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# MYELOGRAPHY WITH WATER SOLUBLE CONTRAST MEDIUM IN LUMBAR AND SACRO-LUMBAR TUBERCULOUS SPONDYLITIS

*By*

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It has sometimes been found at operation that pathologic findings in myelograms of patients with lumbago-sciatic-like pain have been interpreted as a herniation of an intervertebral disk instead of as tuberculous spondylitis. As it is thus apparently difficult to distinguish these conditions from one another roentgenographically, a systematic study was made of myelograms of patients with obvious tuberculous spondylitis in the hope that it might reveal details differing from those in the picture of a herniated intervertebral disk.

## LITERATURE

No collection of myelographically illustrated cases of tuberculous spondylitis were found in the literature.

*Girdlestone* (8) suggested myelography with lipiodol in the investigation of those cases of spondylitis with paraplegia in which ordinary roentgen examination failed to locate the level of the cord injury and in which he thought laminectomy was indicated. He did not describe the appearance of such radiograms.

Myelography has been discussed by inter alia *Arnell* (2), *Knutsson* (10, 11), *Lindblom* (15) and *Lindgren* (16).

*Alvik* (1) described a case of tuberculous spondylitis without extradural abscess but with a 2 cm. long, homogenous, greyish-red mass on the inside of the dura and on a level with the spondylitis. Histologic examination revealed no characteristics of tuberculosis. The patient had had no signs of meningitis.

In the literature no particular attention has been given to the

etiologic importance of extradural tuberculous lesions in the development of neural symptoms. Neural involvement is claimed to be commonest in tuberculous spondylitis of the thoracic section, less common in tuberculosis of the cervical vertebrae and least common in lumbar tuberculosis spondylitis (*Flesch-Thebesius* (7)). Frequencies of 3 per cent to 19 per cent have been recorded (*Lange* (13)). According to *Flesch-Thebesius* (7) and *Kremer & Wiese* (12), involvement of the spinal cord, roots or plexus will cause pain.

Pain from the nerve roots in the lumbar and lumbo-sacral region has attracted great interest since the introduction of surgical treatment of herniated intervertebral disks. The arisal mechanism of the pain has not been cleared up completely. That a herniated intervertebral disk is the most frequent cause of lumbar and lumbo-sacral root pain is accepted by most authors (e.g. *Barr & Mixter* (4), *Bradford & Spurling* (5), *Sahlgren* (18), *Sjöqvist* (19)). *Ekvall* (6) and *Lindahl* (14) thought that sciatic pain is due either to neuritis of the root or to neuritis + compression of a nerve root. *Norlén* (17) showed how the distribution of the peripheral symptoms in a given case was dependent upon which nerve roots were involved.

*Sorrel & Sorrel-Dejerine* (20) found cerebrospinal fluid to be of no differential-diagnostic value in tuberculous spondylitis.

## AUTHOR'S SERIES

Patients (17 females and 13 males) were selected with certain tuberculous spondylitis somewhere between the second lumbar vertebra and the first sacral vertebra, all of them in a good general condition. The age of these patients varied from 19 to 49 years; the history of the disease ranged from 2 months to 8 years. They were all examined between February 1949 and March 1950.

## METHOD

Before the myelograms were taken a thorough *neurological examination* of the patients was made. Only asymmetric paresis and markedly unequal reflexes were noted. Lasègue's test was also carried out, but in none did it cause pain in the leg. The legs could be elevated at most 70° in 11 patients, who had been in bed on the average for 6 months. Those patients whose legs could be elevated more than 70° had been confined to bed on the average for 2 weeks. As a rule the angle was equal for both legs. In one the difference was 20° and in another 15°.

