OSSIFICATION OF SUBDURAL HEMATOMA
REPORT OF TWO CASES

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Although the connective-tissue membrane surrounding a subdural hematoma has been described as hyalinized, or calcified partially or in patches, by several authors, only occasional references to totally organized, calcified or ossified hematomas have been found. Munro, among 310 cases, noted 1 such hematoma, Christensen mentioned only 1 case, and Krayenbühl, Lazorthes, Hanke, Dandy, and Voris did not refer to any similar cases in their large materials.

The earlier literature deals mainly with ossified or calcified crust-like hematomas covering the hemisphere, most of which, from pathological and radiological descriptions, were accidental findings. Lewis first mentioned the calcified hematoma, and Goldhahn (1930) reported the first successful removal of one by operation. Schiller and Dyke and Davidoff described the radiological diagnosis of calcified hematomas. Allen et al., and more recently Mosberg and Smith reported accidental findings of these lesions at autopsy. There are only sporadic reports of calcified or ossified subdural hematoma operated upon successfully and not one author was found who had published more than 1 case.

CASE REPORTS

Case 1 (1932/1956). K.T., a female aged 22 years, had had "meningitis" when she was 3 years old. She was unconscious for 3 weeks and temporary paralysis of the left extremities developed. Since that time development and motion of the left extremities had been poor. For the last 10 years she had suffered very frequently occurring epileptic attacks with unconsciousness, which began with adversity on the left, and usually with psychomotor agitation. The child attended an institution for the education of defective children; she learned to write and read but was unable to learn sums.

Examination. The left part of the body and the left extremities were underdeveloped. The right pupil was larger than the left. There was left central paresis of the 7th and 12th nerves. Tendon reflexes on the left were increased, and Babinski's sign on the left was positive. There was left-sided spastic hemiparesis, most characteristic in the hand. There were no disturbances of sensation. Behavior was infantile, with adherence and inclination to perseverance. Disposition was unsteady. She could deal with only the most simple everyday ideas.

Lumbar spinal fluid contained 2/3 cells and 34 mg. per cent protein, Pandy was negative; electroencephalogram showed right-sided diffuse moderate dysrhythmia. Temporal conductions were upward steadily with tendency to theta-dysrhythmia of medium amplitude; during this course repeatedly high-amplitude inverted spikes appeared. When administering Evipan, inverted spikes appeared frequently in the right temporal conduction.

Roentgenograms of the skull showed thickening of the bone in the right temporoparietal region; here there were sharp, sclerotic thin edges (Fig. 1). Sella turcica was normal. Right percutaneous carotid angiography showed normal filling. Lumbar pneumoencephalography revealed abundant subarachnoidal filling, and enlargement of the ventricles; the ventricular system definitely was displaced to the right.

On the basis of the neurological changes caused by the focal epileptic fits and the electroencephalographic findings it was decided to perform a temporal lobectomy.

Operation. Right frontotemporoparietal craniotomy was performed. After turning down the bone flap, a bone-hard plate was found under the dura mater covering the whole opening. On opening the dura mater, the plate, 3–6 mm. thick, was disclosed. It covered the convexity and spread to the base, where it was thicker. The whole plate of bone, which was not adherent to the dura mater, was removed successfully. The surface of the brain was considerably atrophic, the gyri were

Fig. 1. Case 1. Anteroposterior roentgenogram of skull showing sharp-edged sclerotic deformation of bone in right temporoparietal region.
narrow and cicatrized above the Sylvian fossa, and the whole material was hard and congested. Corticography indicated slow, high-amplitude delta-theta waves all over the cortex of the temporal lobe; now and then a nontypical fast wave occurred. We removed the convexity of the temporal lobe and the basal cortex, and also the cicatrized cortical substance above the Sylvian fissure. Only delta-theta activity was present on the control corticography. The wound was closed in layers.

Course. There were rapid signs of recovery from the left hemiplegia, and the patient left the hospital capable of walking.

