

RESULTS OF THE REMOVAL OF TUMORS OF THE SPINAL CORD*

ALFRED W. ADSON, M.D., AND WILLIAM O. OTT, M.D.
ROCHESTER, MINN.

Results following the surgical treatment of tumors of the spinal cord depend on the duration of symptoms and on the position, level and type of tumor. The histories vary but are suggestive and give the first clue to the diagnosis. The onset of symptoms is gradual; sensory disturbance is usually the first, that is, paresthesia or anesthesia, accompanied by motor disturbances. The condition may improve temporarily; but the symptoms gradually progress to a loss of sensibility and motor function, in conjunction with exaggerated reflexes below the cord segment involved.

About thirty-five years have elapsed since the first tumor of the spinal cord was removed by Horsley. During this short time, many tumors of the spinal cord have been removed; but many have also been overlooked because a definite level of loss of motor power and sensibility was not present or the exact history of motor or sensory loss that was expected was not given.

In our experience, pain in the spine while the patient is lying down, exaggerated by coughing, sneezing, jarring and bending, and often relieved by getting up and walking around, is an early symptom of intradural extramedullary tumor, generally situated in the vicinity of the cauda equina. If pain persists along the sciatic nerves for years without yielding to treatment for sciatica, the possibility of tumor of the cord must be considered. In 1921, we removed four tumors of the spinal cord from patients who complained of very little except the pain herein described.

Spinal puncture is of value in the diagnosis, inasmuch as the presence of yellow fluid, that is, fluid containing xanthochromia, helps to confirm the diagnosis of tumor of the spinal cord. However, it does not differentiate extramedullary and intramedullary tumors. A dry tap in the fourth lumbar space, while fluid is obtained at a higher level, is also of value. The cisterna magna puncture in conjunction with spinal puncture is a valuable aid in confirming the presence or absence of obstruction in the canal, which most often is due to tumor of the spinal cord.

* From the Section on Neurologic Surgery, Mayo Clinic.

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The rate of progress depends on the position and type of the tumor. Soft neoplasms and neoplasms of the intramedullary type usually progress slowly, while hard, encapsulated tumors produce considerable pressure and cause marked paralysis in a few months, the damage to the cord being much more permanent than that caused by soft tumors. Tumors pressing the cord dorsally cause sensory disturbances before

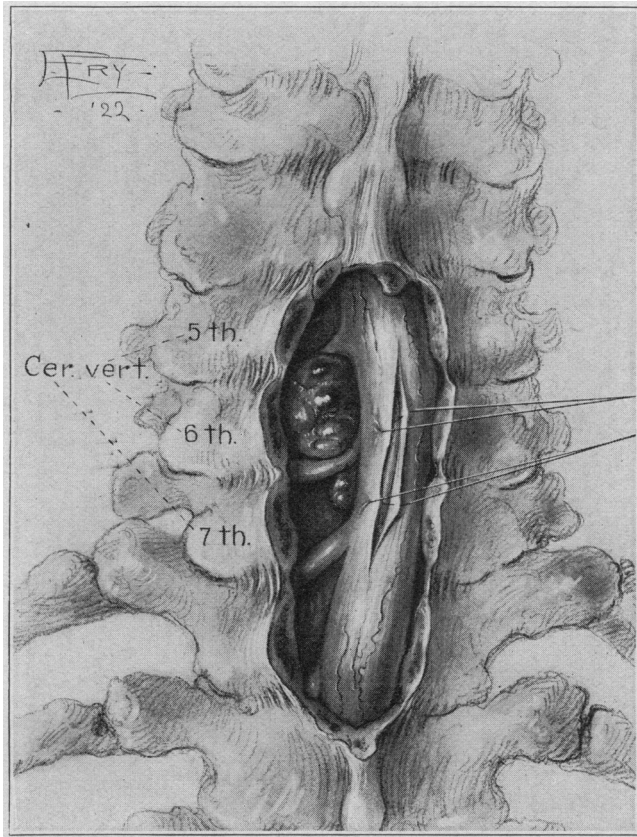


Fig. 1.—Fibrochondroma situated anterolaterally to the cervical cord. This illustration and Figures 2, 3 and 4 represent extradural tumors of the spinal cord.

motor; those situated laterally or anteriorly are more likely to produce Brown-Séquard's syndrome, with motor disturbances before sensory. Tumors of the cervical and dorsal cord cause symptoms earlier than those of the lumbar cord; those arising from the vertebrae or from the meninges, extradural or intradural but extramedullary, produce pressure on the cord without invading it, while those arising within the cord

itself produce destruction of the medullary portion and later destruction of the medullated fibers. Tumors of the spinal cord may occur in any part of the spinal canal or spinal cord; most occur in the thoracic region, fewer in the cervicodorsal, and fewer still in the dorsolumbar.

