PSYCHOMETRIC TESTING OF PATIENTS WHO HAD BRAIN TUMORS REMOVED DURING CHILDHOOD

LYLE A. FRENCH, M.D.
Department of Surgery, Division of Neurosurgery, University of Minnesota Hospitals, Minneapolis, Minnesota

(Received for publication October 31, 1947)

The problem of mental deterioration following the removal of a brain tumor has been considered by most neurosurgeons. This is especially important with the relatively benign cerebellar tumors in children, for after radical surgical excision these tumors do not recur. Tumors in such a location produce symptoms due to involvement of the cerebellar structures as well as from an associated hydrocephalus due to obstruction of the flow of cerebrospinal fluid. Radical resection of these tumors can be accomplished without persistent physical stigmata. The question of whether after such an operative procedure there is mental deterioration due to the tumor or the associated hydrocephalus is the subject of this report. Included in this report are the results of psychometric testing of patients who during childhood underwent an operative procedure for removal of a cerebellar tumor. These patients represent all those who have survived 8 months or more and who were available for testing. In none of the 10 patients tested was there psychometrically demonstrable evidence of deterioration.

The average age of the patients was 7\(\frac{1}{2}\) years. The age range was from 3 years to 12 years. There were 6 girls and 4 boys. The histological diagnosis in 8 patients was astrocytoma, in 1 it was angioblastoma, and in 1 it was tuberculoma. Psychometric testing of these patients was performed after a period varying from 8 months to 12 years following surgery. The average interval after surgery was 4 years and 9 months. Because of the wide range in the age of the patients as well as individual visual and language difficulties, the same tests could not be used in all cases. In general, an attempt was made in each patient to determine the I.Q. with either a modification of the Stanford-Binet or the Wechsler-Bellevue scales. Deterioration sensitive tests were then given and the results of these tests correlated with the determined intelligence. The following tests were used: Stanford-Binet scale form L and M, Wechsler-Bellevue, Koh’s blocks, digit span, Hunt test, Ellis visual designs, Goodenough drawing test, Healy picture completion, Mare and Foal, and the Sequin form board.

CASE REPORTS

Case 1. (6837480) A.W. was an 11-year-old girl with a 3 months’ history of dizziness, headaches, vomiting, and a staggering gait. Neurological examination: Bilateral papilledema and cerebellar dysfunction. Skull roentgenograms: Widening of the cranial sutures, increased digital markings, erosion of the clinoid processes, and an area of calcification in the subtemporal region. On April 17, 1935, a cystic astrocytoma in the left cerebellar hemisphere was totally removed.

January, 1947, 12 years after surgery. Examination: No neurological abnormality. Psy-

**Conclusion.** This 23-year-old girl showed no psychometrically determinable evidence of organic brain damage.

**Case 2.** (662546) E.A. was a 12-year-old girl with congenital deafness who gave a 2 months’ history of headaches, somnolence, vomiting, diplopia, and decreased vision. Examination: Bilateral papilledema, bilateral loss of hearing, and cerebellar dysfunction. Skull roentgenograms: Increased convolutional markings and decalcification of the clinoids. Ventriculograms: Dilated lateral and third ventricles. In October, 1937, an angioblastoma was removed from the right cerebellar hemisphere.

February, 1937, 10 years after surgery. Examination: Bilateral loss of hearing and minimal cerebellar dysfunction. Psychometric testing—Koh’s blocks: Weighted score of 14, which is “very superior” ability.

**Impression.** It was difficult to test this patient because of the deafness and the inability to speak well. The Koh’s blocks are considered the best single test of non-verbal intelligence and involves both synthetic and analytical ability. Therefore, it can be used as a diagnostic test for mental deterioration. The patient’s performance on it not only indicated that she is probably of above average intellectual capacity but that there are probably no disturbances in the higher perceptual processes.

**Case 3.** (695413) C.A.H. was a 14-year-old Indian boy with a tuberculoma in the left cerebellar hemisphere upon whom a suboccipital decompression was performed in May, 1940. Ventriculograms performed preoperatively revealed large symmetrically dilated lateral and third ventricles.

February, 1940, 11 years after surgery. Examination: Visual ability restricted so that there was only light perception; no cerebellar dysfunction. Psychometric testing—Wechsler-Bellevue scales (verbal scale only): I.Q. 93.

**Impression.** This patient is a Chippewa Indian and has some language difficulty which may have handicapped his verbal scale I.Q. Nevertheless, the test showed that he is of at least average intelligence. The deterioration sensitive subtests of this scale (digits, arithmetic, and similarities) all were good and there were no significant differences between any of the subtest scores. Therefore, the tests in no way followed the pattern established by Wechsler as typical of brain damage.