On examination 3 years later there was further improvement in signs of recovery from the hemiplegia. The proximate group of muscles of the upper extremities and the active movement in the lower extremities corresponded with preoperative conditions; between the wrist and fingers there was slight flexion contracture with paresis more grave than before. No epileptic seizures had occurred since operation. Electroencephalography showed low-amplitude, moderate dysrhythmical activity of the cortex. The variation in waves of temporocentral activity in the right hemisphere pointed to cortical atrophy.

Pathologic Report. The surgical specimen was 6×11 cm. in diameter and 3–6 mm. thick, and like a crust of bone to the naked eye. In shape it corresponded to the surface of the cerebral convexity. The surface of the upper part was smooth; the lower surface was lumpy and uneven to touch. Microscopic sections, made after decalcification, revealed compact, spongy and predominantly hyaline-like connective tissue extraor- dinary poor in cells, widely changing into bone-like material, and in several places regular structure of bone was found.

The removed part of cortex was 4×6 cm. in diameter, and 14–16 mm. thick. The gyri were narrow on the surface and slightly discolorated to yellow. They were compact and hard on palpation. Histologic sections show that nerve cells are rare, especially in layers III–V, and occasional pyknotic degenerative forms can be seen. Glial cells are decreased considerably, and on the whole there is no glial reaction around the vanishing nerve cells. Where the nerve cells have almost disappeared the basic substance is markedly spongy and here the perivascular spaces are enlarged, with definite formation of glial chambers.

Case 2 (148/1958). K.I., a male aged 39 years, had sustained an injury of the skull during an explosion in a mine 15 years before admission. He was unconscious for about 15 minutes. After the accident hearing in the left ear was poor. For the last 6 months he had suffered increasing headache, mainly on the left side. Roentgenograms in an out-patient department showed an intracranial calciferous shadow, and he was sent to our institute.

Examination. There was central paresis of the 7th cranial nerve and a peripheral lesion of the 8th nerve. There were no other abnormal neurological findings.

Lumbar spinal fluid contained 68/3 cells and 49 mg. per cent protein. Pandy was positive. Electroencephalography showed dysrhythmical activity of low amplitude; no indication of an organic lesion could be discovered.

Radiogram and tomogram of the skull showed large irregularly shaped calcareous shadows, measuring 8×3 cm. in the left frontoparietal region and approximately 5×1 cm. on the right. They were intracranial under the lamina interna and presumably were extracerebral. Left percutaneous carotid angiography showed the anterior cerebral artery dislocated moderately to the right (Fig. 2) and the curve of the artery was depressed somewhat. Pneumoencephalography showed dislocation of the whole ventricular system to the right. The left frontal horn was pressed inwards and the left temporal horn was narrower.

Though the radiograms of the skull indicated intracranial calcareous shadows on both sides, the tomogram and primarily the angiogram indicated a space-occupying lesion on the left side only. For this reason we thought it advisable to remove the calcified hematoma on the left only.

Operation. A left frontotemporoparietal craniotomy was performed. After opening the dura mater, the whole thin, bone-like plate, which partly covered the convexity, was removed (Fig. 3). The plate of bone was adherent to the dura mater and cortex only by loose connections which could be removed bluntly without causing bleeding. The wound was closed in layers.

Course. After operation hypotension of the cerebrospinal fluid occurred with grave disturbance of consciousness, which after appropriate treatment (infusion, intrathecal filling) gradually settled.

After 1 year the only neurological abnormality was central paresis of the 7th nerve on the right.

Pathologic Report. The thick crust-like curved tissue removed was 8×5 cm. in diameter and 5 mm. thick. It felt like bone and was grayish-yellow in color. The convex surface was smooth; the concave surface and its edges were uneven.

Histologic sections show compact, fibrous connective tissue here and there as basic material, characterized by its scarcity of cells and hyaline-like degeneration. However, the greater part of the tissue is composed of bone with haversian canals (Fig. 4).
DISCUSSION

The most frequent symptom of ossified subdural hematomas is epilepsy existing for many years, which in the majority of cases is focal in character. In most of the published cases epilepsy was the main symptom, and the increasing number of attacks or the progressive or fluctuating hemiplegia gave reason for detailed examination.