TYPE OF TUMOR

The character of tumors of the spinal cord depends directly on their origin; those arising from the vertebrae and from the tissues of the spinal canal are bony, cartilaginous or fascial; those arising from the

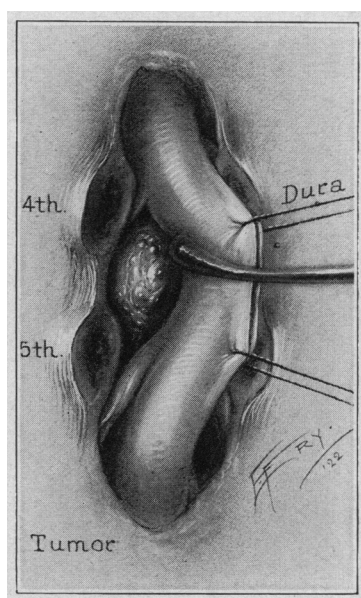


Fig. 2.—Fibrochondroma situated anteriorly to the cord, opposite the fourth and fifth lumbar vertebrae.

meninges are endotheliomas, fibromas, psammomas, and so forth. Such tumors, as a rule, are not very large, are slow growing, and are rarely malignant; their early removal favors ultimate cure.

Tumors of the cord itself are usually gliomatous, and arise around the central canal; some degenerate and become cystic, others remain firm and solid. Ependymal gliomas arise from the conus and extend downward through the canal of the lumbar region, and occasionally to the sacral region. Most ependymal gliomas in the lumbosacral region are encapsulated and not adherent to the lumbosacral roots, but may be situated between them and fill the spinal canal.

TABLE 1.—FINDINGS IN LESIONS OF THE SPINAL CORD

	Patients	Males	Females	Average Age, Years	Oldest, Years	Young est, Years	Duration of Symptoms			Presence of Root Pain	
							Aver- age, Months	Short- est, Months	Long- est, Months	Patients	Per Cent.
Tumors: Extradural.....	14	10	4	42.5	64	16	23	1	132	8	57
Intradural but extramedullary.....	30	16	14	44.5	61	20	45	2	168	20	66
Intramedullary.....	31	19	12	44.0	63	12	45	4	156	22	71
No tumor found; meningomyelitis (?).....	27	14	13	33.0	50	16	40	3	153	13	54
Varicose veins.....	3	2	1	27.0	30	22	79	10	204	1	33
Echinococcus cyst.....	1	..	1	44.0	80	..	7	..	..	1	100
Tuberculoma.....	2	2	..	45.0	59	32	15	12	18	1	50
Gumma.....	2	2	..	29.0	34	25	29	25	34	2	100
Cerebellospinal tumors.....	2	1	1	25.0	48	2.5	25	2	46	..	..
Total.....	112	64	48								

TABLE 2.—FINDINGS IN LESIONS OF THE SPINAL CORD

	Paralysis												Spinal Fluid Findings							
	Motor				Sensory				Bladder								Rectal			
	Ab-	Par-	Com-	Ab-	Par-	Com-	Ab-	Par-	Com-	Ab-	Par-	Com-	Ab-	Par-	Com-	Spinal Punc- tures	Dry Tap	Xantho- chromia	Cell Count	Nonne Average Postive
Tumors: Extradural.....	14	3	4	7	2	6	6	4	4	6	4	4	4	6	11	1	1	6	6	
Intradural but extramedullary.....	30	3	18	9	3	17	10	4	15	11	4	15	11	21	21	1	5	11	3	
Intramedullary.....	31	..	24	7	..	22	9	7	14	10	7	9	15	23	23	1	7	12	5	
No tumor found; meningomyelitis(?).....	27	..	23	4	1	18	8	3	21	3	2	20	5	18	18	..	..	3	4	
Varicose veins.....	3	3	..	..	..	3	..	3	..	3	..	3	..	1	1	..	..	..	5	
Echinococcus cyst.....	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	..	..	..	1	
Tuberculoma.....	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	..	..	..	2	
Gumma.....	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	..	..	..	1	
Cerebellospinal tumors.....	2	1	1	..	..	..	..	..	..	..	..	..	..	1	1	..	..	1	1	
Total.....	112	7	75	30	8	68	36	20	59	33	19	53	40	89	2	2	13	33	33	

