HEMISPHERECTOMY AND HEMITHALAMECTOMY IN MAN

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The thalamus is a large and well-differentiated nuclear mass and many of its connections have been worked out anatomically. Primarily, it has been considered to be the end station of most of the sensory systems of the body, being the recipient of at least seven afferent tracts. Despite this, in cases of tumors originating in the thalamus, sensory signs and symptoms are not at all prominent. Furthermore, in the operation of chemo- or electrothalamectomy, lesions are placed deliberately in the ventrolateral thalamus, and sensory sequelae are not common.

The thalamus, with special reference to the thalamic reticular system, has been considered to play a role in the coordination of cortical electrical activity and in the maintenance of consciousness. Yet, recent studies of hemispherectomy and hemithalamectomy in the monkey have shown no such disturbance of consciousness.

The most striking result of lesions of the thalamus to date has been the relief of abnormal motor phenomena such as parkinsonism and hemibalismus, results that are hard to understand in the light of present knowledge and physiology.

Following a hemidecortication in both monkey and man, there usually is a temporary abolition of all forms of sensation. This then is followed by a partial return of sensations of light touch and pin-prick over the face and body, but sense of position and other forms of deep sensibility are abolished permanently. Two explanations have been offered to explain the results of hemidecortication: either the thalamus of the ablated side is sufficient to account for the residual sensation or there is ipsilateral representation in the opposite thalamus. Convincing evidence has been advanced to support both points of view.

It is, of course, not possible to perform a hemidecortication without performing a partial thalamectomy as all cortical relay and association nuclei of the thalamus will show retrograde degeneration.

The preservation of motor function following hemicorticecctomy generally has been attributed to ipsilateral cortical representation rather than to the residual basal ganglia.

The results of ablation of the thalamus in primates have not been studied satisfactorily until recently. Although studies of hemidecorticate animals had been made by many observers, it was Mettler who, in 1943, succeeded in removing hemisphere, thalamus and subthalamus in a monkey in two operations. However, it remained for White et al. to develop a single-staged surgical technique that resulted in the survival of most of the animals. They did not attempt to isolate the afferent arteries first but carried out a sectional removal, entering the 3rd ventricle widely. They noted the following:

State of consciousness—within 2–6 hours after the operation, the animal was awake and responding to the environment. It was never somnolent. The animal would begin to eat 24–48 hours after the operation and resumed normal behavioral patterns within 2 weeks.

Motor activity—there was an initial flaccid hemiplegia, but the animal was crawling within 2 days, sitting by 4 days, and walking at 1 week.

There was excellent motor recovery in 2–3 months, the animal being able to stand, walk, run and climb. It did not regain fine movements in foot or hand. There was a limited spasticity and a slight hyperreflexia of the involved side without a Babinski’s sign. No extrapyramidal symptoms were present.

Sensation—there was complete hemianalgesia up to 24 hours. Following this there was gradual improvement, reaching a maximum in 1 month. Response to pin-prick was maximum in the face. Localization was poor and usually limited to recognition of the extremity stimulated. Response to heat was fairly good, apparently being interpreted as painful. There was no response to touch or vibration and tests for sense of position, hopping and placing were absent.

Control hemidecorticate animals recovered sensation more rapidly and to a higher degree than did hemispherectomized animals.

Comparable preparations in man are lacking. As pointed out by Penfield and Evans, the operation designated as hemispherectomy should in reality be called a hemicorticecctomy because every effort is made to spare the thalamus and basal ganglia. Austin and Grant found after “hemispherectomy” complete degeneration of the nucleus ventralis posterolateralis in the presence of pin-prick response, and postulated an ipsilateral thalamic representation.
Fig. 1. Appearance of right cerebral hemisphere prior to hemispherectomy. Note tumor at surface of brain in inferior and middle frontoparietal region. Inferiorly, the defect resulting from the previous temporal lobectomy may be seen.

CASE STUDY

History. The patient was a right-handed boy who was admitted to Mount Sinai Hospital at the age of 12 years, with complaints of headache, nausea, and weakness of the left side of 8 weeks' duration. Examination revealed bilateral papilledema and a left hemimotor and hemisensory syndrome. A right carotid angiogram disclosed a large nonstaining mass in the region of the right Sylvian fissure, dislocating some branches of the middle cerebral artery upwards and others downwards. At subsequent craniotomy, he was found to have an astrocytoma involving the insula and invading both temporal and inferior frontoparietal regions. A right temporal lobectomy was carried out for a distance of 6 cm. from the temporal pole, the dura mater was closed and the bone flap was wired back in place.

