SPEECH DISTURBANCES IN ASSOCIATION WITH PARASAGITTAL FRONTAL LESIONS*

J. G. CHUSID, M.D., C. G. DE GUTIÉRREZ-MAHONEY, M.D. AND M. P. MARGULES-LAVERGNE, M.D.

Neurological Division, St. Vincent's Hospital, New York, New York

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SINCE the classical descriptions of Broca, Pierre Marie, and Dejerine, the area of the dominant cerebral hemisphere most intimately associated with the function of speech has been considered to be that part that centers about the lateral portion of the central (Rolandic) sulcus and the adjacent portion of the lateral (Sylvian) sulcus. Bouillaud had previously stressed a relationship between the frontal lobes and motor speech and Auburtin described an experiment on a patient of Cullerier in which light pressure with a spatula on the exposed frontal lobes caused an immediate interruption of speech during interrogation. Because of interest in language disorders associated with lesions of more medially situated areas of the dominant hemisphere, we have assembled data that bear upon this subject.

Parasagittal meningiomas may be associated with language dysfunction of variable degree. In 1879 Magnan reported the case of a 61-year-old woman, who, he stated, "was unable to give any account of herself. She pronounced words or monosyllables without connection, and could not name objects. She reflected, tried, became impatient, wept occasionally, but was unsuccessful; but occasionally she hit upon the right name, on which her countenance expanded, and she seemed pleased at her success. She had the irritability, sensibility and mobility of aphasics, generally." She had a right hemiplegia and "having a cardiac affection so it was natural to suppose embolism and softening of the third frontal convolution on the left side, the insula, corpus striatum and deep parts. On post mortem quite a different affection was actually found." The calvarium was adherent at the vertex and there was an osseous elevation at the posterior part of the left frontal and anterior part of the parietal bones on the inner side. Reflection of the dura mater disclosed a tumor "inserted in the internal aspect of the dura mater." The tumor projected into the posterior half of the first two frontal convolutions and the upper two-thirds of the ascending frontal. "Notwithstanding the immediate proximity of the tumor, the cortex of the third frontal had not been softened." The tumor was composed of considerable connective tissue with fusiform cells in some places, and in others polygonal

cells with one or more nuclei and only traces of connective tissue. The diagnosis was "neuroglia sarcoma" of the frontal lobe.

Elsberg in 1931 stated "Parasagittal meningiomas over the left cerebral hemisphere, even if not large, sometimes produce definite disturbances of speech, either a sensory or motor or mixed type of aphasia. . . . The growths are often not large enough to make direct pressure upon the areas in which the centers of speech are supposed to lie, nor is the intracranial pressure seen at the operating table sufficiently high to permit one to predicate a diachysis in von Monakow's sense."

In the Cushing and Eisenhardt monograph on meningiomas, there are noted 7 instances of left parasagittal meningiomas (Cases 16, 25, 28, 30, 36, 37 and 51) occurring in right-handed individuals in association with speech disturbances. A review of the records in these cases, all of which were from Dr. Cushing's service at the Peter Bent Brigham Hospital in Boston, was made and the following pertinent data were abstracted:

Case 16. S.S., a woman aged 41, had severe headaches for 3 years with failure of vision, blindness, and weakness of the right arm and leg. She spoke no English and the history was obtained through her husband.

The following notes were made regarding her speech. "Patient apparently has an aphasia of moderate degree, husband stating that patient often uses the wrong words." Dr. Horrax noted "the husband is also very sure that the patient's speech has been affected." A month after admission, the husband observed that the patient's speech had become distinctly poorer and he found great difficulty in understanding her.

Operation was carried out in two stages. At the first, a left temporal bone flap was reflected and at the second session, the area exposed had to be enlarged with rongeurs. A 60 gm. parasagittal meningioma was removed which, from Dr. Cushing's sketches, would locate it in a position straddling the fissure of Rolando at the midline (Fig. 1).