MAYO CLINIC SERIES

The records of the Mayo Clinic from January, 1910, to April, 1922, show that 112 patients were operated on for tumor of the spinal cord. Fifteen laminectomies were performed from 1910 to 1916, in six of which tumors were not found. From 1916 to April 1, 1922, ninety-seven patients were operated on for tumor of the cord, in seventy-six of which neoplasms were found; in twenty-one the findings were negative except for inflammatory processes. In four of the twenty-one, later examination revealed the presence of tumors; two of these were intradural but extramedullary, and above the level explored; both were verified at necropsy. One of the patients had two endotheliomatous tumors, about 15 cm. apart. Two had developed huge tumors, arising

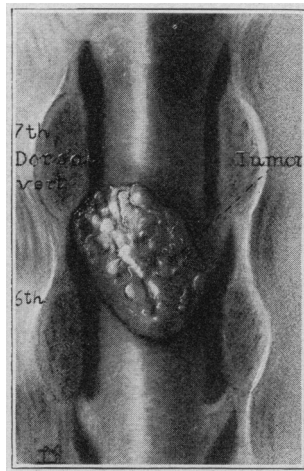


Fig. 3.—Angioneuroma situated dorsally to the spinal cord, opposite the sixth dorsal vertebra.

from the sacrum, posterior to the rectum; these were not palpable by rectal examination before laminectomy. Sixty-four of the patients were men and forty-eight were women. For detailed study, we have divided the patients into nine groups.

Group 1 consists of fourteen patients with extradural tumors.

Group 2 consists of thirty patients with intradural but extramedullary tumors.

Group 3 is composed of thirty-one patients with intramedullary tumors.

Group 4 consists of twenty-seven patients in whom no tumor was found. A few had chronic meningomyelitis, and in four tumors were found at a later date.

TABLE 3.—FINDINGS IN LESIONS OF THE SPINAL CORD

	Patients	Level of Tumors				Tumors Removed	Type of Tumor Removed										Type of Tumor Partially Removed										Exploration
		Cervical	Dorsal	Lumbar	Sacral		Lipoma	Fibroma	Angioneuroma	Neurofibrosarcoma	Fibrochondroma	Glioma	Hemangioma	Psammoma	Neurofibroma	Endothelioma	Echinococcus Cyst	Inflammatory Tumor	Tumors Partially Removed	Gliomasarcoma	Neurofibroma	Sarcoma	Degenerating Neoplasm	Glioma	Endothelioma	Inflammatory Tumor	
Tumors: Extradural.....	14	3	8	3	1	10	2	1	1	2	4	2	1	1	1	1	4	2	1	1	1	1	1	1	1	1	
Intradural but extramedullary.....	30	7	19	3	1	29	..	3	..	..	..	..	..	..	..	..	1	18	..	1	1	2	13	..	..	1
Intramedullary.....	31	6	25	..	..	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	10
No tumor found: meningomyelitis (?) [*]	27	..	24	..	2†	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	3
Varicose veins.....	3	..	1	3	..	1	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	2
Echinococcus cyst.....	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	2
Tuberculoma.....	2	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2
Gumma.....	2	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	2
Cerebellospinal tumors.....	2	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2
Total.....	112	18	59	9	3	43	..	..	..	..	..	..	..	..	..	..	..	26	..	..	..	..	1	1	..	16

* Four tumors were found at a later date, two were endotheliomas and two Mitteldorpf tumors.

† Found at necropsy.

‡ Palpable on pelvic and rectal examination after operation.

Group 5 consists of three patients with angiomas of the spinal cord (varicose veins).

Group 6 consists of one patient with an echinococcus cyst of the cord, who had been operated on previously for echinococcus cysts of the lung and the liver.

Group 7 is composed of two patients with tuberculoma of the cord, one of whom had an extensive tuberculoma on the anterior and lateral surfaces of the cervicodorsal cord, associated with miliary tuberculosis. These findings were verified at necropsy. The other patient had a unilateral inflammatory lesion of the cauda equina, resembling tuberculoma without neoplastic cells. The condition had not progressed farther since 1917.

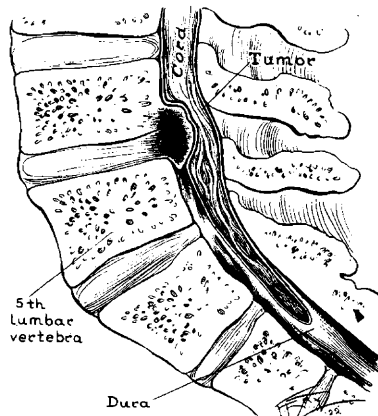


Fig. 4.—Sagittal section of region of fourth and fifth lumbar vertebrae in the case shown in Figure 2.

