CEREBELLAR FITS

RUSSELL G. MacROBERT, M.B. (Tor.)
Associate Physician, Neurological Institute

AND

LAURENT FEINIER, M.D.
Senior Resident Physician, Neurological Institute
NEW YORK

This paper is based on the seizures that occurred in a series of forty-five cases of subtentorial brain tumor, in which the patients were operated on at the Neurological Institute during the past few years. Twenty-three were cases of cerebellar tumor, six were cases of tumor of the pons and midbrain, and sixteen were cases of the cerebello-pontile angle.

EXPERIMENTATION AND CEREBELLAR EXCITABILITY

Since the well-known experiments of Flourens with pigeons nearly a century ago, it has frequently been demonstrated that ablation of parts of the cerebellum may be followed by peculiar forced movements of the limbs and body. A dog with half of the cerebellum removed may circle about toward the side of the lesion. Monkeys with the inferior cerebellar peduncles divided, thrust their body and limbs about in an odd manner and assume various rigid and sustained attitudes.

The electrical excitability of the cerebellum is a matter for further investigation. Since the first experiments of Ferrier¹ many important studies have been made, notably by Pruss, Versiloff, Negro and Rosendo, Clark and Horsley,² Rothmann, Uffenorde and others. Some of the findings are uniform but many are contradictory. For instance, some observers (Pruss,³ Versiloff³) have obtained by electrical stimulation of the cerebellar cortex, certain motor responses of the neck, trunk and extremities, which in their general character resemble those obtained by stimulation of the cerebrum in that the contractions of isolated muscle groups were both tonic and clonic. Clark and Horsley, remarking that strong stimuli are required to evoke a decisive effect from the cortex of the cerebellum, as all experimenters have agreed, questioned whether in positive cases the results obtained might not be due to diffusion of the stimuli to underlying nuclei. Later these

1. Ferrier: Allbutt's System of Medicine **7**:376, 1901.

2. Clark and Horsley: Brain **31**:121, 1908.

3. Pruss, Versiloff, quoted by Tilney: Neurol. Bull. **2**:303 (Aug.), 1909.

observers,² using a perfected technic with the bipolar method, concluded that the cerebellar cortex is not excitable.

As the problem of cerebellar excitability is still the subject of dispute, it seems to us impossible to derive therefrom any satisfactory conjectures as to the mechanism of cerebellar fits or the frequency with which they might be expected in lesions of the cerebellum, such as result from the growth of a tumor.

THE CEREBELLUM AND MOTILITY

André-Thomas⁴ calls attention to certain clinical and experimental observations which are of especial interest to the subject of this paper.

According to the observations of Horsley, the activity of the nerve centers is "translated" by a combination of clonus and tonus factors, and the resultant motor manifestations differ according to the proportions of one or the other of these factors. Clonicity is a property of the cerebral cortex and tonicity of the lower centers. The conclusions of Horsley and Bouché on this point were demonstrated experimentally. They injected essence of absinthe into the jugular vein of a cat three weeks after ablation of its left cerebral hemisphere. On the right side of the body, represented cortically in the ablated hemisphere, an attack of tonic contractions occurred, with the limbs in extension. On the left side, represented in the intact right cerebral hemisphere, a tonic-clonic attack of contractions was produced, with the limbs in flexion. During the course of an attack, the authors made an instantaneous section through the midbrain: immediately the clonic movements were changed into tonic movements of the whole body, the head was drawn backward and the limbs of the formerly flexed left side went into extension. Excitations of the inferior centers, among which is counted the cerebellum, gave rise to exclusively tonic attacks.

Some clinical facts sustain these observations. Hughlings Jackson⁵ cited the case of a child afflicted with a tumor of the median lobe of the cerebellum, in which tetanoid convulsive attacks were observed. The forearms were flexed on the arms, the arms were held close to the sides, the head drawn backward, the body was in a position of opisthotonos with extended legs. Jackson concluded from this: 1. In convulsions of cerebellar origin the spasm is tonic, whereas in cerebral convulsions it is principally clonic. 2. Cerebellar convulsions affect more the bilateral muscles of the legs and trunk, whereas in cerebral affections one side is more involved than the other and the arm more than the leg. 3. Cerebellar crises resemble tetanus more than epilepsy.