Case 25. C.J.T., a 48-year-old lady, complained of paralysis of her right side and inability to talk. For 15 months she had had headache and had become dull mentally. Convulsions involving the right arm and leg had occurred for about 10 months. She became drowsy, cerebrated slowly and her memory failed. She also had much difficulty talking.

She had bilateral papilledema, right hemiparesis and there was no apraxia. "Patient is very slow in all her answers. She knows the month, the day and the date and what hospital she is in. She is able to name all the objects in the room excepting the electric lamp. She could not get the name for that. Also, in general conversation, it is apparent that at times she has great difficulty in finding the right word. She does not mispronounce words or use wrong words." Her husband also noted that "for the past 2 months she has had difficulty in finding the right word at times." He thought that she understood perfectly everything that was said to her.

The tumor measured 8.5 cm. in length and extended fairly well forward of the fissure of Rolando and half of its bulk was anterior to the dividing line between the frontal and central thirds of the longitudinal sinus. The tumor weighed 162 gm. and was removed in a two-stage procedure (Fig. 2).

Toward the end of the operation she kept repeating "I want to" and many attempts were made to supply the blank, asking if she wanted a drink, etc., but
shortly afterwards she said “I want to get well.” Because of her difficulty with speech during the procedure, a running series of notes was made about her speech for a period of 4 hours after operation. A few days afterwards it was noted that she pronounced her words well but she had occasional difficulty in getting a sentence started although it was evident she knew what to say. A week after operation it was observed that there was “no aphasia.”

*Case 28.* P.F.D., a man aged 42 years, complained of failing vision, dizziness and headaches for about 5 months. His family had also noted slowness and failure of his memory, but on examination he had difficulty in understanding what was said to him and questions had to be repeated before he understood. He answered slowly, with some difficulty, and often paraphrased. He avoided nouns. In attempting to explain the difficulty he had in talking, he said “I—I don’t know, I don’t seem to have the same track twice.” He had no definite anomia although he had to stop and consider before giving the name of objects. Dr. Horrax noted “very marked difficulty in calculation and some hesitancy for words,” and subsequently said “the speech disturbance and mental symptoms are the only things of any localizing significance in this case.”

A left frontal parasagittal meningioma was removed by Dr. Horrax (Fig. 3).

A week after operation there was “very marked improvement in speech which patient himself recognizes.” Three weeks after operation he “has a slight hesitation in talking from time to time and gropes for phrases rather than for words.”
Case 30. B.K., a lady aged 26, complained of failing vision, had headaches for 8 years, weakness of the right leg for 1 year and "about 1 month ago she became conscious of the fact, particularly at some times more than others, that her tongue felt thick and large and speech was slow. She wishes to talk rapidly but can talk only slowly." She had papilledema, right facial weakness and answered questions quite definitely slower but no aphasia was demonstrable.

A ventriculogram disclosed a "tumor of the left hemisphere depressing the ventricles." A left parasagittal tumor straddling the junction between the frontal and central thirds of the longitudinal sinus was removed (Fig. 4).

On the following day she was able to answer only by "yes" and "no." She indicated that her speech was limited to this extent. A fortnight after operation (2nd stage): "speech still hesitant; difficulty in finding words." A month after the 2nd-stage operation, Dr. Leo Davidoff noted "quite marked aphasia, anomia and inability to express self in adequate language."

Case 36. W.H.B., a 31-year-old man, complained of weakness of the right side and convulsions of the right arm and face of 3 months' duration. For 2 months he had had intermittent difficulty finding words to express himself. He knew what he wanted to say but the words uttered did not make sense and had no connection with his thoughts. If he talked slowly and took a great deal of time about it, he could make simple things intelligible. Subsequently he had a convulsion and "his motor aphasia was even more marked and he found that he could see a newspaper but the words did not mean anything to him."