Group 8 is made up of two patients with gumma of the cord, both of whom gave histories positive for syphilis and presented definite levels of paralysis. In one the meninges were thickened and adherent to the cord in one large mass for 4 cm.; the other, who gave a short history, approximately six months, presented very similar findings except that the dura could be separated from the soft inflammatory mass. We were able to remove part of the inflammatory mass at operation; the wound was closed and the dura left open. The patient recovered his motor power and sensation, and is apparently free from symptoms. It is also interesting to note that one of the patients of Group 5, in whom an angioma was found, gave a positive history of syphilis.

Group 9 consists of two patients with cerebellospinal tumors; one of them was 48 years of age, and the other 2½ years. Both had large

vermis tumors, extending through the foramen magnum into the spinal canal. Only a partial removal was possible, and both patients died soon after operation.

Duration of Symptoms.—The average duration of symptoms in Group 1 was twenty-eight months; in Group 2, forty-five months; in

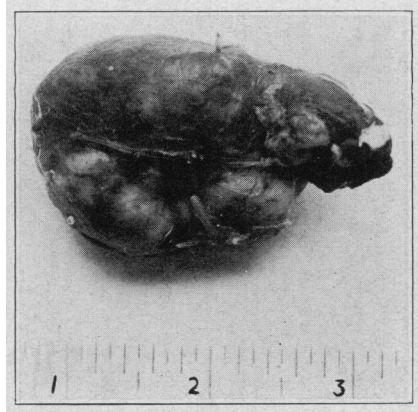


Fig. 5.—Psammoma. This illustration and Figures 6, 7 and 8 represent intradural but extramedullary tumors of the spinal cord.

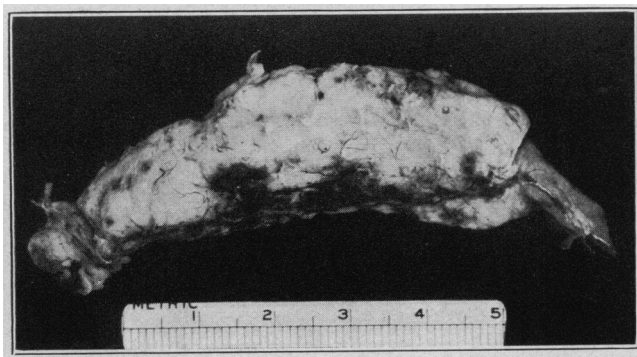


Fig. 6.—Encapsulated intramedullary endothelioma removed from the dorsolumbar cord, extending upward from the conus.

Group 3, forty-five months, and in Group 4, forty months. The other groups are so small that a definite average was not obtained.

Root Pain.—Root pain was present in eight patients (57 per cent.) of Group 1; in twenty (66 per cent.) of Group 2; in twenty-two (71 per cent.) of Group 3, and in thirteen (54 per cent.) of Group 4. In Groups 5, 6, 7, 8 and 9, four patients (44 per cent.) had root pain.

TABLE 4.—FINDINGS IN LESIONS OF THE SPINAL CORD

	Patients	Died	Average Time in Hospital, Days	Hospital Convalescence										Died After Leaving Hospital				
				Cause of Death										Cause of Death				
Tumors: Extradural.....	14	2	26	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Intradural but extramedullary...	30	4	25	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Intramedullary.....	31	3	60	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
No tumor found; meningomyelitis (?).....	27	5	21	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Varicose veins.....	3	1	21	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Echinococcus cyst.....	1	1	21	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Tuberculoma.....	2	1	13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gumma.....	2	1	17	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cerebellospinal tumors.....	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 1 gives the number of patients with and without motor and sensory paralysis of the bladder and rectal areas.

Spinal Fluid Findings.—These findings (Tables 1, 2, 3 and 4) are of interest, as frequency of xanthochromia, high cell count, globulin and a positive Wassermann reaction are shown. In the 112 patients operated on, eighty-nine spinal punctures were performed. In thirteen instances,