**Case 4.** (709707) C.O. was an 8-year-old girl with a 3-year history of intermittent headaches, vomiting, and incoordination of the right hand. Neurological examination: Right cerebellar hemisphere dysfunction. Skull roentgenograms: Increased convolutional markings, widening of the cranial sutures, and decalcification of the dorsum sella. In June, 1941, a cystic astrocytoma of the right cerebellar hemisphere was totally removed.

January, 1947, 6 years after surgery. Neurological examination: No abnormality. Psychometric testing—Stanford-Binet. Intelligence scale, Form L: C.A. 13–7, M.A. 11–8, I.Q. 87. This test places the patient in a “low average” intelligence rating. Her test pattern suggested emotional interference in the early portion of the test which affected her performance and so this intelligence rating may be too low. Memory, generally, seemed very good. Verbal ability was not as good as performance ability.

Koh’s blocks (Wechsler version): “High average” performance. Results not only indicate average intelligence but since this is a deterioration sensitive test it seemed to indicate the patient had no particular difficulties in visual motor organization.
Ellis visual designs: Approximately 11½ year level. This test indicated no evidence of deterioration.

Impression. This patient is of "low average" intelligence. She shows no particular difficulty in visual-motor organization and no psychometrically determinable evidence of mental deterioration.

Case 5. (726893) G.R. was an 8-year-old boy with a 6 weeks' history of intermittent nausea, vomiting, and staggering gait. Examination: Bilateral papilledema and bilateral cerebellar dysfunction. Skull roentgenograms: Widening of the cranial sutures. A non-cystic astrocytoma was totally removed from the vermis and left cerebellar hemisphere in December, 1942.

March, 1947, 4 years after surgery. Examination: No neurological abnormality. Psychometric testing—Stanford-Binet scale, Form L: C.A. 11–2, M.A. 12–8, I.Q. 113. There were no signs in this test of mental deterioration; his memory was excellent and he was able to reproduce the designs with no difficulty. He was also able to reverse 5 digits (1½ year level) with ease. Koh's blocks: "Superior intelligence."

Impression. This patient is of high average or superior intelligence and has no indications on psychometric testing of mental deterioration.

Case 6. (740512) L.T. was a 3-year-old boy with a 6 months' history of intermittent headaches, vomiting, and staggering gait. Examination: Bilateral papilledema, hyperactive deep tendon reflexes on the right, and cerebellar dysfunction on the left. Skull roentgenograms: Widening of the cranial sutures. A cystic astrocytoma in the left cerebellar hemisphere was totally removed in February, 1944.

January, 1947. Examination: No neurological abnormalities. Psychometric tests—Stanford-Binet scale, Form M: C.A. 6–10, M.A. 6–6, I.Q. 95. Performance on this scale was quite even. He was able to reverse 3 digits (7 year level) indicating there was no memory defect. He is in the "average" range of intelligence.

Goodenough drawing test: Results on this test were relatively poor (approximately 5 year level). Since this was the first test given and the child seemed unusually shy, it is possible that this influenced the test results.

Healy picture completion: Approximately 6–3 level (average level).

Koh's blocks: 5.5 year level—performance on this test was poor. This test is not particularly interesting to younger children; the low score would not necessarily indicate deterioration in a 6-year-old child.

Impression. This patient is of lower average intelligence. Although his memory was as good as would be expected for his age, performance on 2 of the 4 tests was poor. The poor performance was probably due to lack of interest and shyness rather than to any intellectual impairment since performance on the other 2 tests was not uneven. It was not thought that this was sufficient evidence to be indicative of mental deterioration.

Case 7. (750987) F.E.L. was a 3-year-old boy with an 8-month history of intermittent headaches, vomiting, staggering gait, and personality changes. Examination: Bilateral papilledema, increased deep reflexes on the right, and cerebellar dysfunction on the left. Skull roentgenograms: Widening of the cranial sutures and increased convolutional markings. A cystic astrocytoma in the right cerebellar hemisphere was totally removed in February, 1945.


Impression. Whereas the Stanford-Binet scale places this patient in a
normal intelligence class, performance tests place him in a superior ability class. His form perception and ability to analyze forms into component parts is excellent. There are no indications of mental deterioration.

Case 8. (768752) S.S. was a 9-year-old girl with a 5-year history of intermittent headaches and vomiting, dizziness, and decreased visual acuity. Examination: Bilateral papilledema, hyperactive deep tendon reflexes on the right, and incoordination of the right hand. Skull roentgenograms: Widening of the coronal suture, decalcification of the sella, and depression of the floor of the sella. A cystic astrocytoma of the right cerebellar hemisphere was totally removed in March, 1946.


Koh's blocks: 11.5 year equivalent. The patient had some difficulties in this test in analyzing the whole into its component parts. She tended to follow the figures rather than the components, an approach often noted in individuals who have a certain lack of synthesizing ability.