*Myelography–Technique.* The procedure adopted was essentially that described by *Arnell* (2) (introduced by *Arnell & Lidström* (3)). The direction of the needle was checked roentgenographically in order to be sure that it could not touch the changed vertebrae. About 5 $cm^3$ of liquor was collected, and 1½–2 $cm^3$ of an

anaesthetic (Decicain Astra), heavier than liquor, was injected. When the anaesthesia had reached the first lumbar segment, 10 $cm^3$ of the water-soluble contrast ("Kontrast U", Leo, = abrodil) was injected. With the patient in the prone position and with horizontal X-rays, 3 exposures were made after the injection of the contrast medium: 1 with the patient tilted 10° to the right, 1 with the patient tilted 10° to the left and 1 with the patient untilted. Afterwards 3 exposures were made under fluoroscopic control with vertical X-rays and with the patient in the positions just described. Finally 2 lateral views were taken with vertical X-rays, 1 with the patient on the right side and 1 with the patient on the left side. The aperture was made as small as possible. Unfortunately the technical equipment was not intended for myelography, so that the myelograms were not always technically quite satisfactory.

*Examinations of the Cerebrospinal Fluid.*–Specimens of about 5 $cm^3$ from 27 patients were collected and examined immediately for protein and cells. Precipitation by both the tests of *Nonne* and of *Pandy* was said to indicate a pathologic change.

Precipitation in only 1 of the tests was not regarded as pathologic. With regard to the cells, a result which included more than 15 white blood cells per 3.2 $mm^3$ cerebrospinal fluid was said to be pathologic.

## COMPLICATIONS

Headache for 1 to 2 days after myelographic examination was recorded in 3 patients. In 1 the headache persisted about 2 weeks, during which there was also transient partial paresis of the bladder. Pain in the legs or the back for a period of at most 3 days was claimed by 3 patients. In 1 case the contrast medium had been deposited extradurally and caused a few minutes' severe pain in the back. In many patients it was observed that the anesthesia increased in cranial direction, in 2 cases to the vicinity of the region of the jugular fossa, despite the fact that the head of the examination table was elevated 10° to 15°.

## RESULTS

a) *Radiographic Appearance.*–The radiographic appearance was not normal in any of the *4 cases of "healed" spondylitis.* In 3 of the cases, 3½–8 years after onset, the dura seemed to lie slightly closer to the vertebral body at the level of the "healed" spondylitis than cranially and caudally to it (Fig. 1). One of these patients had been operated on earlier on account of assumed herniation of the intervertebral disk at the site of the spondylitis. The only change observed in the dural sac was that mentioned above. In the fourth case, in which the patient was re-examined 6 years after the onset, a small indentation was seen in the contrast outline dorsolaterally near the arch of the diseased

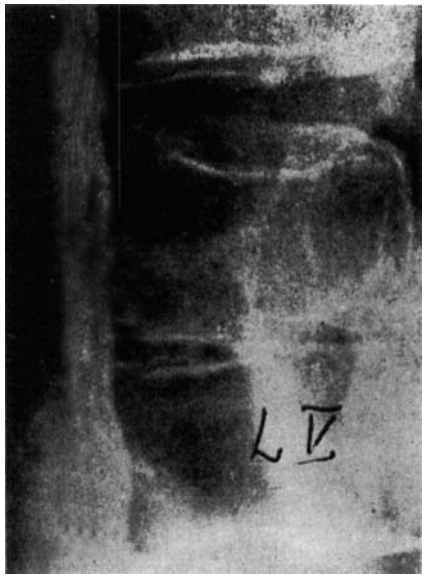


*Fig. 1.*
Dura adherent to the fifth lumbar vertebra. History of 8 years.

intervertebral body. A small lesion located somewhat ventrolaterally to the site of this dural impression had been observed on an earlier occasion in the same vertebra. It seems probable that the indentation was due to a contracture of the tissues caused by the healing. The distance between the dura and the vertebral body seemed to be normal.

Changes were seen in the myelograms of *25 patients with unhealed spondylitis*,–namely, a varying degree of increase in the distance between the dura and the vertebral bodies at the level of the spondylitis in or immediately adjacent to the middle line. This distance gradually decreased cranially and caudally, as a rule quicker in the latter direction (see below). The indentations were well defined in all cases. The size of the indentation showed no relation to the size of the bony lesion. In the 26th case, in which the contrast medium had been deposited extradurally, no definite changes could be observed in the myelogram.