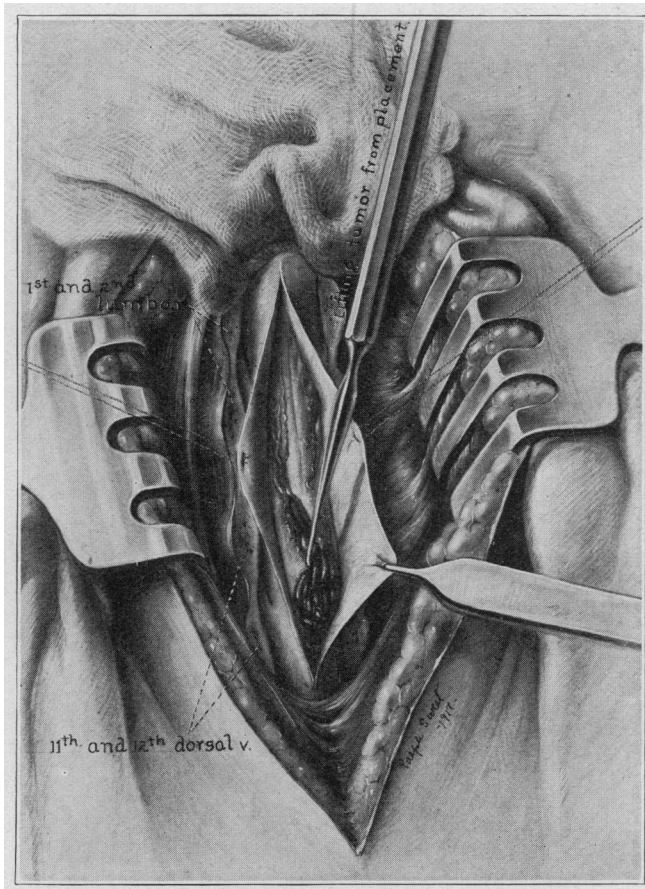


Fig. 7.—Angioma or varicose veins of the cord.

xanthochromia was found in the spinal fluid; in thirty-two the Nonne test for globulin was positive, and in those in which a cell count was made the average count was 3, and the highest count was 18. The Wassermann reaction on the spinal fluid was negative in every instance, even though three patients gave histories positive for syphilis.

Location of Tumor.—In fifty-nine patients, the tumor was in the dorsal region; occasionally, however, it extended into the cervical and

TABLE 5.—END-RESULTS IN TREATMENT OF LESIONS OF THE SPINAL CORD

	Patients	Living	Average Length of Postoperative Life, Months	Well and at Work	Improved and Working Some	Improved but Not at Work	Improved for an Average of Five Months	Helpless	Not Traced
Tumors: Extradural.....	14	11	37.5	5	1	3	..	..	2
Intradural but extramedullary.....	30	24	32.0	13	2	3	..	1	5
Intramedullary.....	31	22	35.0	1	3	9	..	4	5
No tumor found; meningomyelitis (?).....	27	17	34.0	2	1	1	2	9	2
Varicose veins.....	3	2	75.0	..	..	1	..	..	1
Echinococcus cyst.....	1	1	21.0	..	..	1	..	..	..
Tuberculoma.....	2	1	54.0	1	..	1	..	..	..
Gumma.....	2	1	8.0	..	..	..	..	..	..
Cerebellospinal tumors.....	2	..	....	..	..	..	..	..	..
Total.....	112	79	...	22	7	19	2	14	15

Neoplasm found in 85 patients (76 per cent.) of 112 in whom laminectomy for cord tumor was performed.
 43 tumors removed completely = 51 per cent. of tumors found are removable.
 23 tumors partially removed = 30 per cent. of tumors found are partially removable.
 23 patients well and working.
 7 improved and working some.
 19 improved and not working.
 — 48 total improved = { 43 per cent. of 112 in whom laminectomy was performed.
 { 56 per cent. of 85 in whom tumors were found.

the lumbar areas, but the principal part was in the dorsal region. In eighteen patients, the tumor was in the cervical region, in nine in the lumbar region, and in three in the sacral region. In twenty-three a tumor was not found, or the symptoms were due to an inflammatory process.

Removal of Tumor.—Tumors were removed completely from forty-three patients (39 per cent. of the entire series); tumors were removed partially from twenty-six (23 per cent.).

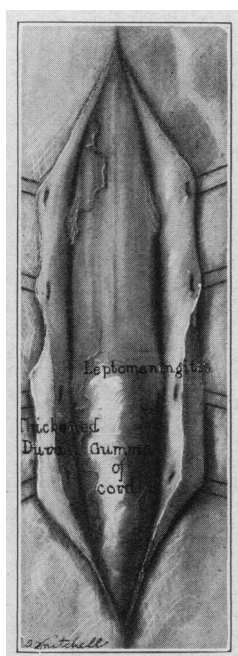


Fig. 8.—Gumma of the spinal cord and meninges.

End-Results.—Of the 112 patients operated on for tumor of the spinal cord during the period of our study (twelve years), seventy-nine are alive. Twenty-two of the living have recovered completely and are doing their regular work; seven have improved sufficiently to do a little work, and twenty-one have improved, but are unable to work; fourteen are helpless. Fifteen patients did not reply to our letter of inquiry. It is fair to assume that a few of these have improved, since patients who have not improved are more likely to reply than patients who are well and free from symptoms.

