Intracerebral Injection of Procaine into the Globus Pallidus in Hyperkinetic Disorders

Irving S. Cooper

Department of Neurosurgery, New York University, New York

In April, 1953, the author described a new investigative technic in the neurosurgical treatment of hyperkinetic disorders (*1, 2*). This technic consists of surgical occlusion of the anterior choroidal artery in order to selectively decrease or obliterate the blood supply to certain intracerebral structures which are dependent upon this vessel for their blood supply. The structure most affected by occlusion of the anterior choroidal artery is the medial segment of the globus pallidus (*3, 4*).

During the past year it has been demonstrated that, in selected, far-advanced cases of Parkinsonism, surgical occlusion of the anterior choroidal artery may produce varying degrees of alleviation of resting-type, or pill-rolling, tremor. The most significant result of this procedure, however, has been reduction of Parkinsonian rigidity which was so severe as to incapacitate the patient by rendering him incapable of useful voluntary motor function. The operation has not been successful in every instance in which it was carried out. The percentile incidence of successful results that can be anticipated will depend upon a long-term study upon selected patients, which is now in progress. In certain cases, however, the relief of rigidity has been significant enough to permit the reversal of rigid, dystonic deformities which were heretofore considered to be irreversible (Fig. 1).

The results of anterior choroidal artery occlusion have been confirmed by several independent investigators. Doctors J. Lawrence Pool, A. Earl Walker, James Gardner, T. I. Hoen, W. Scoville, C. Bertrand, J. A. MacLean, and David Fairman have informed the author of cases in which significant lessening of resting tremor or rigidity, or both, followed surgical occlusion of the anterior choroidal artery in patients with far-advanced Parkinsonism.

The results of this investigation raised the question of proper selection of patients for anterior choroidal artery occlusion. Since the operation has not been successful in every case in which it was performed, and since this procedure carries the operative risk of a craniotomy in chronically ill patients, the importance of proper selection of patients is obvious. This problem led us to investigate the possibility of selectively blocking the globus pallidus as a diagnostic procedure. Such a procedure might enable one to predict whether a more destructive operation would be of value in any particular case.

Anatomical studies led us to conclude that a small caliber ventricular needle could be introduced into the brain through a trephine opening in the skull, and brought to lie in close enough apposition to the medial and intermediate segments of the globus pallidus to permit injection of procaine into that area of the brain without using a stereotaxic instrument or performing a major transcerebral operation. The coronal and horizontal planes in which the globus pallidus lies are illustrated in Fig. 2. The point of intersection of these planes on the surface of the skull determined the site of trephination for this procedure. The third dimension, or saggittal plane, of localization of the globus pallidus was found to lie from 4.5 to 5.0 cm medial to the dura, when the brain is unfixed and *in situ* in the skull.

It is the purpose of this communication to report that procaine injection into the substance of the brain in the region of the medial and intermediate segments of the globus pallidus has been performed 10 times, and in 8 instances has resulted in temporary cessation of resting tumor and alleviation of rigidity in the contralateral extremities. The technic involved placing the patient in a sitting position on the operating table with the head supported by the Craig neurosurgical headrest. Under local anesthesia a small trephine opening is placed in the skull 1.5 cm behind the level of the tragus of the ear and 1.0 cm above the uppermost level of the helix of the ear. A small opening is made in the dura, and a small caliber ventricular needle is placed

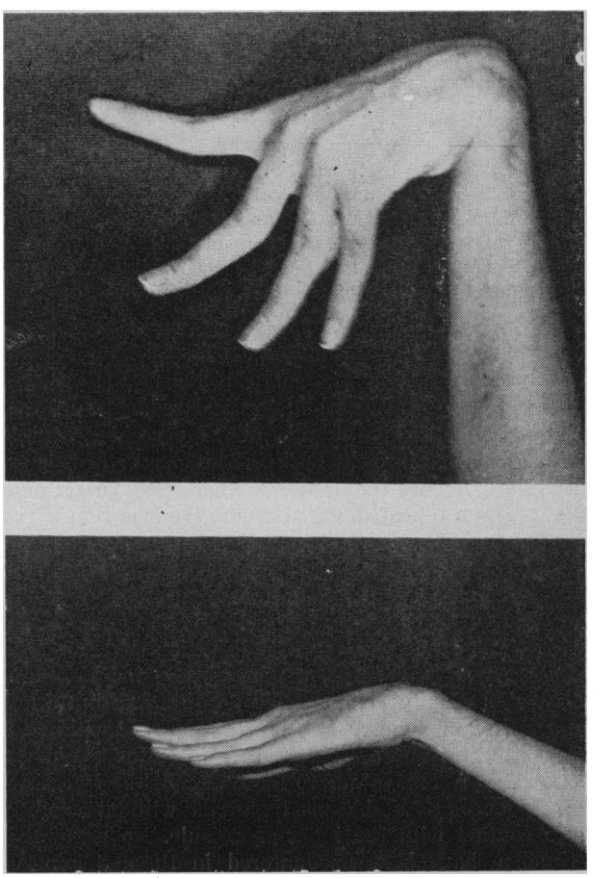

FIG. 1. (Upper) Marked dystonic deformity of long standing due to rigidity of Parkinsonism. (Lower) Reversal of deformity following alleviation of rigidity by surgical occlusion of the anterior choroidal artery.