The narrowing of the dural sac was said to be severe when the depth of the indentation was about two-thirds or more of the depth of the sac, moderate when it was one half to one quarter.

When the indentation was relatively short, i.e. the vertical depth of a single vertebral body, it gave a smooth and regularly roundish


*Fig. 2.*
History of 1¼ years.

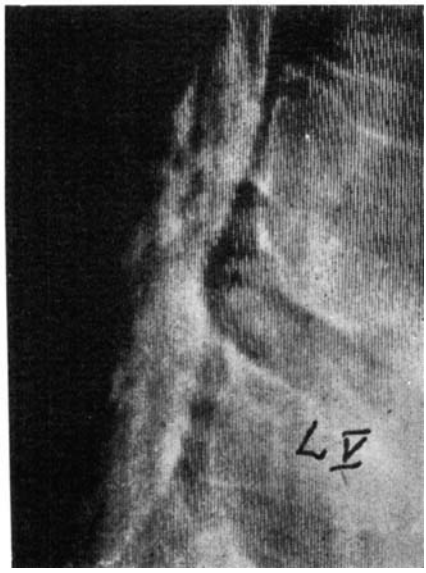


*Fig. 3.*
History of 1⅓ years.

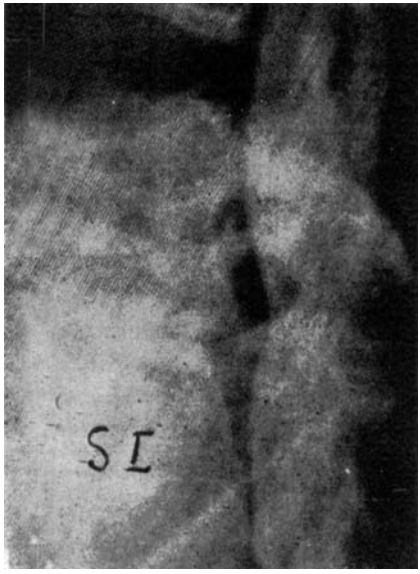


*Fig. 4.*
History of 7 months.


*Fig. 5.*
History of 2½ years.

outline. Its vertex was always situated slightly nearer its caudal border than its cranial (Figs. 2, 3, 4). In shape the indentation resembled a side view of a drop of water on a slanting slide. In frontal views the contrast shadows were slight or absent over most of the indentations. In those cases in which the roots could be observed at the level of the spondylitis, no definite dislocation or asymmetry in the filling of the root pockets could be seen. For this reason no frontal views are given in the illustrations.

In 1 case (Fig. 5) among those with more extensive changes, i.e. when the indentation was as long as the vertical depth of 2 vertebral bodies, an admittedly sharp but irregular outline was seen that suggested the presence of several partly confluent processes. When the indentations were long as in these cases, the asymmetry described above was not so obvious as when they were short (Figs. 5, 6). In 1 case the indentation extended up to the intervertebral disk immediately cranial to the spondylitis (Fig. 5) and in 5 cases (e.g. Figs. 6) to the intervertebral disk immediately caudal to the spondylitis.

The changes seen in the myelograms could not be correlated with the age of the spondylitis.

The indentations are probably caused by tuberculous pus, caseation necrosis, granulations and edema. Sequestra were also observed in the indentations in several cases (Figs. 3, 4, 6). It was, of course, not


*Fig. 6.*
History of 1 year.

possible to exclude the presence of the above-mentioned changes described by *Alvik* (1).

In 3 cases myelograms were made on 2 occasions:

In 1 patient with a history of 1 year and in whom no neurologic signs were observed at the time of the first myelograms there was a severe indentation and the cerebrospinal fluid contained an increased amount of protein but no cells. Myelograms taken 6 months later showed that the indentation had, if anything, slightly diminished. No neurologic signs had in the meantime appeared. The protein content was increased but slightly and the number of cells was normal.

In another case in which the patient had a history of 7 months and in which slight atrophy of the left calf was noted, the first myelographic study showed a moderate narrowing. No increase in the number of cells or the quantity of protein in the cerebrospinal fluid was recorded. In myelograms taken 3 months later the indentation had decreased in depth but had become a little longer. The protein, but not the number of cells, had in the meantime increased slightly. No new neurologic signs were observed.

