THE MYELOGRAPHIC APPEARANCE OF ADHESIVE SPINAL ARACHNOIDITIS

WILLIAM B. SEAMAN, M.D., SUMNER N. MARDER, M.D.,* AND
HERBERT E. ROSENBAUM, M.D.

Edward Mallinckrodt Institute of Radiology, and Department of Neuropsychiatry,
Washington University School of Medicine, St. Louis, Missouri

(Received for publication September 8, 1952)

A review of the literature reveals a paucity of illustrations of the myelographic appearance of spinal adhesive arachnoiditis.\textsuperscript{1,3,5,6,11,12} Most of those published are of the extensive variety that cause little diagnostic difficulty. In view of the recent report of Kennedy \textit{et al.}\textsuperscript{8} emphasizing the frequency of adhesive arachnoiditis following spinal anesthesia, it was felt that publication of the following 7 surgically verified cases would be of interest. The clinical features and therapeutic aspects have been recently reviewed by one of us,\textsuperscript{10} and the present communication will be limited to the radiographic findings in verified cases.

Since the diagnosis of chronic adhesive spinal arachnoiditis is frequently a difficult one to establish clinically, myelography may be a very helpful procedure. In 1929 Odin and Runström\textsuperscript{9} reported 14 cases of arachnoiditis and described the myelographic picture as one showing the contrast material in the form of droplets and streaks. From a study of the pathologic alterations produced by arachnoiditis, they postulated that the following alterations might occur in the myelographic appearance: a complete block to the passage of contrast material, the formation of pockets with retention of opaque substance, or the production of a filling defect in the contrast shadow. They observed no instances of complete block and most of their cases exhibited the picture characterized by streaks and droplets of contrast material.

It was probably because of these multiple possibilities that Dyke\textsuperscript{3} wrote that there is no characteristic picture of this condition. He mentioned complete and incomplete obstructions to the passage of opaque material as occurring in this disease as well as scattering of opaque oil in small globules over a large portion of the spinal canal. Davidoff, Gass and Grossman\textsuperscript{2} pointed out that a localized adhesive spinal arachnoiditis could occur following the removal of a cord tumor and simulate a recurrence by both clinical symptoms and myelographic findings. In 3 of their 5 cases a complete block to the flow of opaque oil during myelography was demonstrated.

Elkington,\textsuperscript{4} in a recent review of arachnoiditis, stated that myelography is perhaps the most valuable aid to the correct diagnosis. In his experience a clear-cut arrest of the contrast medium either above or below the affected segments of the cord is rare. He stated that in some cases the picture re-

\* Now at the National Cancer Institute, Bethesda, Maryland
sembles the guttering of a candle or of a sheath lining the circumference of the spinal canal in a manner difficult to explain other than by a diffuse and partial occlusion of the subarachnoid space.

CASE REPORTS

Case 1. H.W., a 17-year-old colored gravida 1 para 1, was delivered of an apparently normal child on March 28, 1950 under saddle-block anesthesia (2.5 mg. “heavy nupercaine”). The delivery was uneventful as was the anesthetic, except that the patient noted numbness of her body from the rib margin down in spite of the so-called “saddle” technique.

The postpartum period was entirely normal until the 5th week, when she noted slight numbness and weakness in her feet. This condition progressed in severity and on July 3, 1950 she returned complaining of numbness from the waist downward, inability to walk without support, and dysuria for the previous 2–3 weeks.

She was admitted to Barnes Hospital, with clinical findings typical of transverse myelitis at the level of the 7th thoracic dermatome and profound sensory changes below the iliopsoas group. There were bilateral pathological toe signs, and ankle and patellar clonus. Routine laboratory findings and x-rays of the spine were normal. Lumbar puncture was unsuccessful on three attempts.

Myelography. A small amount of pantopaque was introduced into the spinal canal at the level of the 1st and 2nd lumbar vertebrae. This remained stationary and could not be moved up or down (Fig. 1).