4. André-Thomas: *Cerebellar Functions*, New York, 1912, p. 167.

5. Jackson, Hughlings: *Med. Times & Hosp. Gaz.* 1:626, 1865.

This contrast between the clonic character of cerebral convulsions and the tonic character of cerebellar ones is to be compared, according to André-Thomas, with the special form that movement takes in persons with cerebellar atrophy. It becomes "discontinuous and clonic," apparently on account of the disappearance of the tonic cerebellar influence.

MAJOR CEREBELLAR SEIZURES

For the classic picture of what may be considered a major cerebellar seizure, we are indebted to the observations made years ago by Hughlings Jackson.⁵ He declared that attacks of tonic rigidity of muscles of the back of the neck, with retraction of the head, associated with flexion of the forearms and extension of the legs and pointing of the toes, were an especial feature of tumors of the middle lobe of the cerebellum and a direct result of cerebellar irritation.

Rigidity of the muscles of the neck and jaws, with rigid extension of the extremities and flexion of the arms, was noted by McCewen⁶ in cases of subtentorial abscess. Retraction of the head and rigidity of the masseters were reported in similar disease states by Drummond,⁷ Friedeberg⁸ and others long ago. While such symptoms are not unusual in inflammatory conditions in the posterior fossa, they have seldom been observed to occur with tumors of this region.

In Stewart and Holmes'⁹ series of forty cases of cerebellar tumor, there was one case, a large tumor of the under surface of the vermis, in which extensive hemorrhage occurred into the substance of the left cerebellar hemisphere during operation; whereupon, while the patient was still under the anesthetic, a rigid spasm of the whole body occurred which "was purely tonic in all the limbs and uniformly maintained for about three minutes." There was retraction of the head and opisthotonos. The face and respiration were undisturbed. Attacks similar to the first recurred frequently until death nine hours later.

Dana¹⁰ has described attacks that occurred in cases of tumor of the cerebellopontile angle, which consisted of loud tinnitus or a roaring sound, vertigo with a tendency to pitch or fall to the ground, sometimes sudden blindness or clouding of consciousness and, in severe attacks, tonic spasms of the extensors lasting from two to five minutes.

In our series, one case comes under the heading of major cerebellar seizures.

6. McCewen: *Pyogenic Diseases*, 1893, p. 197, Case 1.

7. Drummond: *Lancet* **2**:190, 1894.

8. Friedeberg: *Berl. klin. Wchnschr.* Aug., 1895, p. 719.

9. Stewart and Holmes: *Symptomatology of Cerebellar Tumors; A Study of Forty Cases*, *Brain* **27**:520, 1904.

10. Dana: *The Cerebellar Seizure (Cerebellar Fits), A Syndrome Characteristic of Cerebellar Tumors*, *New York M. J.* **81**:270, 1905.

CASE 1.—A. P., a girl, 11 years old, at the age of 3 began to have attacks of nausea and vomiting. A short time later some gait disturbance became noticeable: she did not lift her feet clear of slight obstructions. Occasionally she complained of pain over the mastoid region. The interesting feature is the occasional occurrence, after the first year of her illness, of attacks of general rigidity with opisthotonos, both arms flexed and raised, lower limbs extended, toes pointed. These attacks were accompanied by vomiting and marked nystagmus. It is remarkable that only at these times was nystagmus observed.

At operation (Dr. Elsberg) a cystic tumor was found involving the middle and right lobes of the cerebellum.

ATTACKS OF TONIC SPASM AND FORCED MOVEMENT

Stewart and Holmes reported a few seizures in large tumors of the pons and cerebellum, which were unlike anything they had seen in forebrain lesions in that the spasms were attacks of purely tonic rigidity quite different from the typical tonic-clonic spasms which result from instability or irritation of the cerebral motor areas. They also described attacks of jerking of an irregular shock-like character, in the homolateral arm in a case of one sided cerebellar tumor. According to the statement of the patient, the contralateral arm was also occasionally simultaneously affected but always in slighter degree.