Operation.—We employ no special technic in laminectomies for the removal of tumors of the spinal cord, aside from precautionary

measures against traumatizing the cord or permitting hemorrhage within the dura. The spines and laminae are removed; the muscles are closed in two planes with interrupted and continuous sutures of catgut, and the skin is closed by a subcuticular stitch of catgut, besides a dermal suture. If the tumor is in the cervical region, a unilateral laminectomy is performed, with the removal of the opposite lamina and the spine over the tumor. This precaution is taken because one patient had a recurrence of symptoms owing to slipping of the bodies of the cervical vertebrae, causing traction and pressure on the cervical

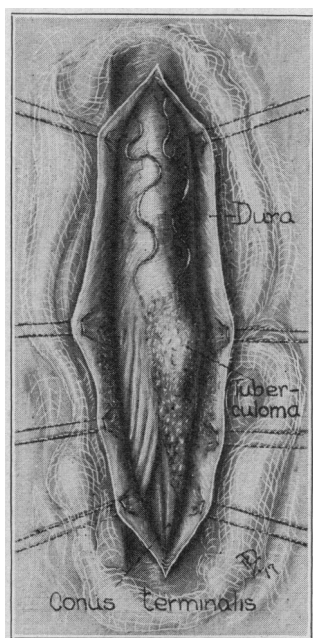


Fig. 9.—Tuberculoma (?) of the cauda equina, unilateral lesion.

cord and resulting in paralysis. While we prefer the one-stage laminectomy, we have found it necessary to perform a two-stage operation in seven of our cases, and a three-stage operation in one, because of the extensiveness of the lesions. As a rule, we remove three spines and laminae before we open the dura; five or six can be removed with little difficulty. Ependymal gliomas of the cauda equina usually extend from the eleventh dorsal to the first or second sacral vertebra, and in such cases trouble will be encountered if too much is attempted at one operation. Otherwise, the one-stage operation is very satisfactory, especially to the patient, and there is danger of infection in opening a recent wound for a second operation.

Ether anesthesia has been employed in the greater number of cases; however, we have found paravertebral anesthesia very satisfactory in obese patients and in patients who are poor surgical risks. It is necessary to apply a 1 per cent. solution of procain to the dura, as it is exposed during laminectomy, since it is not desensitized in the paravertebral anesthesia by procain. A few drops of 1 per cent. solution of procain can be injected into the dural canal above the tumor without danger. Intraspinal anesthesia by procain can also be used in low

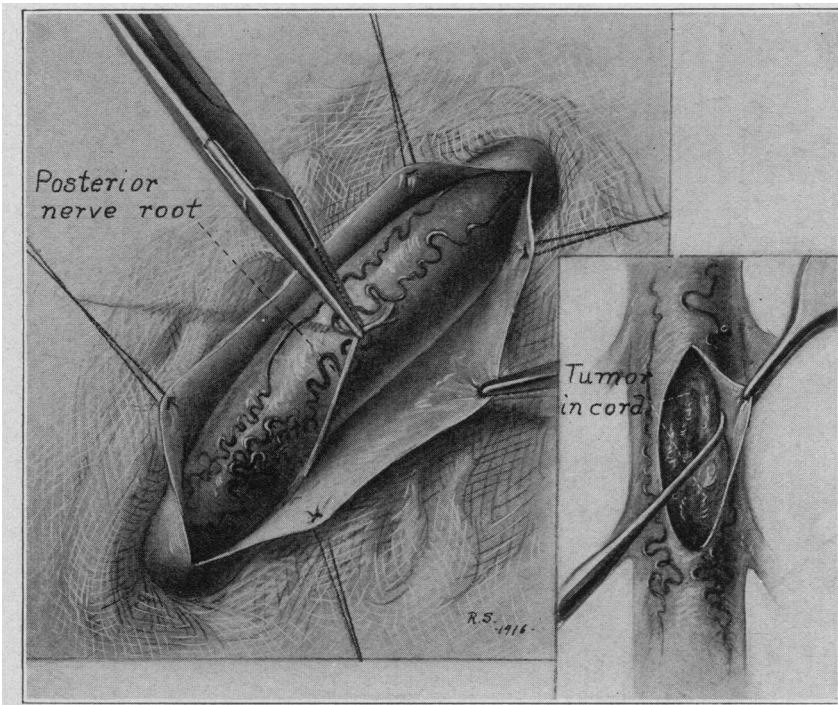


Fig. 10.—Intramedullary degenerating glioma of the dorsal cord.

laminectomies of the lumbar and sacral regions, but should be used cautiously, if at all, in middle dorsal or upper dorsal lesions.