Fig. 1. Case 1. Opaque material was injected at the L1–L2 interspace and would not move up or down. Note irregular shape and eccentric position within the spinal canal.

One cc. of pantopaque was then introduced via cisternal puncture and it moved downward freely to the level of the 8th dorsal vertebra where it met a complete block.

Laminectomy. The dura mater was thickened and firmly adherent to the pia-arachnoid. On incision of the dura mater, the entire spinal cord in the exposed area was found to be surrounded by a dense mass of thickened adherent arachnoid, which could not be dissected free from the pia and cord. A biopsy was taken which confirmed the gross appearance of chronic inflammation of the meninges.

Case 2. F.L., a 29-year-old white gravida 3 para 3, was delivered of a normal child on Jan. 3, 1949 under saddle-block anesthesia (heavy nupercaine 3.75 mg.). The delivery was uncomplicated and the anesthetic was classical in the distribution of hypalgesia with complete recovery in 2 hours. She remained well for 9 months, but in September 1949 she noted numbness in both thighs and legs, slightly more
on the right. There was slow progression and by June 1950 the numbness extended to the “saddle area” and was associated with slight weakness of both legs and an unsteady gait. She had also noted marked hesitancy in voiding and on at least one occasion incontinence of urine.

She was admitted to Barnes Hospital on July 2, 1950. She was an obese white female who walked slowly and unsteadily. Examination revealed a sensory deficit below L3, a diminished right knee jerk, absent ankle jerks, no plantar response, and bilateral weakness of both gluteal groups and anterior tibial groups. There was moderate anal relaxation. Laboratory findings and spine films were normal. Lumbar puncture was unsuccessful below L1, but at that level the CSF dynamics and chemistry were normal. Cystometrogram showed a hypotonic bladder with residual urine.

Myelography. There was a complete block at the level of the lower border of D11, with a large, smooth filling defect at the level of L1 on the right side (Fig. 2). This combination of findings was interpreted as indicating the presence of an intraspinal tumor.

Laminectomy. The dura mater was thickened and adherent to the pia-arachnoid, although it was possible to free some of the adhesions. No evidence of a tumor was found. Biopsy showed chronic inflammation of the meninges.

Case 3. M.A., a 40-year-old white gravida 1 para 1, was delivered of a normal infant on Mar. 1, 1950 under saddle-block anesthesia (heavy nupercaine 2.5 mg.) which produced satisfactory hypalgesia up to the rib margin. The postpartum period was normal until the 3rd month when she noted the onset of intermittent headache and back pain. After 1 month these symptoms disappeared but were replaced by progressive numbness which within 2 weeks had involved the previous area of

Fig. 2. Case 2. There is a complete block to cephalad flow at the level of D12. Note the irregular oblique character of the advancing opaque column and the smooth filling defect below suggestive of a tumor.
anesthesia. Associated with the numbness there was progressive motor loss in both legs until the patient was unable to walk without assistance. She had no bowel or bladder difficulties.

She was admitted to Barnes Hospital on July 3, 1950. Examination revealed a thin white female who walked only with assistance and then showed a slow spastic gait. Routine laboratory findings and spine films were normal. There was a marked sensory deficit below D7. Abdominal reflexes were absent, knee and ankle jerks were hyperactive but equal, and patellar and ankle clonus and pathological toe signs were present bilaterally. There was marked motor weakness in all muscle groups of both

lower extremities. A spinal puncture was performed at the L1–L2 interspace, and dark yellow spinal fluid containing 590 mg. protein was obtained.

Myelography. The spinal canal was narrow and irregular in the upper lumbar and lower dorsal area, although the lower lumbar region was within the normal limits. A complete block was demonstrated at the level of D7-D6 intervertebral space (Fig. 3). Because of the large area involved by the pathologic process it was felt to be most compatible with a diagnosis of arachnoiditis.

