THE EFFECTS OF CHEMONUCLEOLYSIS AS DEMONSTRATED BY COMPUTERISED TOMOGRAPHY

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Computerised tomography (CT) was performed in 30 patients with herniated lumbar discs; this was done both before chemonucleolysis and three months after. In 20 of the 28 patients who were CT positive, the compression produced by the herniated disc was eliminated or reduced. Twenty-three of the 28 patients developed diffuse bulging of the annulus. There was good correlation between the clinical results at three months and the alteration in compression as shown by the CT scan. No evidence of alteration in the bony relationship was seen in the scan and none of the patients developed epidural fibrosis.

Chemonucleolysis has thus been shown to be an effective treatment of herniated lumbar discs, but it is definitely not indicated in cases where compression of the nerve root or dural sac is due to a bulging annulus.

The technique of chemonucleolysis, using intradiscal injection of chymopapain, is now well established in the “conservative” treatment of lumbar disc herniation (Smith 1964; JAMA 1983). The prime mode of action of chymopapain is hydrolysis of the glycoproteins of the nucleus pulposus (Garvin et al. 1965; Krempen, Minning and Smith 1975). Some believe that the degradation of the nucleus pulposus results in a reduction in intradiscal pressure and in a reduction in the inflammatory reaction of the nerve root (Braun 1981). No prospective study has as yet been reported in which computerised tomography (CT) has been used to demonstrate the changes produced by chemonucleolysis. Such a study should demonstrate the changes in both soft tissue and bony anatomy of the lumbar spine (Haughton, Syvertsen and Williams 1980; Genant, Chafetz and Helms 1982). The accuracy of CT in disease of the lumbar spine is comparable to, or better than, other imaging techniques, particularly at the lumbosacral junction (Haughton et al. 1982). Chemonucleolysis using chymopapain has been employed successfully in our hospital since 1980 (Deutman 1983).

A prospective study was initiated to determine the changes demonstrated by computerised tomography in patients with herniated discs who were treated with chymopapain, and also to correlate these changes with their clinical results.

MATERIALS AND METHODS

Sixty-five patients with herniated lumbar discs were treated by chemonucleolysis between May and October 1982. Thirty were studied by CT scanning at the appropriate disc level before chemonucleolysis and again three months later. These 30 patients were not specially selected; some could not be included in the series because of scanner malfunctions or lack of scanning time; others, mainly from further afield, were excluded as they had not undergone all the investigations necessary for inclusion in the study. Twenty-five men with an average age of 38 years (range 22 to 68 years) and five women with an average age of 45 years (range 34 to 70 years) took part in the study.

Every patient had the clinical picture of a herniated disc, persisting despite conservative treatment. None had previously undergone disc surgery or chemonucleolysis. Before chemonucleolysis, each patient had standard anteroposterior and lateral radiographs taken of the lumbosacral spine, a myelogram using watersoluble contrast and a CT scan of the suspected levels. The patients were examined using a Philips Tomoscan 310 CT scanner with angulated consecutive slices parallel to the disc space. The slice thickness was 6 mm through the vertebral bodies and 3 mm through the discs. Detailed interrogation of the digitalised images was performed.

The density changes in the discs and in the herniated fragments were not recorded because of the problems of exact repositioning of the slices, the phenomena of the partial volume effects and the variability of density between one examination and another (Lee et al. 1983).

The following criteria were used to make a CT diagnosis of a herniated disc (Lee et al. 1983).

1. Focal abnormality of the posterior or posterolateral disc margin.
2. A soft-tissue shadow, usually of high density.
3. Displacement of epidural fat, dural sac or the nerve root.
4. Swelling of the distal portion of the nerve.
The presence of these appearances and their later alteration were noted, together with the condition of the annulus and the appearance of the posterior intervertebral joints and associated bony structures.

A discogram was performed immediately before the intradiscal injection of chymopapain. The discogram, besides showing the type and site of abnormality, also showed the exact site of the needle tip. No normal discogram was seen in this series.

**Findings before chymopapain.** The findings before the chymopapain was injected are shown in Table I. In 26 patients all three examinations were “positive” (i.e. abnormal). In two patients the CT scan demonstrated a herniated disc at L5–S1 whilst the myelogram was negative (normal). In one patient the CT scan was negative but the myelogram and an epidural venogram were positive; this patient, with a convincing clinical history, underwent discography which confirmed a rupture of the disc. In a second patient an equivocal CT appearance was later interpreted as negative though the discogram was abnormal. There were, therefore, 28 CT-positive and two CT-negative patients in this study.

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<th>CT scan</th>
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In 20 of the 28 CT-positive patients the scan showed a herniated disc with marked compression of the dural sac or of the nerve root, or both. A further seven showed a hernia with a wider base and less marked compression; six of these occurred at the lumbosacral disc. Although satisfying the criteria for a herniated disc, these could also be described as an asymmetrical non-diffuse bulging of the annulus. One patient showed herniation at L2–3 without CT evidence of compression.

In 12 of the 28 CT-positive patients, the scan showed a slight diffuse bulging of the annulus without compression of the dural sac. No patient with a prominent bulging annulus alone was included in this series.

Three of the 28 CT-positive patients were noted to have asymmetrical facet joints. Three others had minor arthritic changes in these joints. Both CT-negative patients had asymmetrical facet joints and one of them had slight osteoarthritic changes. In none of these patients were we able to demonstrate nerve entrapment.

**Chemonucleolysis.** Four thousand units of chymopapain were injected at the appropriate level. Chemonucleolysis was carried out at L2–3 once, at L4–5 15 times and at L5–S1 17 times. Three patients with a herniated disc at L5–S1, studied by computerised tomography at this level, also showed leakage of contrast medium into the spinal canal at discography at the L4–5 level. They were treated by chymopapain at both levels but only the lower level was included in the study as only this lower level had been studied by computerised tomography.