Postoperative Care.—The care of patients after laminectomy differs little from general surgical care. We prefer to keep the patient on his abdomen on three or four soft pillows, with the head slightly lower than the operative field, for three or four days, besides avoiding undue pressure on the bony prominences. He is then permitted to turn on his side, and after ten or twelve days to lie on his back. About the fourteenth day he may sit up in a chair. We have found that he is more comfortable in the prone position, that the wound heals more

rapidly, and there is less danger of drainage of cerebrospinal fluid, especially in cases of intramedullary tumors in which the dura is left open. Provided the patient has not been catheterized previously, the bladder is allowed to overflow. If cystitis is present and the patient has been catheterized previously, a retention catheter is inserted prior to opera-

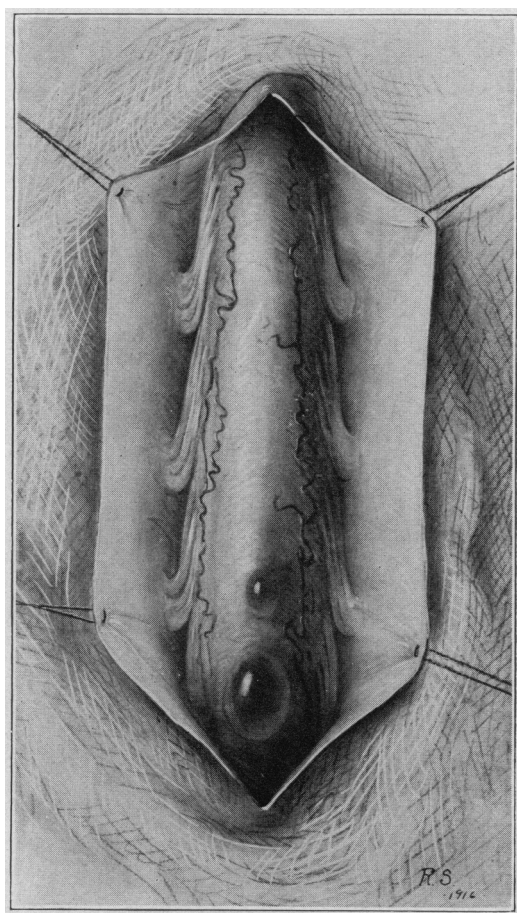


Fig. 11.—Tumor shown in Figure 10, extending down into the conus.

tion, and is changed about once a week. The bladder is lavaged daily with a 2 per cent. solution of boric acid, and about one-half ounce (15 c.c.) of 10 per cent. solution of argyrol is introduced and allowed to remain in the bladder for one-half hour. If there is any evidence of pyelitis, acid sodium phosphate and hexamethylenamin, 7 grains (4.5 gm.) of each, three times a day, are administered. This is followed by a week of rest, and a second course of medication.

Convalescence.—Recovery depends on the duration of symptoms. If the tumor has been removed without trauma, a patient with a duration of symptoms of one year or less may be expected to recover completely; one with a duration of symptoms of not more than three years, to improve markedly. Recovery is more complete following the removal of soft tumors than hard, nodular ones; and, if the same degree of paralysis exists, recovery is more complete if the tumors are in the caudal or lumbar regions, than if in the dorsal or cervical regions. Extradural and intradural but extramedullary tumors can usually be removed completely with very little difficulty, but it is difficult to remove intramedullary tumors. In our group of intramedullary tumors, one endothelioma only could be removed completely. This tumor arose apparently from the pia mater and extended into the cord. We have attempted partially to remove several intramedullary tumors, and sometimes we have split the cord dorsally and permitted the tumor to extrude. The results have been twofold: some patients have been made worse by attempted removal; others have improved for a time and then developed recurrence of symptoms. As a whole, the results of removal of intramedullary tumors are unsatisfactory, and we believe that unless the tumor is very close to the dorsal surface of the cord less damage will be done and more temporary relief afforded the patient by laminectomy and incising the cord dorsally. The administration of radium may prove of some value in this group. One of the patients who were treated by radium apparently improved; another improved for one month following partial removal of an intramedullary tumor and then failed until he was paralyzed completely. If radium is used, it should be screened very carefully and not placed directly on the cord.

SUMMARY

In a series of 112 laminectomies, tumors were found in eighty-five (76 per cent.). Forty-three of the tumors (51 per cent.) were removed completely, twenty-six (30 per cent.) were removed partially, and sixteen were not removed. In twenty-seven cases no tumor could be found at operation; in four of these, tumors were demonstrated later. Seventy-nine patients are living; twenty-two are perfectly well and at work. Seven are improved and doing a little work; twenty-one are improved but not at work, and fourteen are helpless. Fifteen were not traced. Seventeen died in the hospital, and seventeen died subsequently at home, with an average time of two years between operation and death.