Examination disclosed weakness of the right upper extremity, early papilledema and some difficulty in finding words to express his thoughts. He had to speak slowly to have his sentences make meaning. Dr. Fulton noted "patient speaks slowly, occasionally seems to have difficulty in finding the word he wants. Names simple objects such as button, pen, nose; became a little confused when asked what his sister's children's names were. Smiles in a rather vacant way when questioned but does not seem particularly troubled or self-conscious on account of his disability. Says that he has not been able to follow the thread of stories and cannot seem to appreciate what he reads in newspapers. Cannot write with right hand, says he can hold a pen but it will not percolate."

Dr. Cushing removed a large frontal parasagittal meningioma (Fig. 5).

After the operation the patient had to furn-
ple considerably to express himself. Commands had to be repeated two or three times before he comprehended and obeyed. About a month after operation, his speech was adequate for conversation. "Abstractions were still poorly handled. He was alert and intelligent but verbal mentation was slowed."

**Case 37.** D.W., a 54-year-old lady, complained of convulsions involving the left arm and left leg for a period of a few months, headaches and blindness. She had some confusion "particularly in talking and finding names." Her speech disturbance included difficulty in comprehending what she said although she understood other people perfectly well.

Examination disclosed definite anomia and she confused somewhat similar sounding names of dissimilar objects. Sometimes anomia and aphasia were marked symptoms. There was bilateral papilledema of 4 D. The strength of the right side was better than the left; all reflexes were brisk; both plantars were extensor and the x-rays demonstrated increased vascularity in the left frontal bone.

Dr. Cushing removed a left frontal parasagittal meningioma (Fig. 6).

Two years after discharge she died at a psychopathic hospital and postmortem examination disclosed a bilateral parasagittal meningioma limited to the frontal poles and about as large on one side as the other.

**Case 51.** J.O., a 30-year-old man, complained of right-sided weakness, failing vision, headache and vomiting of 9 months' duration. "For three to four months it had been embarrassing to him to discover that he was unable to get words out. He believes that he has never miscalled objects or people, but many times has difficulty in saying the things he wants to say, and at times, gets words twisted, always being aware of this himself however. He has had no difficulty in understanding written or spoken words."

Examination disclosed bilateral papilledema, right homonymous hemianopia, right hemiparesis and paraphasia. "Aphasia is not easily elicited on examination although there is a definite history which is almost conclusive. He has no true anomia, no alexia, no apraxia. He is unable to write because of the paresis of the right hand. In giving an account of his present illness he frequently, however, gets words mixed up, particularly the names of things, but immediately discovers the defect and sets about correcting it."

Dr. Cushing removed a large parasagittal meningioma from the frontal region which extended back just beyond the central fissure (Fig. 7).
About 3 weeks after operation, it was noted that he had "much less speech hesi-
tancy" and a little later Dr. Bronson Ray noted "aphasia very slight now."

The following 2 cases of parasagittal meningioma were studied on the
Neurological Division of St. Vincent's Hospital, New York.

Case L.R. A 30-year-old man was admitted to hospital on Nov. 24, 1948. He had
had a convulsion 2 months previously after which he had speech difficulty of a very
transitory nature which occurred 2-3 times a day for about a fortnight. Subse-
quently, this became more noticeable and he had difficulty forming words and
sentences. A month before admission the right lower extremity became weak and
shortly thereafter the right upper extremity was involved. He then had seizures
involving the right side of his body.

Examination disclosed a right hemiparesis. He was left-handed; his mother was
left-handed and his sister was ambidextrous. He had no very striking speech dis-
turbance other than some hesitancy but no difficulty naming objects. An EEG re-
vealed left frontal focal slowing, most intense near the midline. A ventriculogram
disclosed a depression and shift of the anterior part of the left ventricle toward the
right.

At operation on Dec. 1, 1948, a tumor mass, 3×3 cm., weighing 30 gm. and situ-
ated along the falc, was removed from the left posterior frontal lobe in the para-
coronal area. The tumor was a highly malignant type of meningioma.

After operation there was a striking motor aphasia. This case
was of interest not only because of the situation of the neoplasm,
but also because of the occurrence of a speech disturbance in a
left-handed individual of left-handed stock, the lesion being in
the left hemisphere (Fig. 8).