A third case in which the roentgenograms were technically unsatisfactory is therefore reproduced only diagrammatically (Fig. 7 A). No filling was obtained over the section of maximal indentation although the contrast medium had passed this level. This patient had a history of 2 months. Sensibility was distinctly less over the anterior surfaces of both lower legs. Slight atrophy of the left calf and weakened quadricep reflex of the left side were noted. Examination of the cerebrospinal fluid showed moderately increased protein and slight increase of mononuclear cells. Nine months later, when the sensibility disturbance, but not

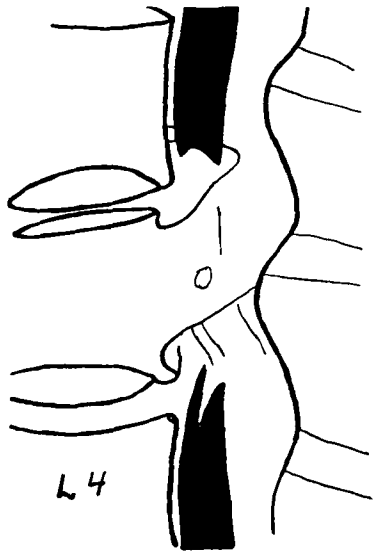


*Fig. 7 A.*
History of 2 months.

the other neurological symptoms, had diminished considerably, the myelogram showed that the indentation had decreased and was now small (Fig. 7 B). Examination of the cerebrospinal fluid revealed nothing pathologic. The large initial changes were attributed mainly to the edema.

TABLE I

*Occurrence of nervous symptoms and pathologic changes in the cerebrospinal fluid in patients with a varying degree of narrowing of the dural sac. Number of cases with pathologic changes in the cerebrospinal fluid is given in brackets.*

| Level of spondylitis | Severe narrowing | | Moderate narrowing | | Slight or no narrowing | | Number of cases |
|---|---|---|---|---|---|---|---|
| | Nervous symptoms | | Nervous symptoms | | Nervous symptoms | | |
| | present | absent | present | absent | present | absent | |
| L 2–L 3 | – | – | – | – | 1 | 1 | 2 |
| L 3–L 4 | 4(3) | 1(1) | 1 | 3 | 1 | 2(1) | 12 |
| L 4–L 5 | 2(2) | 1(1) | 2 | 4(2) | – | 3 | 12 |
| L 5–S 1 | – | – | – | – | 2 | 2 | 4 |

*Note:* Of the patients with severely narrowed dural sac 7 were examined for cerebrospinal fluid-protein; the level was found to be increased in all of them. The eight patients belonging to this category were also examined for nervous symptoms, which were found in 6 of them. The corresponding figures for patients with a slighter degree of narrowing were 3/20 and 7/22, respectively.

TABLE II

*Neurologic signs and symptoms.*

| Level of spondylitis | Muscle atrophy | | Impaired sensibility | | | Asymmetric reflexes | | Paresis | | Earlier symptoms | | | | | Number of cases |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | calf | thigh | lat. surface of lower leg | ant. surface of lower leg | post. surface of lower leg | calf | quadr. | quadr. | flexors of the knee | numbness | pain in thigh or hip | pain in lower leg | pain in entire leg | feeling of weakness | |
| L2-L3 | — | 1 | — | — | — | — | — | — | — | 1 | — | 1 | 1 | 1 | 2 |
| L3-L4 | 3 | 2 | 1 | 1 | 1 | — | 2 | 1 | — | 4 | 2 | — | 6 | 1 | 9 |
| L4-L5 | — | 2 | — | — | — | 1 | 1 | 1 | 1 | 1 | 5 | 1 | 1 | — | 9 |
| L5-S1 | 1 | 1 | — | — | — | 1 | — | — | — | — | 2 | — | 1 | 1 | 3 |

*Note:* Seven of the patients had only back pain. Asymmetric reflexes were noted in 1 patient, who had no symptoms (Fig. 3). The neurologic findings are in good agreement with those recorded by *Norlén* (17). The patient with spondylitis between L 5 and S 1 and atrophy of the thigh had also atrophy of the calf and pain in the entire leg.