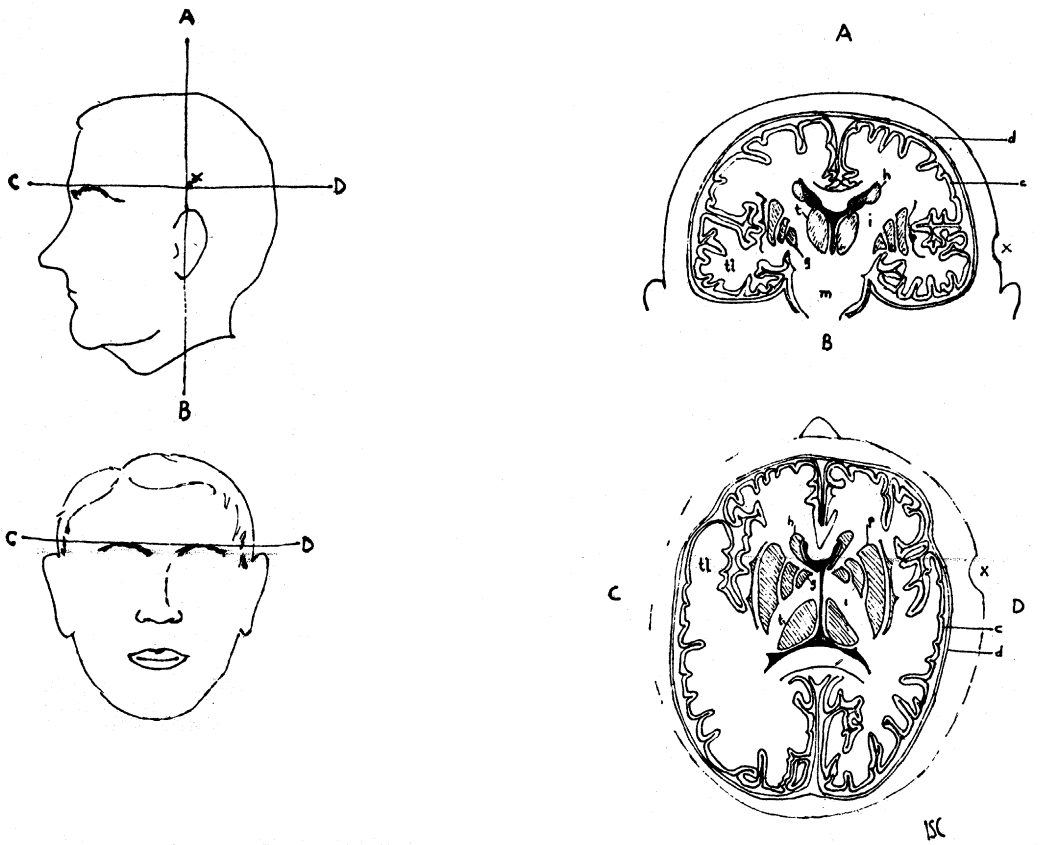

FIG. 2. Diagrammatic localization of site of skull trephination for direct injection of procaine into globus pallidus. AB represents coronal plane in which globus lies. CD represents horizontal plane in which globus lies. X denotes site of intersection of these planes on skull, at which point trephination is made. Sagittal plane in which globus lies is 4.5 to 5.0 cm medial to dura beneath point X. c, cortex; i, internal capsule; t, thalamus; d, dura; m, midbrain; tl, temporal lobe; g, globus pallidus; p, putamen.

horizontally into the brain to a depth of 4.5 cm beyond the dura. At this point the tip of the needle lies between the intermediate and medical segments of the globus pallidus. Five minims of 0.5 percent procaine is then injected into the brain. If no change in tremor or rigidity occurs the needle is advanced 0.25 cm and the injection repeated. On occasion, the injection is repeated once more with the needle at a depth of 5 cm.

In 8 instances in which this procedure was followed, tremor and rigidity in the contralateral extremities were markedly reduced or totally alleviated within 2–5 min after the first injection. Tremor and rigidity remained absent as long as 48 hr, although there was usually some return of rigidity within 3 hr, and return of rigidity was seen in one case within 45 min after injection. In no case was motor weakness encountered. This is due to the fact that the injecting needle encounters the basal ganglia without coming into contact with the internal capsule. No untoward sequellae have been encountered in these 8 experiments. Control injections into the tip of the temporal lobe have failed to produce any change in contralateral tremor or rigidity.

This technic of injection of procaine or neurolytic agents into areas of the brain concerned with motor function deserves exploration. In the case of the hyperkinetic disorders it may enable one to seek out the intracerebral area of structures which, if destroyed, will afford relief of hyperkinetic symptoms. Moreover, that fact that it relies upon such relief of symptoms to designate that area with which the investigator should concern himself indicates that it will point out a dynamic physiologic landmark rather than an empirical anatomical landmark. Roentgenographic methods of anatomically documenting the locus of such a physiologic landmark in individual cases are under investigation.

Addendum. Since submission of this report the author has learned that Dr. Narabayashi in Japan has injected procaine in oil into the globus pallidus in humans, using a stereotaxic instrument.

References

1. COOPER, I. S. *Psychiat. Quarterly* **27**, 317 (1953).
2. ———. *Science* **118**, 193 (1953).
3. ABBIE, A. A. *J. Anat.* **68**, 434 (1934).
4. ALEXANDER, L. The vascular supply of the strio-pallidum. In: *Diseases of the Basal Ganglia*, ch. IV, *Proc. of ARNMD*, Baltimore: Williams and Wilkins, 1942.

Received December 16, 1953.