None of our cases presented an example of general forced movements of the trunk, and it is likely that the forced movements which result from experimental ablation have nothing but an incomplete counterpart when the cerebellum is injured by a lesion such as tumor. Dr. Dana said that in one of his cases, that of a woman with a tumor in the posterior fossa, who, as a comparatively early symptom, would, in what he regarded as a forced movement, extend her body suddenly and slide from her chair to the floor.

Among our forty-five cases there were four which presented at some time or other, homolateral rigidity of an extremity with irregular spasmodic jerking movements.

CASE 2.—C., a girl, 15 years old, for six months had had increasingly severe attacks of headache, usually in the morning, occasionally accompanied by vomiting. The pain was most marked in the temporal regions, especially the right. During the past two or three months vision had been failing and during the past week dizzy spells had frequently occurred. Lately she had had occasional convulsive attacks of the left arm. The movements, unlike a jacksonian fit, were aimless, somewhat sudden stiff jerks, of an irregular or arrhythmic character, with no local point of commencement, no gradual spread to other parts and no clouding of consciousness. Operation (Dr. Elsberg) disclosed a tumor involving the left lobe of the cerebellum.

CASE 3.—L., a woman, 43 years of age, had noticed for ten years "a heavy tired feeling" in the right side of the tongue. For five years hearing in the right ear had been poor and she was troubled by a noise in the head "like

steam escaping from a radiator." At times she talked only with difficulty, as one intoxicated. For two years she had had peculiar attacks involving the right side, arm, and leg, which were quite unlike a jacksonian fit. The movements had no local point of commencement, no gradual spread, and were not rhythmic or clonic in character. The attack might be described as a sudden loss of control of the limbs on the right side, which trembled and were stiffly thrust about. A tumor of the right cerebellopontile angle was found at operation (Dr. Taylor).

CASE 4.—S. P., a woman, 31 years of age, for eighteen months had had increasing difficulty in walking, was ataxic and dizzy. For twelve months the muscles on the left side of the face had been weak. During the past month there had been severe attacks of headache with vomiting, mostly in the morning. During the past week the patient had been confined to bed.

Two attacks had occurred during the past week. The attacks were accompanied by intense headache and numbness of the left side of the face, and the patient was unable to speak although conscious. The movements had no local point of commencement, no gradual spread and were not clonic, but were sudden, jerky, spastic, of wide range, of irregular character, arrhythmic and confined to the left arm. At operation (Dr. Elsberg) a tumor was found in the left side of the cerebellum.

CASE 5.—M., a woman, 48 years of age, for years had had occasional severe general headaches. For the past few months she had had frequent occipital headaches and a more or less persistent pain in the back of the neck. For eight months her gait had become increasingly ataxic. She had marked tinnitus and dizzy attacks so severe as to cause her to fall. Her left leg had felt heavy at times during the past few weeks. Lately attacks involving the left arm had occurred which were not true convulsive movements but might be described as sudden seizures of ataxia or spastic unsteadiness. The fingers trembled and were unable to hold anything, and there was an associated unusual nodding or ataxic tremor of the head. There was no loss of consciousness. At operation (Dr. Elsberg) a tumor was found in the left cerebellopontile angle.

VARIOUS CRANIAL NERVE ATTACKS

Irritation of the cranial nerves about the pons and medulla by tumors in the posterior fossa, may cause striking symptoms of abrupt onset. Starr,¹¹ Sörgo¹² and others have described vagal attacks due to pressure on, or stretching of, the vagus nerve at the foramen magnum. Oppenheim¹³ has mentioned a case, in which the patient had persistent contraction of the soft palate and vocal cords. Cushing¹⁴ speaks of "cerebellar crises" occurring in two of his thirty cases of cerebellopontile angle tumor. He describes them as paroxysms of extreme and agonizing type, with retraction of the neck and head, res-

11. Starr: *Am. J. Med. Sc.* **39**:552, 1910.

12. Sörgo: *Monatschr. f. Ohrenh.* **35**:285, 1901.

13. Oppenheim: *Text-book of Nervous Diseases*, Trans. by Bruce. Foulis. London, Ed. 5 **2**:907, 1911.

14. Cushing: *Tumors of the Nervus Acusticus*, Philadelphia, W. B. Saunders Company, p. 170, 1917.

piration difficulties, altered pulse, a sense of impending death and possibly unconsciousness. There are five other patients in his series who also had some "discomfort" of this kind, but in a much milder form.