Case O.R. A 51-year-old lady was admitted to the hospital as
a patient of Dr. J. T. Daniels on May 28, 1948 because for 3
months she had had weakness of the right side, difficulty in
thinking clearly, and stammering. Her doctor wrote “The pre-
senting difficulty according to the patient’s diary was a sudden
change in legibility of her handwriting. This was followed by
semantic and syntactic aphasia, later including a nominal defect
of speech.”

Examination disclosed a right hemiparesis, mental inap-
titude and a disturbance of naming objects. There was hyperosto-
sis of the skull in the coronal region over the midline. An EEG
disclosed a left frontal slow wave focus and a pneumoencephalo-
gram revealed a shift of the ventricular system to the right, the
anterior horn and body of the ventricle being displaced downward to the right.

On June 22, 1948, partial removal of a left frontal parasagittal meningioma was
carried out, but the patient failed and expired on June 24, 1948.

At post mortem the tumor obliterated the longitudinal sinus completely, meas-
ured 2 cm. in width and 5 cm. in length and extended over into the opposite hemi-
sphere (Fig. 9). Histologically, it was a meningioma.

Erickson and Woolsey\textsuperscript{11} reported focal epileptiform seizures beginning
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with intermittent vocalization, reminiscent of that produced in other patients by stimulation of the “supplementary motor area,” in a patient with a small paracentral meningioma compressing the supplementary motor area. For 3 days after operation this patient had “a slight motor aphasia.” They described 2 additional patients with bilateral frontal parasagittal (“saddle-bag”) meningiomas just rostral to the precentral gyrus, both of whom had profound motor aphasia. Sweet described the findings in a patient with a meningioma lying at the junction of the falx and the superior lateral surface of the dura mater, just ahead of the rolandic motor cortex. “This meningioma was so small it did not produce any increased intracranial pressure, nor was there any distortion or displacement of the lateral ventricle in the pneumo-encephalograms. . . . Seizures began with sudden inability to say what she wanted to say and instead she would simply say “I, I, I, I, I, I.” This would end after a few seconds and the patient would then be able to speak properly. On a few occasions this type of seizure was followed by a typical generalized convulsion.”

Intrinsic tumors of the medial portion of the dominant cerebral hemisphere may also be associated with clinical evidence of language disturbance. In 1882 Hughlings Jackson described the case of an adult male, subject for many years to occasional seizures starting in the right foot, in whom a tumor of the medial portion of the left cerebral hemisphere was ultimately found. At one phase, he mentioned that the patient’s “fits began by inability to talk, probably aphasia.” On one occasion he was unable to speak for three minutes and a half, but no spasm was noted; the patient, however, felt “twittering” in his right toe. Hess scrutinized 245 cases of hemispheric tumors for “misleading” neurological signs and distant electroencephalographic slow wave foci. Two thirds of the “false” clinical signs occurred in cases of left-sided lesions; “false” clinical signs were found in one-quarter (61 cases), one-eighth belonging to the aphasic syndrome.

Experience with the following cases of metastatic carcinoma prompted the present study. The patients were both right-handed and were studied on the Neurological Division of St. Vincent’s Hospital, New York.

Case R.B. A 50-year-old man had had a pneumonectomy for carcinoma of the lung performed about 9 months prior to admission. Two weeks before admission he told his wife he had trouble writing at work. His wife stated that about 10 days prior to admission his speech was “confused” and “did not make sense.” A few days before admission he was found unconscious on the floor, following which weakness of the right upper extremity was apparent.

Examination disclosed a right-sided hyperreflexia, right extensor plantar response and a marked mixed aphasia. On occasion he could repeat phrases that he heard, could follow simple commands and answer simple direct questions. The EEG disclosed a left frontotemporal slow wave focus.
A large frontotemporal bone flap was reflected and a metastatic tumor, 4×5 cm. in size, situated close to the midline in the frontal region (Fig. 10), was enucleated.

