopathic" and should be classified as "physiological calcification", or in the current terminology "pseudocalcification" (13). Its basic pathological process seems to be a colloid deposition in and around the finer cerebral blood vessels with subsequent calcification. It is to be noted that there may occur an admixture of other substances, such as several metals, mostly iron (16). They are usually symmetric and may be associated with calcification of the dentate nucleus. Such deposits appear to be different from the other intracranial calcifications which are attributed to diseases or situated in brain tumors.

CT characteristics

Though basal ganglia calcifications were previously identified radiographically by plain skull films, computed tomography (CT) appears to be much more sensitive for detection of them. CT may be stated to be the method of choice in the diagnosis of intracranial calcifications. Phantom studies indicate that CT is 5 to 15 times more sensitive in this respect than conventional skull radiographs (12). Furthermore, skull films do not permit exact basal ganglia localization of calcifications. Calcium or even "pseudocalcium" (13) has CT absorption coefficients from 50 μ to 500 μ. Its density is easily distinguished from other densities by CT (2, 7).

The attenuation differences between the center of the calcification and normal brain tissue are well documented (14). They ranged from 8 to 190 EMI units. Due to a partial volume effect, microscopically scattered calcifications may also cause only a slight attenuation increase. The calcifications are characteristically located in the pallidum, the putamen, and the dentate nucleus. They are almost always bilateral and usually symmetrical, and represent now a distinct CT entity (1).
In one of our "idiopathic" cases, bilateral calcifications were extensive in the pallidum and the putamen (Fig. 1a). Those in the thalamus (Fig. 1b) and the caudate nucleus were small. Skull films were normal. The patient had no symptoms or signs of extrapyramidal dysfunction and no abnormal serum-calcium-phosphorus levels.

CT and clincial correlation

Most neurological symptoms of our few patients could be explained by findings other than basal ganglia calcification. In other previously described series (3, 8), basal ganglia calcification conformed poorly to a commonly mentioned syndrome of mental retardation, seizures, and extrapyramidal or even pyramidal signs. Most of the patients lacked consistent symptoms or had neurological signs which could be explained by other pathology.
Our material, however, is too small for conclusions in this respect. In our few cases, the symptomatology does not differ with different location of the calcifications, which might be present only in a part of the lesions and not necessarily in the symptom-giving part.
Neuropathological studies (10, 11, 15) show that despite excessive mineral deposits in the globus pallidus, there was seldom significant loss of nerve cells. Although a progressive nature of basal ganglia cal-

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cification had been stated (9), some patients have no symptoms, and in other reported cases the neurological deficits were often transitory (8, 12).

Conclusions

Basal ganglia calcification may be observed microscopically in 40 to 70 percent of routine autopsies (15) without evidence of calcification elsewhere in the brain. Where physiological calcification observed on skull films or CT scans occurs together with neurological disorders the kind and nature of the neurological disturbances vary widely. A presymptomatic population with basal ganglia calcification should be identified by CT.

The pathophysiology of these calcifications still remains essentially unknown. Several theories have been proposed. They are mostly oversimplified approaches, and the normality of calcium metabolism in many patients is still a strong argument against them.

Therefore, patients with symmetric or bilateral basal ganglia calcification, without extrapyramidal signs, do not require extensive or invasive procedures such as angiography, which would only be warranted by further neurological symptoms or coexisting cerebrovascular insufficiency.

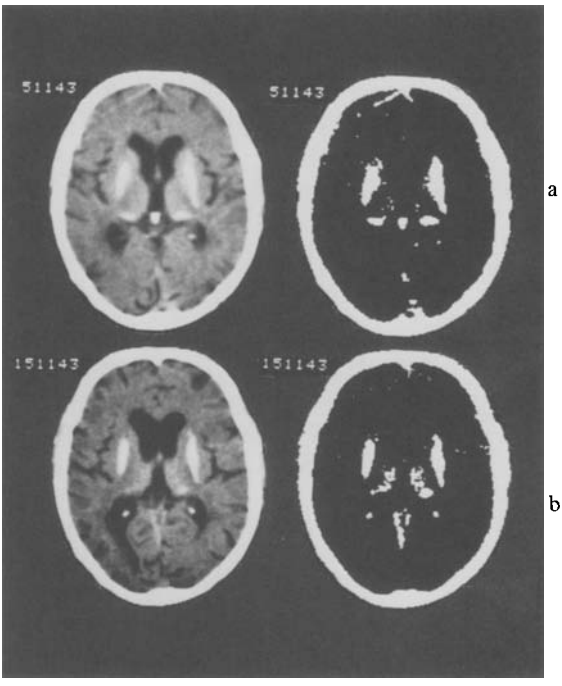

Fig. 1a, b Computerized tomograms illustrating bilateral calcification. a: pallidum, putamen. b: thalamus, pallidum, caudate nucleus. Scanner Siretom 2000 E. Image build-up in different window positions.

Summary

Intracranial calcifications are attributed to many diseases. The globus pallidus is almost always the site of bilateral idiopathic calcium deposits. Computed tomography is superior to conventional skull radiographs in detecting intracranial calcifications. Patients had symptoms that were often explained by other findings. Basal ganglia calcification alone is not a nosological entity and does not justify invasive diagnostic procedures.

Key words:
Basal ganglia – Cranial computerized tomography – Intracranial calcification

Zusammenfassung

Intracraniale Verkalkungen kommen bei zahlreichen Krankheiten vor. Beiderseitige idiopathische Kalkablagerungen finden sich zumeist im Globus pallidus. Zur Entdeckung intracranialer Verkalkungen ist die Computertomographie den konventionellen Röntgenaufnahmen des Schädels überlegen. Die Symptome der Patienten waren aber oft durch ganz andere Befunde begründbar. Verkalkungen in Basalganglien bilden keine nosologische Einheit und sie sind kein alleiniger Grund zu invasiven diagnostischen Maßnahmen.

Schlüsselwörter:
Basalganglien – Craniale Computertomographie – Intracraniale Verkalkungen

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