Effects of Human Hippocampal Ablation

ALEXANDER GOL, M.D., AND GEORGE M. FAIBISH, PH.D.
Veterans Administration Hospital, and Baylor University College of Medicine, Houston, Texas

The hypothalamus, anterior thalamic nuclei, gyrus cinguli, hippocampus, and their connections were believed by Papez\(^5\) to constitute a harmonious mechanism which may elaborate the functions of central emotion as well as participate in emotional expression. A broader concept of the function of the limbic system was expressed by Herrick,\(^3\) who considered the limbic system an activator of all neocortical functions facilitating or inhibiting not only affective behavior, but memory and learning as well.

The hippocampus itself is regarded by many authors as the "hub" of the limbic system. Papez speaks of the "central emotive process of cortical origin" being "built up" in the hippocampal formation before being relayed to the mammillary bodies and the anterior nuclei of the thalamus. Grunthal\(^7\) suggests that the hippocampus acts as a "catalytic activator" essential for the central affective and neocortical activity.

To gain a greater insight into the function of the hippocampus, a technique for subtotal hippocampectomy was developed in the cat and monkey.\(^1,9\) Following hippocampectomy, a marked taming effect was observed, similar to that described by Klüver and Bucy\(^4\) and Schreiner and Kling.\(^7\) During these studies it was noted that following hippocampectomy the animals showed less response to painful stimuli. Whether this was due to diminished perception or reactivity remained undetermined.

The laboratory findings provided an encouraging basis for further exploration of the effects of hippocampectomy on a clinical level. It appeared that the procedure might prove useful in psychosurgery and pain control. The transfer of a laboratory procedure to the clinical level is fraught with many unexpected pitfalls, and it was decided, therefore, to use the procedure only for intractable pain due to widespread carcinomatosis, or pain states which had not responded to routine neurosurgical pain-relieving procedures. Over a period of 2 years this careful selection produced seven cases. Thus the evaluation of hippocampectomy, on the clinical level, can only be considered to be in a preliminary stage, and the observations are presented more as a study of results than a proposal of a new technique with definite therapeutic indications.

Technique of Hippocampectomy

The technique of the procedure for clinical trial was adapted from the methods previously developed in the laboratory. Initially, a series of twinbladed retractors were made (Fig. 1); these were inserted into the middle part of the temporal lobe between the superior and middle gyri, just in front of the vein of Labbe. Through this transventricular approach, the hippocampus was removed by suction, with suction tips of varying shapes. The attached photographs will illustrate the extent of the lesion. The transventricular approach in the human subject proved to be far less satisfactory than in the animal, and was characterized by incomplete resection and fairly marked damage to the overlying neocortex of the temporal lobe.

Hippocampectomy was next attempted by means of lesions produced by coagulation, with stereotaxic approaches made through the posterior parietal lobe and the trigone of the ventricle, and with the electrode running along the medial wall of the temporal horn in the hippocampus to the tip of the temporal horn. Multiple small coagulation lesions were made at 1 cm intervals.

Case Reports

Case 1. This 27-year-old man was admitted to the V.A. Hospital, Houston, Texas, on December 6, 1962, with a diagnosis of Hodgkin’s disease, based on a biopsy in 1954. In 1962, bony lesions were found in the right ilium, lumbar spine, and left femur. The lesions were treated with irradiation and Vincristine. One week before admission he

Received for publication May 26, 1966.
Revision received October 17, 1966.
developed increasingly severe lumbar pains, a marked paraparesis, dysuria, and difficulty in defecation.

On examination he was found to have widespread adenopathy, marked tenderness of the spine from T-11 to the sacrum, severe flaccid paraparesis, and a sensory level at T-11, with hypesthesia below this level. X-rays demonstrated multiple bony lesions of the lower thoracic, all lumbar and sacral vertebrae, and the pelvis. Myelographic blocks were present at T-10 and L-2. A decompressive laminectomy was performed at these sites without any significant improvement. Following decompression, morphine at $\frac{1}{4}$ gr every 2 hours was required to control the pain of the spinal and pelvic lesions. No psychological testing was possible in this very ill, emaciated and drowsy patient, who only woke up sufficiently to ask for more medication. Grossly he appeared to be fairly well oriented though semi-illiterate and dull.

First operation. On December 11, 1962, a right hippocampectomy was performed through a 1-inch incision between the upper and middle temporal gyri, just in front of the vein of Labbe, and an estimated 80 to 90% of the right hippocampus was removed.

Postoperatively, all narcotics were discontinued. A temporary mild disorientation was noted in the first postoperative week, but this cleared completely. During this period the patient never complained of pain and showed a remarkable lack of concern for painful stimuli. By December 24, the patient had some return of pain, but this was controlled by Darvon every 4 hours and he was able to get up in a wheelchair. Psychological testing on December 27 showed an I.Q. of 72, no disorientation, a slight memory impairment, and signs of indifference.

The patient was discharged home in a wheelchair where he remained for approximately 2 months. By then the pain had once again become too severe to be controlled by Darvon.

Second operation. February 21, 1963, a left hippocampectomy was performed in the same fashion and extent as before. Again, all analgesic medication was withdrawn. Psychological evaluation 3 weeks later showed a Wechsler and Verbal I.Q. of 66 and a comparable rating on Performance subtests. The patient was fairly well oriented in time and space. He knew where his home was but could not remember the house number. He knew the year but not the date, and he could not name the president. After 3 weeks he was discharged home in a wheelchair with a supply of Darvon tablets which seemed to control the residual discomfort in his spine until his death at home on June 9, 1963. No autopsy was obtained.

Case 2. This 73-year-old man was admitted to the V.A. Hospital on December 31, 1963. The diagnosis of carcinoma of the prostate with metastases to the spine and pelvis had been made in April, 1963. In July, 1963, a decompressive laminectomy at T-5 had been performed and was followed by a right mid-thigh amputation for gangrene of the foot due to vascular insufficiency. After the last operation, the patient had severe pains in the stump.

On examination the patient was found to have metastases in his right femur, pelvis, lumbar and thoracic spine, and one scapula. In the week prior to hippocampectomy, he required Morphine $\frac{3}{4}$ gr four to six times a day.

Operation. On January 20, 1964, a series of lesions were made stereotaxically (Fig. 2) throughout the length of the left hippocampus by means of a leucotome, and this was followed by a series of coagulative lesions at 1 cm intervals in the same area (Fig. 3).

Following the operation the patient became markedly dysphasic and would only talk in his Spanish mother tongue, although before the hippocampectomy he had been fairly fluent in English. He did not complain of pain, and all narcotics were stopped. By