At postmortem examination 5 days later no other metastatic or gross lesions of the brain were present.

Case E.G. A 57-year-old man had speech impairment of about 3 weeks’ duration, parietal headache, failure of memory and change in personal habits. His wife characterized the alteration in speech as one in which the patient’s “conversation became less and less” and finally reached a “yes or no” stage about a week before admission. He apparently could not comprehend what he read at this time. A few days before admission he said without apparent reason “I went to the . . . Paper Company and did very good, very good, very good.”

Examination disclosed right facial weakness, right extensor plantar response and right hemiparesis. He could name objects correctly, carried out simple commands, and could identify persons properly. He could read aloud, but could not comprehend the contents of what he had read. The EEG disclosed a frontal slow wave focus most intense near the midline.

Following ventriculographic studies, a left frontoparietal bone flap was made with extirpation of a metastatic tumor of the frontal lobe (3×2×1 cm.) near the midline (Fig. 11).

Postoperatively he was completely aphasic for several days, but gradually improved thereafter. At autopsy 7 months later there was no evidence of other metastases to the brain; a hypernephroma of the kidney was present.

Lesions of the dominant cerebral hemisphere associated with occlusion of the anterior cerebral artery may be associated with significant language disorder. Liepmann and Maas reported the case of a 70-year-old diabetic man with onset over a 24-hour period of a right hemiparesis and inability to speak. After a few weeks, he made attempts to speak, but his speech was not clear. He could repeat single letters as well as words. Reading aloud of
single letters was undisturbed, although he made a few mistakes on reading several words. Because of the right-sided paralysis, an attempt was made to have the patient write with the left hand, but spontaneous and dictated speech could not be written with the left hand. At postmortem examination there was softening in the distribution of the left anterior cerebral artery from the frontal to the paracentral region, involving also the left half of the corpus callosum. Critchley\(^6\) mentioned that speech defects of various types, usually transient, may occur with left-sided anterior cerebral artery lesions and characterized these as being defects partly of an aphasic order and partly dysarthric. Hyland\(^3\) reported the case of a 61-year-old woman with thrombosis of the common trunk of an anomalously distributed anterior cerebral artery which divided into two branches at the dorsum of the corpus callosum, in whom aphasia was a prominent sign. Davison, Goodhart and Needles\(^6\) remarked that aphasia, generally temporary, if encountered in cases of anterior cerebral artery lesions “is due to edema or pressure.” Poppen\(^9\) mentioned the presence of aphasia following left anterior cerebral artery ligation during surgery in the last 2 of 10 cases he reported. In his Case 9, a large meningioma of the left frontal lobe attached to the anterior portion of the falx at the level of the genu of the corpus callosum was removed and the left anterior cerebral artery was ligated. After this there was “complete aphasia,” which disappeared and was considered to be “no more than that observed after a left craniotomy in which considerable edema occurs owing to necessary manipulations of the brain.” In his Case 10, a metastatic carcinoma attached to the lower margin of the falx and the anterior cerebral vessels was enucleated and the main trunk of the left anterior cerebral artery was ligated. Postoperatively the patient was aphasic and was “still somewhat aphasic” 2 months later.