*Fig. 7 B.*
History of 11 months
(same case as in Fig. 7 A).

Vertebral compression was seen in 5 (36 per cent) of the 14 unhealed patients without neurologic signs and in 7 (58 per cent) of 12 with neurologic signs. Compressed vertebrae were demonstrated in 6 (60 per cent) of 10 unhealed patients with changed cerebrospinal fluid and in 4 (31 per cent) of 13 with normal cerebrospinal fluid. These differences are not statistically significant.

b) *Neurologic Signs and Symptoms* (tables 1 and 2).

Neurologic signs were observed in 13 (43 per cent) of the 30 patients. Table 2 summarizes the earlier symptoms of these patients. On the occasion of the examination, when the patients had been using a plaster bed for a varying length of time, some of them claimed only slight local, but not radiating, back pain. Earlier, as will be apparent from Table 2, radiating pain had been common (67 per cent). Seven gave back pain as the only symptom. In 1 case (Fig. 3) the patient had never been given any trouble by his back and the spondylitis was discovered by chance. Back pain in association with numbness was the only complaint in 2 cases (e.g. Fig. 6). Pain in one leg on coughing or sneezing was claimed by 2 patients in both of whom obvious neurologic signs were noted (e.g. Fig. 7 A).

The series was divided into 2 groups: those patients with a history of less than a year being assigned to one group, and the remainder to the other group. The frequency of changes in the cerebrospinal fluid and the incidence of neurologic signs were equal in both groups.

c) *Cerebrospinal Fluid* (table 1).

Lumbar puncture was performed cranial to the spondylitis in 19 cases, and caudal to it in 8: evidence of a pathologic condition was found in 7 and 3 respectively. The incidence of pathologic changes in the cerebrospinal fluid was thus roughly equal in both groups. All of the 10 with pathologic findings belonged to 23 of the unhealed patients. Increased protein content was the only observation made in 6 instances: in 1 it was severe, in 2 it was moderate and in 3 slight. In 4 cases the number of mononuclear and polynuclear cells observed in the cerebrospinal fluid had increased to a level varying from 19 to 670 per 3.2 $mm^3$. Increased protein content was also recorded in these 4. In none of the patients was evidence of meningitis recorded. The radiograph of the patient in whom the greatest increase in cellular count and in protein was recorded is reproduced in Fig. 6. He felt well 8 months after the examination, when the neurologic signs consisted of a very probably decreased sensibility and numbness of the posterior aspect of both thighs and calves.

## DISCUSSION

The myelographic appearance of "unhealed" tuberculous spondylitis in this series was characterized by an indentation towards the dura, always in or immediately adjacent to the middle line. On herniation of an intervertebral disk the indentations in the dura are as a rule situated laterally. It is of course possible that tuberculous spondylitis may occasionally cause indentations situated far laterally.

Whether dural indentations in herniation of an intervertebral disk have the same asymmetric form as that described above in tuberculosis is not apparent from the literature, but it seems a priori probable.

The increases in the amount of protein in the cerebrospinal fluid are perhaps not quite certain, because the methods used are claimed to be open to serious error (*Izikowitz* (9)). However, the neurologic signs and symptoms and the changes in the cerebrospinal fluid were possibly due to the spondylitic indentation of the dura rather than to the collapse of the vertebral bodies (see Table I and page 266).

No late nervous symptoms were recorded with certainty in the 4 "healed" cases in the present series.

The opinions presented by *Ekvall* (6) and *Lindahl* (14) could be neither confirmed nor disproved in the present study. However, it seems as if the nerve roots may be compressed without resultant radiating pain: 2 patients had complained of a certain numbness, and 1 of them also of relatively decreased sensibility in the legs, but no pain (e.g. Fig. 6). Nothing can, of course, be said as to the degree and variation of this pressure. The pressure exerted on the nerve roots is, however, probably not so great as in herniated intervertebral disks. In this connection it should be mentioned that at autopsy of 1 of the

non-myelographed patients at the hospital with tuberculous spondylitis with extradural abscesses but without nervous symptoms, the nerve roots in question were examined histologically. No signs of inflammation were observed.