Ellis visual designs test: Average scale of 4 which would be an average score for a child below 8½ years of age.

**Impression.** This patient is in the average range of intelligence. However, the spread of her performance would indicate that she may actually be brighter than this. Her vocabulary was at a 12 year level. There was no indication in any of the tests of organic brain damage.

Case 9. (741476) M.L.O. was a 3-year-old girl with a 6 months' history of headaches, intermittent vomiting, and listlessness. Examination: Bilateral papilledema and bilateral cerebellar dysfunction. Skull roentgenograms: Widening of the cranial sutures, increased convolutional markings, and erosion of the sella. A cystic astrocytoma in the vermis of the cerebellum was totally removed in June, 1944.

January, 1947. Examination: No neurologic abnormalities. Psychometric tests—Stanford-Binet, Form M: C.A. 6–1, M.A. 7–2, I.Q. 118. Although the total score placed the patient on a superior level, the test performances were uneven. Her attention span was short although the reasoning ability, vocabulary, and verbal ability were excellent. Her memory was average.

Healy picture completion: 7 plus year level.

Koh's blocks: 5.5 year level. The patient did not show much interest in this test and this may have influenced the results.

**Impression.** This patient is of superior intelligence. Her attention span is somewhat shorter than would be expected and her memory span is not quite in keeping with the mental age. This was not severe enough, however, to indicate mental deterioration.

Case 10. (771192) M.B. was a 10-year-old girl with a 4-year history of pain in her face and intermittent vomiting. For 5 months there had been locomotor ataxia and personality changes. Examination: Bilateral papilledema, greatly diminished visual acuity, and bilateral cerebellar dysfunction. Skull roentgenograms: Widening of the cranial sutures, a shallow and calcified sella, and a calcified mass in the cerebellar region. A diffuse astrocytoma involving both cerebellar hemispheres was subtotally removed in September, 1946.

April, 1947. Examination: Bilateral optic atrophy with greatly diminished visual acuity. Psychometric tests—Stanford-Binet scale, Form L: C.A. 10–10, M.A. 9–8, I.Q. 89. Performance was uneven and the spread was wide. The earliest failures came on the memory for designs, items which were completely failed at the 9 year level. Memory for digits was average, reasoning ability was poor, and attention span short.
PSYCHOMETRIC TESTS AFTER BRAIN TUMOR REMOVAL

Goodenough drawing test: M.A. 7-9. Although the total mental age obtained on this patient was 3 years below the patient’s chronological age, her performance was not uniformly poor. She began with a profile drawing which would place her at a fairly high level. She lost credits, however, due to omissions in her drawing.

Koh’s blocks: 9-10 year level. Healy picture completion I: 11 year level.

Impression. This patient is functioning at about an average level of ability but her performance is uneven. Her performance on the Healy picture completion test, on which most children with brain damage have great difficulty, was excellent. Performance on the Koh’s blocks, which is a “deterioration sensitive” test, is over half a year below the mental age level. She has poor vision which possibly accounts for some of the spread. It cannot be stated that she shows evidence of mental deterioration from these tests.

COMMENT

The 10 patients varied in age from 6 years to 23 years at the time of testing, and therefore, the same tests could not be used in all the cases. Direct comparison, therefore, was not possible but the results were obvious enough that generalizations could be made. The results of the intelligence tests revealed an I.Q. average that was at the high end of the normal range (4 patients were of average intelligence, 4 of high average or superior intelligence). Deterioration sensitive tests (such as the Hunt test for organic brain damage and the Koh’s blocks) showed in 5 cases better than average performance, in the others just average performance. Visual motor ability and ability to analyze forms into components was very good except in 2 patients (Case 6 and Case 10) in whom it was only fair. There was, therefore, no psychometrically determinable deterioration in these cases.

In 2 cases, ventriculographic studies revealed a moderately severe hydrocephalus; such studies were not performed in the other 8. However, 6 of the remaining 8 patients had ventricular estimates which indicated at least a moderate hydrocephalus, for the ventricle was entered at a depth of 3 cm. or less from the cortex. In all 10 patients there was evidence on plain skull roentgenograms of increased intracranial pressure (widening of cranial sutures, increased convolutional markings, and decalcification of the sella). All 10 patients had a bilateral papilledema of 2 or more diopters preoperatively. Thus, in spite of an obstructive hydrocephalus and evidence of increased intracranial pressure, there was no evidence of mental deterioration.

SUMMARY

1. Psychometric tests to determine evidence of mental deterioration were given to 10 patients who previously had been operated upon for removal of a cerebellar tumor.

2. There was no evidence of mental deterioration according to these tests in any of the 10 patients.

Acknowledgement is made of the invaluable assistance given by Miss Audrey Arkola, clinical psychologist in child psychiatry, Department of Pediatrics, University of Minnesota Hospitals.