From clinical neurophysiological studies there are indications that the medial portion of the dominant cerebral hemisphere may play a part in speech. In 1940, Brickner\(^4\) reported the findings upon electrical stimulation of the mesial cortex of the left cerebral hemisphere in a 32-year-old right-handed woman with a history of major and minor seizures since the age of 17 years. At operation, during routine cortical exploration, an area approximately 1 cm. in diameter was discovered “accidentally” which was low down in area 6 (Brodmann), at its junction with the posterior superior portion of area 92, which on stimulation caused the patient to utter, in a stereotyped manner, syllables resembling “err, err, err.” When the patient was asked to say the alphabet and an electrical stimulus was applied to this area, repetition of the syllable last spoken occurred for the duration of the stimulus, following which the continuation of the alphabet was immediately resumed. The letters repeated were slightly distorted and their rate of production was slightly slower than the rate at which the patient recited the rest of the alphabet. The patient stated she was fully aware of what was happening, but could not check herself. Histological study of the area disclosed no abnormalities.
Smith's studies on electrical stimulation of the rostral cingular cortex of monkeys indicated that vocalization response, identical to that made by the animal under the usual conditions of laboratory existence, can occur. At times the "vocalization" appeared as part of a complex reaction characterized by opening of the eyes, dilatation of the pupils and vocalization. Movements of the facial muscles, usually bilateral, often accompanied the vocalization with protrusion, rounding or retraction of the lips. While a low-pitched gutteral sound was the one most frequently obtained, there occurred at times, cries, soft and plaintive, such as the animal makes at feeding time. While ordinarily such vocalization response occurred only upon electrical stimulation of the rostral cingular zone, it was noted that after the production of vocalization, the immediate excitation of the cortex above the cingular gyrus also resulted in a vocalized response.

Penfield and Rasmussen reported "arrest of talking" on stimulation of the most medial portion of the convexity of the cerebral hemisphere in the region of area 6, or of the suprarotund zone of the paracentral lobule. They stated:

"Two bilateral cortical areas of vocalization, Rolandic and superior frontal, have been demonstrated in man. Electrical stimulation of either of these areas, in either hemisphere, may produce vocalization or it may produce arrest of speech. The difficulty in speaking applies to all words alike. In no case yet observed has it produced aphasia in these areas." [p. 106]

"More recent cases suggest that inactivation of the superior frontal zone within the longitudinal fissure on the dominant hemisphere is capable of producing aphasia." [footnote p. 107]

"A part of the mesial surface of the superior intermediate frontal region is occupied by the supplementary motor representation in which is included bilateral synergic movement and vocalization. Removal of this area in the non-dominant hemisphere alone produces no specific deficit that we have detected as yet. Removal on the dominant side alone has also been carried out in its anterior portion without obvious clinical sequel." [p. 199]

"We have only once removed the area all the way to the precentral gyrus within the longitudinal fissure on the dominant side. That patient (D.T.) became speechless during the ablation of this final posterior portion. He died of pneumonia a week later without having spoken again, and autopsy showed no obvious cause of this speechlessness." [footnote p. 199]

Our study suggests that disorders involving language function may occur in conjunction with lesions of the medial portion of the dominant cerebral hemisphere. Varying degrees and types of speech disturbance as well as convulsive seizures characterized by vocalization have been encountered. In some tumor cases improvement in language function occurred after operation; in vascular cases remission was sometimes noted after recovery from the acute episode. Although the electrical stimulation studies reported by Brickner, Smith, and Penfield and Rasmussen serve to establish a possible neurophysiological basis for language disorder associated with lesions of the medial aspect of the dominant cerebral hemisphere, the presence of associ-
ate defects dependent upon involvement of the classically recognized cerebral language areas cannot be excluded as a factor in some of the cases reviewed. This is obviously true in tumor cases, in which altered circulation, mechanical displacement and compression, edema and related pathological changes are not unusual. However, the uncritical dismissal of all language disorders encountered with lesions of the dominant cerebral hemisphere purely upon such a basis is unwarranted, since language disturbances have also occurred in cases of small parasagittal lesions in which remote tissue changes were not found.

SUMMARY

1. Impaired language function of varying degree and type and convulsive seizures characterized by vocalization may occur in patients with lesions of the medial portion of the frontal lobe of the dominant cerebral hemisphere.

2. The clinical features of 11 cases in which disturbed speech occurred in association with parasagittal tumors are presented and similar findings in other reported cases are cited.

3. Reports of language disorders after interruption of the anterior cerebral artery of the dominant cerebral hemisphere are noted.

4. Electrical stimulation studies of mesial cerebral cortex suggest a neurophysiological basis for language difficulties associated with lesions of the medial portion of the dominant cerebral hemisphere.

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