Laminectomy was performed between D6 and D8. The dura mater was found to be thickened and adherent to the pia-arachnoid and appeared to be strangulating the spinal cord.
Case 4. B.M., a 27-year-old gravida 1 para 1, was delivered of a normal infant April 28, 1950 under saddle-block anesthesia (1 cc. 3 per cent metycaine). The delivery was not remarkable nor was her postpartum course. She was quite well until June 1951 when she first noted that her legs felt somewhat heavy and she was beginning to be uncertain of her balance. She also noted that the floor seemed to feel hot to her. These symptoms progressed until her admission to Barnes Hospital, Dec. 11, 1951.

On admission her gait was unsteady and she swayed markedly in Romberg's position. The quadriceps were weak bilaterally, more marked on the left side. There was also weakness of the muscles of the leg and foot on the left with associated left foot drop. The deep tendon reflexes were slightly hypoaactive but equal on both sides. The abdominal reflexes were absent bilaterally and there was no response to plantar stimulation. Sensory examination revealed patches of absent to diminished sensitivity to pin prick, heat and touch, extending from about the level of the 8th dorsal dermatome to the 5th lumbar bilaterally. There appeared to be diminution of vibratory sense over the iliac crests and the patellae of fairly definite degree. Position sense in the lower extremities was intact.

Laboratory findings were not remarkable. Lumbar puncture revealed an initial pressure of 135 mm. spinal fluid. The Cone test demonstrated an almost complete block. The CSF protein was 197 mg. per cent with a negative Wassermann and colloidal gold curve.

Myelography. The spinal canal appeared normal in the lower lumbar region. Opposite the interspace between the 1st and 2nd lumbar vertebrae a partial block and a smooth oval filling defect were noted (Fig. 4). Some of the opaque material flowed as high as the 12th dorsal vertebra around the right side of the filling defect but no significant amount passed cephalad to this level.

Laminectomy. Because of the possibility of an intraspinal neoplasm as suggested by the presence of a filling defect on the myelogram, it was felt that an exploratory operation was warranted. On exposing the spinal cord the diagnosis of adhesive arachnoiditis was obvious and no evidence of a tumor was found.

Case 5. V.H., a 40-year-old white female, had had four previous hospital admissions for the excision of multiple neurofibromata involving the brachial plexus, intercostal, sciatic and ilio-inguinal nerves on the right side. There was no history of spinal anesthesia. During her fourth hospital stay myelography had been performed with the demonstration of an irregular opaque column in the region of the 5th lum-
bar vertebra, a filling defect on the left and a smaller one on the right (Fig. 5). These were thought to represent either multiple neurofibromata or a ruptured nucleus pulposus.

In January 1952 she was admitted to the hospital for the fifth time because of pain in the right leg of 18 months’ duration. Examination revealed a diminished right knee jerk and an increased right ankle jerk. Minimal hypalgesia of the lateral two toes of the right foot and right upper outer thigh was present.

Myelography was repeated with findings that were identical to those of the previous examination 7 months before.

Laminectomy. An exploratory operation was performed and the surgeon described thickened, reddish arachnoid with partial obliteration of the subarachnoid space. Just below the left 5th lumbar nerve root was a heavy adhesive band, densely adherent to the arachnoid and dura mater, which was felt to be responsible for the localized myelographic defect seen at this level. No evidence of tumor was found. Microscopically the biopsy specimens showed evidence of chronic inflammation.

Case 6. B.J., a 36-year-old white male, was admitted to Barnes Hospital in January 1952 for treatment of a urinary tract infection. Ten years before he had experienced a 2-week episode of painful paraplegia with complete recovery. Five years later he began to note gradual progression of weakness and sensory loss of both legs. For the last 2 years the paraplegia had been complete.

Examination disclosed a well developed young male who was paralyzed and anesthetic from the level of the 9th dorsal nerve down bilaterally.

Myelography. The spinal canal was irregular in both the lumbar and lower dorsal region with a complete block at the level of D9. At the level of T12 a 1×2 cm. oval irregular filling defect was demonstrated that suggested the presence of a tumor (Fig. 6). Although the appearance of the myelogram suggested arachnoiditis, it was felt that because of the presence of the filling defect a laminectomy was warranted to exclude the possibility of an associated spinal neoplasm.