In our Case 1, the increasing occurrence of epileptic seizures during 12 years was the only subjective complaint of the patient. There were absolutely no symptoms of increased intracranial pressure. The focal seizures, of psychomotor and consistently adusive character, as well as the atrophy and paresis corresponding with the seizures, pointed to a circumscribed organized (atrophic) intracerebral lesion, and therefore directed our attention to the possibility of a successful operation for epilepsy. In Case 2, the knowledge of the severe trauma of the skull and...
the subsequent permanent headaches, although they were not severe, led to the detailed examination.

All authors emphasized the importance of cranial radiograms. We too noticed the calcified shadows directly under the calvarium—mentioned and described consistently in the literature—in our own cases, but their exact location can be determined only by tomography. The decrease of space in the skull existing for several years from distortions of bone can be analyzed by roentgen ray. Such distortions have been described as the results of hemorrhages in infancy by Dyke and Davidoff. Thus, because of the deepening of the middle fossa, the edge of the small wing of the sphenoid is displaced and the bones at the top of the skull may be thin. We did not find such changes in our cases. In Case 1 the hemorrhage occurred in early childhood. Presumably the cerebral atrophy and decrease of volume compensated for the decreased space, while a hemorrhage in an adult, as in our Case 2, can not result in the development of such changes in the skull.

As to the origin of degenerative symptoms (calcification and ossification) no satisfactory specific explanations were found. According to Lang the calcification induces irritation of tissue, which results in metaplastic ossification. Munro raised the question as to the indication of general calcification (calcinosis universalis). Fuchs believed it to be a hyperplastic process. In the opinion of the writer, the calcification or ossification of the hematoma is not an individual characteristic change, but should be classified among the dystrophic calcifications. Regressive phenomena occur in the chronic subdural hematoma, namely fatty degeneration, etc. We perceived in the capsule of many other chronic hematomas extensive necrosis of cells, and hyalinization of connective tissue, and in some cases there were only histologically proven grades of calcification. The poor circulation and absorption in the subdural space and the vascular thromboses show a well known inclination to depositing calcium.

The process demands many years according to present experiences, especially before the beginning of the occasional ossification. In both of our cases and all those mentioned in the literature the plate of bone was lying loose under the dura mater, and during operation it was removed with ease without causing bleeding. The fact that the hematoma is free from the dura mater, both macro- and microscopically, is against the opinion of Fuchs that the hematoma is caused by pachymeningitis.

After analyzing the pathological findings, the clinical process and the literature, it is presumed that once a hematoma has occurred it has a capacity for decreasing space, but it does not cause complete, permanent confusion of intracranial dynamics in every case and may be compensated for by unknown factors. Thus there is a possibility of transformation of the connective tissue of the hematoma, which after a long period becomes degenerated and, moreover, may become ossified.

**SUMMARY**

The author reports 2 cases of chronic calcified and ossified subdural hematomas diagnosed and operated upon successfully. After surveying the literature he emphasizes the extraordinary rarity of the findings and discusses the question of pathogenesis.

Histological sections of calcified or ossified subdural hematomas show the occurrence of gradual degeneration and transformation of the connective tissue, which need many years to develop according to his own and the cases reported in the literature. There is no specific explanation as to the process of calcification or ossification, but the author classifies the process among those of dystrophic calcification. All this indicates that the existence of such a hematoma is of many years' duration with maintenance of equilibrium of intracranial dynamics.

The genuine subdural location of the hematoma and the secondary organization in every case point to an intact dura mater. Macro- and microscopically the ossified hematoma is independent from its surroundings, which is against the theory that it is caused by pachymeningitis.

**REFERENCES**


9. KRAYENBÜHL, H., and NOTO, G. G. Das intracranial dynamics in every case and may be compensated for by unknown factors. Thus there is a possibility of transformation of the connective tissue of the hematoma, which after a long period becomes degenerated and, moreover, may become ossified.