Two of our patients had speech and swallowing difficulties, and one of them had also periodic choking sensations with respiratory embarrassment, but there were no patients in our series with severe "cerebellar crises," such as Cushing describes.

CASE 6.—K., a woman, 27 years of age, for four years had been troubled by a roaring sound in the right ear, which she compared to the sound of falling water. Since it began she had been almost deaf in this ear. Fifteen months before, while pregnant, dimness of vision had commenced; headaches with attacks of vomiting commenced about the same time. These symptoms persisted after the baby was born, and then in addition there came times when she would see double. During the past few months the patient had staggered toward the right. Her eyesight had continued to fail rapidly, and for the past few weeks she had been quite blind in the left eye and nearly so in the right. Lately she had had spells in which it was difficult for her to speak and sometimes difficult to swallow, accompanied by a panicky feeling as though she were about to choke. At operation (Dr. Elsberg) a glioma was found involving the right cerebellar lobe.

CASE 7.—Kr., a woman, 47 years of age, for two and a half years had had constant discomfort in the left eye: "It feels as though an eyelash were in it." At about the time that this came on, she also began to have a queer sensation in the left side of her face, "like a bug crawling." Until six weeks before there had been no headache, but since that time she had had considerable pain in the occiput and back of the neck. For one month she had been dizzy and ataxic, staggering toward the left. Her tongue had felt numb, there had been a constant sweet taste in her mouth and a discomfort in her throat which caused her to swallow constantly in an effort to get rid of it. There was an occasional roaring or whistling sound in her ears, especially in the left. Lately she had had difficulty in speaking and in swallowing, and a convulsive tic had commenced in the left side of her face, which in the past few days had become almost constant. At operation (Dr. Elsberg) a tumor was found in the left cerebellopontile angle.

FACIAL SPASM

Spasms of the face, which may be wrongly diagnosed as jacksonian epilepsy, may result from irritation of the facial nerve by tumors in the posterior fossa. Operations have been performed over the motor area on this account. Hughlings Jackson,⁵ in 1865, noted homolateral attacks of facial spasm which he had difficulty in accounting for. Stewart and Holmes mention them as possible though inconspicuous symptoms. Two cases are cited by Mills and Weisenberg,¹⁶ and some

16. Mills, C. K. and Weisenberg, T. H.: Cerebellar Symptoms and Cerebellar Localization, J.A.M.A. **63**:1813 (Nov. 21) 1914.

slight facial twitching was present in three of Cushing's patients, in one of them bilaterally.

In our series there are three cases in which an attack of homolateral facial twitching occurred. In none was it an early symptom, and it was otherwise unlike a jacksonian attack in that it had no local point of commencement with gradual spread. It remained limited to the face. On careful consideration the spasms in these cases will be found to conform more in character to those of facial convulsive tic (facial spasm) than to those of an epileptiform attack. It is likely, too, that some associated symptoms, such as involvement of other cranial nerves, will assist in making their subtentorial origin apparent.

CASE 8.—Mc., a woman, 45 years of age, for two years had suffered with headache and vomiting. She also had had intermittent pain over the eyes and left side of the face and tinnitus with comparative deafness of the left ear of gradual development. At times during the past year she had seen dazzling lights before her eyes and had been ataxic in gait. Two months before she had had severe twitching of the left facial muscles. At operation (Dr. Taylor) a tumor was found involving the left side of the cerebellum.