Tumor of the spinal cord is more common than is realized; many are overlooked or are found late. The best results are obtained by early operation.

DISCUSSION

DR. CHARLES H. FRAZIER, Philadelphia: I have recently made a very critical analysis of fourteen consecutive laminectomies performed for tumors. The diagnosis is the most important. The surgical problems present relatively few difficulties. Dr. Adson has dwelt very properly on the question of pain as an important diagnostic feature. Not only was pain present in all but one of my cases, but it was a constant symptom in all and was referred to a constant location in all from the time of onset until the time of operation. Pain was present in one half of the cases for three years prior to the onset of motor disability and in at least one third of the remaining cases for two years prior to motor disability. So for these various reasons we lay greater emphasis on pain as a diagnostic feature. In the development of the syndrome I think you will find that, while pain is the first symptom in almost all cases, paresthesia is almost invariably the second symptom. Pain, being a root symptom, is on the side of the lesion, and paresthesia, a cord symptom, may be homolateral or contralateral. Motor impairment has come on comparatively late in my series; it has not been particularly important so far as diagnosis was concerned. It was the principal reason for surgical consultation, which was precipitated because, while the patient had been disturbed by pain and paresthesias, it was not until paralysis developed that surgical assistance was sought. With reference to segmental diagnosis we have placed emphasis on the following signs as of importance in their relative order: the level of sensory loss or impairment; the point to which the pain was referred; the loss of a given reflex; the sympathetic ocular phenomena, which always imply tumor in the lower cervical or upper thoracic region, and lastly muscular atrophy. In twelve of these fourteen cases, we found tumors which were distinctly operable; that is to say, they were localizable, definitely encapsulated and quite accessible, and they presented no great operative difficulties. Of the two exceptions, one was a metastatic carcinoma, involving the vertebral bodies, and the second a large, and, as I thought, an inoperable tumor of the cauda equina. There are two practical points in the surgical aspects of spinal tumors: (1) adequate exposure and (2) prevention of recurrence. In probably forty-nine out of fifty cases in which a mistake has been made the opening was too low rather than too high; to avoid this mistake we have adopted this rule: we select as the lower limit of the opening the spinal process opposite the segment representing the highest level of sensory loss or impairment. In this series of fourteen cases the tumor was exposed in every instance. In two cases, the tumor was only partly exposed by the laminectomy opening as originally planned, and in one of these the tumor extended within the cranial cavity. The second point of importance is the avoidance of recurrence. Extradural tumors take their origin invariably from the meninges and almost invariably from the lateral aspect of the spinal canal, and to avoid recurrences we must remove not only the tumor but also that portion of the dura to which the tumor is attached.

DR. ERNEST SACHS, St. Louis: Spinal cord tumors are not rare. Every case of what has heretofore been called transverse myelitis should be potentially considered as a tumor until proved otherwise. That will necessitate a considerable number of negative explorations, but a patient with a transverse lesion of the cord, unless some other etiologic factor has been found, has not been given a fair chance unless every method of diagnosis has been exhausted. A point emphasized by Dr. Adson and by Dr. Frazier, I would not agree with. In my experience with fifty cases, the first symptom was not pain. Very frequently it was paresthesia. Possibly because I live in Missouri, a large

number of these cases had been treated for a considerable time by various types of "adjustment." I know of nothing that is more discouraging than to have a negative exploration, and any method that will help reduce the number of negative explorations should be welcome. I have welcomed the work of Dr. Ayer, of Boston—his combined cistern puncture, which some of us thought rather dangerous, though it has not been so in his hands. Dr. Ayer has shown that if a lumbar puncture is done, and then the jugular veins are compressed, if there is a spinal block the cerebrospinal fluid in the tube connected with the needle will not rise. At least in one case, this method has prevented me from doing an exploration. I think we should keep this method in mind and make use of it and in that way, perhaps, reduce the number of negative explorations.

Dr. A. W. Adson, Rochester, Minn.: Pain is an important sign, but it is not absolutely diagnostic, as many patients have spinal cord tumors without the presence of root pain as a symptom. Puncture of the cisterna magna in conjunction with the spinal puncture is of some value. It is a spectacular procedure when one finds the pressure is greater in the cisterna magna than in the spinal canal, but this does not locate the tumor, and occasionally may give misleading information when adhesions are present between the arachnoid, pia mater, and the dura.