No connection was found between nerve symptoms and changes in the cerebrospinal fluid.

## SUMMARY

Myelograms were made of 30 patients with lumbar or lumbo-sacral tuberculous spondylitis: in 4 of these cases the condition was "healed".

In 25 of 26 of the unhealed cases the myelogram showed a varyingly sized antero-posterior indentation towards the dura, regularly in or near the middle line. The depth was largest caudal to the centre of the indentation. In 3 of the healed cases the distance between the vertebral bodies and the dura was smaller at the level of the "healed" spondylitis than cranial and caudal to it.

No correlation was found between the size of the indentation and that of the skeletal foci.

The nervous symptoms, practically always slight, were observed in 43 per cent of the 30 cases. These symptoms (like the changes in the cerebrospinal fluid) seem possibly to be due more to the indentation than to the presence of any vertebral compression.

Compression of the nerve roots by tuberculous spondylitis need not cause radiating pain, even though peripheral signs of root involvement are demonstrated (numbness + relatively impaired sensibility).

## ZUSAMMENFASSUNG

Bei 30 Patienten mit lumbaler oder lumbo-sakraler tuberkulöser Spondylitis wurde eine Myelographie vorgenommen: In 4 von diesen Fällen war die Erkrankung „geheilt".

In 25 von den 26 ungeheilten Fällen zeigte das Myelogramm eine anteroposteriore Aussparung von verschiedener Grösse in Richtung der Dura, regelmässig in oder nahe der Mittellinie. Am grössten war die Tiefe caudal vom Zentrum der Aussparung. In dreien der geheilten Fälle war in der Höhe der "geheilten" Spondylitis die Distanz zwischen den Wirbelkörpern und der Dura geringer als cranial oder caudal.

Eine Wechselbeziehung zwischen der Grösse der Aussparung und der des Knochenherdes konnte nicht gefunden werden.

Nervöse Symptome, beinahe immer nur leichte, wurden bei 43 %

der 30 Patienten beobachtet. Diese Symptome (ebenso wie die Veränderungen in der cerebrospinalen Flüssigkeit) scheinen ihre Ursache mehr in der Vorvölbung (Aussparung), als in der vertebralen Kompression zu haben.

Eine Kompression von Nervenwurzeln durch tuberkulöse Spondylitis muss nicht notwendigerweise ausstrahlende Schmerzen hervorrufen, selbst wenn periphere Zeichen von Wurzelaffektion (Parästhesien und teilweise Herabsetzung der Sensibilität) nachgewiesen werden können.


## RESUME

Il a été fait le myélogramme de 30 malades souffrant de spondylite tuberculeuse lombaire ou lumbo-sacrée: dans 4 de ces cas il y avait « guérison ».

Chez 25 des 26 cas non guéris, les myélogrammes montrent une indentation antéro-postérieure de grandeur variable à travers la dure-mère, en règle générale dans ou près de la ligne médiane. La plus grande profondeur est située caudalement jusqu'au centre de l'indentation. Dans 3 des cas guéris, la distance entre le corps vertébral et la dure-mère était plus petite au niveau de la spondylite « guérie » que dans la partie cranienne et caudale.

On n'a pas trouvé de corrélation entre la dimension de l'indentation et celle des foyers squelettaux.

Des symptômes nerveux qui sont pratiquement toujours bénins ont été observés dans 43 % des 30 cas. Ces symptômes (de même que les modifications dans le liquide cérébro-spinal) semblent pouvoir être dus plutôt à l'indentation qu'à la présence d'une compression vertébrale.

La compression des racines nerveuses causées par la spondylite tuberculeuse ne provoque pas nécessairement de douleurs irradiantes, bien que l'on ait démontré qu'il y avait périphéralement des signes de racines atteintes (engourdissement + sensibilité relativement affaiblie).


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