Laminectomy. On Jan. 2, 1952 an exploratory operation was done, with removal of the 8th and 9th dorsal laminae. The subarachnoid space was obliterated by thickened, opaque fibrotic arachnoid and the spinal cord appeared atrophic. No evidence of tumor was found.

Case 7. J.G., a 48-year-old negro, entered Barnes Hospital because of weakness
of both lower extremities of 2 years' duration coming on following an acute illness characterized by fever, chills and stiff neck. He also complained of impotence and urinary incontinence.

Examination revealed a markedly spastic gait with hyperreflexia and Babinski responses in both lower extremities. Spinal puncture and associated manometric tests disclosed a partial subarachnoid block. The CSF protein was 77 and 83 mg. per cent on two occasions but the Wassermann and colloidal gold were negative.

**Fig. 6. Case 6.** (Left) Complete block at the level of D9 with an irregular frayed margin at the head of the opaque column. (Right) Apparent filling defect suggestive of the presence of an intraspinal tumor.

**Myelography.** The opaque oil was observed to flow normally to the level of the interspace between D10 and D11 where a complete block was found. The leading edge of the opaque column had an irregular frayed appearance. A small amount of opaque oil was then introduced by cisternal puncture and a complete block was found at the D1 and D2 interspace. Because of the extent of the block, from D2 to D10, it was thought that arachnoiditis was the most likely diagnosis (Fig. 7).

**Laminectomy.** An exploratory operation was carried out and the arachnoid membranes were found to be gray, opaque and dense. Several small loculations of spinal fluid were seen as well as adhesions binding down some of the dorsal roots.

**DISCUSSION**

The deviations from the normal myelogram observed in the above-described cases of spinal adhesive arachnoiditis coincide with what one
might predict from the gross pathological changes found in this disease. When obliteration of the subarachnoid space is total, a complete block is found on myelography. If obliteration is partial or patchy, filling defects and/or pockets are demonstrated by myelography. These appearances may be indistinguishable from the changes produced by either tumors or ruptured intervertebral discs.9

Jantz7 has emphasized the difficulty of differentiating spinal cord tumor

and spinal arachnoiditis when there is a complete block. He states that in the presence of either an intra- or extradural tumor when a complete block occurs the margin of the opaque column adjacent to the block is smooth and homogeneous. In the presence of arachnoiditis it is ragged or irregular because of adhesions that extend beyond the point of the obstruction. This observation was confirmed in 4 of our cases (Figs. 1, 3, 6 and 7) and may be a helpful sign. However, in 4 patients (Figs. 2, 3, 4 and 6) the presence of an intraspinal tumor was suspected because of a large, smooth filling defect. Presumably these represented localized areas of complete obliteration of the subarachnoid space.
MYELOGRAPHIC APPEARANCE OF SPINAL ARACHNOIDITIS

The classical picture of extensive arachnoiditis in which the contrast material is spread out in the form of streaks and droplets may be readily recognized although it might be confused with subdural and extradural injections of radiopaque oil. Actually the roentgen picture of adhesive arachnoiditis is quite different from that of misplaced oil. In 3 cases we were able to demonstrate obliteration of a large area of the subarachnoid space, and a diagnosis of arachnoiditis was considered likely despite the absence of the so-called "characteristic" myelographic picture. The coexistence of arachnoiditis with other lesions must always be considered. Localized arachnoiditis has been reported associated with ruptured intervertebral discs.  

SUMMARY

1. The myelographic appearance of 7 surgically proved cases of adhesive spinal arachnoiditis has been presented.

2. The myelographic changes produced by chronic adhesive arachnoiditis consist of complete or partial block, formation of pockets and filling defects, and the spreading out of the opaque oil in the form of streaks and droplets.

3. Because of the occurrence of a complete obstruction and filling defects, differentiation from intra- and extradural tumors is difficult. An irregular ragged margin of the opaque column at the site of obstruction favors the diagnosis of arachnoiditis.

REFERENCES