CASE 9.—W., a woman, 43 years old, three years before had commenced to feel weak, dizzy and nauseated at times. A year and a half before she had begun to have tinnitus, bilateral, but especially marked in the right ear. Her hearing had become poor in this ear, and she had had neuralgic pains in the right eye and right side of the face and head. During the past year she had had much headache, generalized and severe, and her vision had rapidly failed. In the past few months the right side of her face had felt numb, and her neck large and stiff. On one occasion, three months before, the right side of her face had twitched spasmodically for five minutes, preceded by an attack of dizziness. At operation (Dr. Elsberg) a tumor of the right side of the cerebellum was found.

GENERALIZED CONVULSIONS

In not one of our forty-five cases did generalized convulsions occur, nor were any reported in Stewart and Holmes' series of forty cerebellar tumors. This should be interesting to those who have considered an epileptic convulsion to be a common general sign of intracranial tumor, attributable, like headache, vomiting and optic neuritis, to heightened intracranial pressure, for it is a well-known fact that the intracranial pressure increases early in subtentorial tumors and usually to a marked degree.

We accept the view that a generalized epileptic convulsion in the last analysis is always the expression of one physiologic state (no matter what influences entered into the production of that state)—a more or less generalized cortical instability. This is in accord with the belief expressed years ago by Ferrier,¹⁷ one of the most experienced investi-

17. Ferrier: *Allbutt's System of Medicine* 7:375, 1901.

gators of cerebellar excitability, that if a generalized convulsion occurs in connection with a cerebellar lesion, it has an indirect relationship only, and is not due to direct irritation of the cerebellum. This is also the conclusion of James Collier¹⁸ in his important paper on "The False Localizing Signs of Intracranial Tumor." He tells of "several" cases of tumor of the brain stem and cerebellum, in which general convulsions occurred, " . . . but in all these cases the symptoms were of long standing when the convulsions first occurred, and in all of them the autopsies revealed considerable ventricular distention." He considers that the convulsions were the result of internal hydrocephalus which by pressure had produced an unstable condition of the cerebral cortex. Generalized convulsions as the result of cerebellar tumor are rare, and Collier's explanation for their occurrence may be accepted.

JACKSONIAN CONVULSIONS

No jacksonian attacks occurred in any of our forty-five cases, nor were there any spoken of among the forty cases of Stewart and Holmes. Collier,¹⁸ however, calls attention to two cases in which tumor of the cerebellum caused jacksonian attacks. Local convulsions of slow spread and confined to the arm and face were observed. No lesion except cerebellar tumor was present, but the ventricles were considerably distended, and some bilateral spasticity was present. The cases were of long standing when the convulsions occurred. Collier attributes the spasms to cortical instability, the result of pressure from internal hydrocephalus. He believes that the occurrence of such attacks should not lead to confusion in localizing the tumor, if signs of intracranial pressure have long been present, for cerebellar signs will probably have been conclusive early in the illness.

CONCLUSIONS

There are nine cases only in this series of forty-five posterior fossa tumors in which phenomena occurred that might be considered under the caption of "fits." From a study of these cases and a brief review of the literature, we have concluded that convulsive phenomena of any sort in tumors of the posterior fossa are rare; that the chief distinguishing feature of those which have been noted is the irregularity and sustained tonicities of the movements, in comparison with the rhythmic, clonic movements of forebrain fits.

Sudden involuntary movements, similar in a measure to the so-called forced movements which follow experimental ablation of parts of the cerebellum, were observed in some cases.

18. Collier, James: The False Localizing Signs of Intracranial Tumor, *Brain*. Pt. 14:490, 1904.

Sudden characteristic disturbances in the function of the cranial nerves in the posterior fossa, such as tic-like spasms and respiratory embarrassment, may result from irritation by a tumor in this region.

Fits of any kind usually occur late in the illness, after conclusive signs of cerebellar disease have long been present.

Jacksonian convulsions, which may result from instability induced by the growth of a tumor in the vicinity of the cerebral motor cortex, are easily distinguishable from cerebellar fits by the deliberate, progressive, clonic character of the spasms.

We wish to express our indebtedness to Dr. Elsberg, Surgeon to the Institute, for the privilege of studying the operating room records.

20 West Fiftieth Street—149 East Sixty-Seventh Street.