He made a good recovery and later was started on a course of radiotherapy. He returned to school and did well, but was readmitted to the hospital several times for convulsions. Two years after the operation, he began to have some weakness of the left side and a pneumoencephalogram done at this time showed considerable increase in the size of both lateral ventricles. There appeared to be a small mass bulging in the region of the caudate nucleus and the lateral ventricles were slightly dislocated to the left. The thalamic shadow appeared normal.

Last admission, almost 2½ years after operation, because of sudden headache, vomiting and drowsiness.

Examination. He appeared slightly obtunded but was oriented for time, place and person. Calculation was fair, as was memory. There was a severe spastic left hemiparesis, arm being more involved than leg. The deep tendon reflexes were 2½ plus on the right, 3 plus on the left. A left Babinski's sign was present. There was a left-sided sensory deficit involving all modalities. A complete left homonymous hemianopsia was present. There was bilateral papilledema.

A right carotid arteriogram showed marked dislocation of the anterior cerebral arteries to the left. The middle cerebral artery was depressed and its terminal branches were separated. There was now a stain typical of a malignant glioma in the parietal region. In the anteroposterior projection this stain appeared to be superficial. A pneumoencephalogram showed essentially the same findings as on the previous study but the thalamic shadow did not visualize clearly.

Course. The patient became more stuporous, with increased left hemiparesis and signs of increasing pressure. Because the stain on arteriography appeared to be superficial and because prior pneumoencephalogram had not shown invasion of the thalamus, it was elected to carry out a hemispherectomy on this young individual.

Operation. First, the skin and bone flaps of the previous craniotomy were extended so as to expose the whole hemisphere. The tumor was visible on the surface of the brain in the middle and inferior frontoparietal regions (Fig. 1).

It was intended to ligate the principal feeding arteries, then the veins and to remove the hemisphere intact as a specimen. Therefore, the carotid siphon was exposed first and occluded with a temporary Mayfield clip, and the anterior and middle cerebral arteries were clipped and divided a short distance from their origins in order to spare the perforating vessels. Because of dense scarring from the prior temporal lobectomy and herniation of the hippocampal gyrus through the incisura, it was not possible to follow the posterior communicating artery to the posterior cerebral artery and to occlude it, as planned.

Following this, all the superior cerebral veins were coagulated and divided. It was observed gradually that the hemisphere was increasing in size, so that it was not possible to pass along the mid line to the corpus callosum. As the herniation continued, it was apparent that emergency measures were necessary. The frontal lobe was removed rapidly back to the sphenoid ridge and the parietotemporo-occipital area was removed anteriorly to the incisura. During this procedure there was brisk bleeding, both retrograde through the anterior communicating artery and through the posterior cerebral artery. This procedure arrested herniation of the mesial segment. It then was possible to pass along the faix, divide the corpus callosum, enter into a markedly distorted right lateral ventricle, and then to pass laterally lifting the whole middle cortical segment and insula off the deep structures down to where the removal joined the previous temporal lobectomy.

It then was apparent that the tumor, which had extended to the surface in the middle of the hemisphere, passed deeply into the region of the thalamus and basal ganglia. Slow, careful intranephologic removal was carried mesially by suction until the tumor was observed to extend to the 3rd ventricle, which was opened widely. At the end of the dissection it appeared as if the entire right cerebral hemisphere and the thalamus had been removed. Tumor appeared to pass into the mid brain and probably across the corpus callosum (Figs. 2 and 3).

Following this, the dura mater was isolated all the way around, tented to the bone and closed completely, utilizing several small pericranial grafts. The bone flaps were wired back in place.

Postoperative Course. Observations could be made on this patient for 10 days following operation.

1) State of consciousness—at the end of the procedure, patient was observed to be moving both sides, the left slightly, and consciousness apparently was light. When examined 8 hours later, he was awake and would answer questions in a weak voice, saying that he felt fine. This represented an improvement over his preop-