**RESULTS**

Three months after chemonucleolysis a lateral radiograph of the lumbar spine was taken to assess the reduction in disc height and the patients were also examined by a CT scan of the treated level. A clinical assessment was made using Macnab’s (1971) grading, and this was compared with the CT changes.

The lateral radiograph showed an average reduction in disc height of 26%, ranging from 0% in one patient to 50% in three. No relationship was found between the degree of reduction and the clinical result.

The CT examination of the CT-positive patients showed that in 14 the herniated disc had disappeared, in nine it was reduced in size, and in the remaining five it was unchanged. The development of diffuse annular bulging, or an increase in a pre-existing bulge, was noted in 23 of the 28 patients with a disc hernia. If we, therefore, consider the total degree of compression caused by the herniated disc and the annular bulging together, we find that 11 have complete or almost complete relief of dural sac or nerve root compression. In nine others compression was slightly relieved; this slight change could be seen as an increase in the amount of epidural fat visible, a reduction in the asymmetry of the dural sac, or in a reduction in the distal nerve root swelling. In seven cases, the degree of compression remained the same. In one patient there was no evidence of compression of nerve root structures before or after chemonucleolysis.

In the two CT-negative patients, there was no sign of disc herniation before or after chemonucleolysis. The only difference seen in these patients was some mild increase in annular bulging in one of them.

No change was detected in the facet joints in any of the patients at the CT examination three months after chemonucleolysis. In two patients a minimal repositioning of L4 in relation to L5 was seen on the lateral radiograph at three months. The CT study, however, showed no evidence of alteration in the form of the foramen or spinal canal. No patient showed evidence of epidural fibrosis after chemonucleolysis.

The clinical result, as assessed at three months, was also correlated with the reduction in compression. Using Macnab’s grading of the 28 CT-positive patients, 8 had an excellent result, 13 a good result and 7 a fair result. There were no poor results and no patient required operation in this, albeit short, interval. There was good correlation between the degree of reduction of compression and the clinical result. The two CT-negative patients
Case 1. Figure 1—CT image of a posterolateral herniation of the L4-5 disc (large arrow). Note symmetrical fat in the neural foraminal (small arrows). Figure 2—CT image of the same level three months after chemonucleolysis. No evidence of a hernia is seen, but there is a slight diffuse bulging, with obliteration of the foraminal fat at this level (arrows).

Case 2. Figure 3—CT scan of a right posterolateral herniation of L3-S1 disc. Note asymmetrical disc protrusion on right (open arrow) with posterior displacement of right S1 root. The epidural fat is replaced in contrast with the normal epidural fat on the left (small arrow) and the sharply defined left S1 root (arrow). Figure 4—CT scan 3 months after chemonucleolysis. There is still asymmetrical disc protrusion on the right with posterior displacement of the right S1 nerve root, but there is more epidural fat (arrows) and better definition of the dural sac and nerve root is possible on the right.

Case 3. Figure 5—CT scan of a right posterolateral herniation of the L4-5 disc (arrow). Figure 6—CT scan three months after chemonucleolysis. There is still an asymmetrical protrusion of the disc (arrow) apparent on the right and development of an obvious diffuse bulging of the annulus with obliteration of foraminal fat at this level (small arrows).
scored respectively a good and a fair result. We present three cases to illustrate these findings.

CASE REPORTS

Case 1. A 40-year-old teacher had suffered from back problems since the age of 17. For the preceding year he had sciatic pain in his right leg and examination demonstrated a positive Laségue sign at 25°. The myelogram, CT scan (Fig. 1) and discogram showed a disc herniation at L-4-5 and chemonucleolysis was performed at this level. At three months he had only an occasional numb feeling on the lateral side of his leg and foot. The reduction in disc height was 42%. The CT scan at three months showed no herniation of the disc and there was no longer any compression (Fig. 2). He was free from pain and returned to work, and was classified as an excellent result.

Case 2. A 22-year-old student had sciatic pain in his right leg with mild backache for six months. Bedrest gave initial relief of symptoms but they returned after two months. Examination showed some restricted movement of the lumbar spine, no paresthesia, a reduced ankle jerk on the right and a positive straight leg raising test at 50°. Myelography, performed earlier by a neuroradiologist elsewhere, showed a herniated disc at L-5-S1 on the right. CT scanning (Fig. 3) and discography confirmed this diagnosis and chemonucleolysis was performed at this level. Three months after chemonucleolysis he still had some stiffness in his back and some cramp-like sensations in the right leg. He considered himself 70%, improved and he had resumed sports. Examination showed no neurological symptoms. The lateral radiograph of the lumbar sacral spine showed a reduction of 50%, in the disc height. The CT scan at three months still demonstrated a herniated disc at L-5-S1 (Fig. 4), but with some relief in compression when compared with the CT scan before chemonucleolysis. The clinical result was assessed as good.

Case 3. A 42-year-old storekeeper had a six-month history of right sciatic pain, following a period of backache. After clinical investigation at another hospital, a myelogram was performed which demonstrated a herniated disc at L-4-5. He was referred to our hospital after the failure of conservative treatment. At that time clinical examination showed restricted movement of the lumbar spine and a positive straight leg raising test. CT scanning (Fig. 5) and discography confirmed the herniated disc at L-4-5, and chemonucleolysis was performed at this level. At three months he had only slight relief of his sciatic pain. He did not use analgesics, but he was not able to start working again. Examination showed improved movement of the lumbar spine and no neurological symptoms. Disc height reduction was 22%. The CT scan, however, showed an increased bulging of the annulus and the same appearance of compression of the dural sac and nerve root as before chemonucleolysis (Fig. 6). Operation was not felt to be indicated at that time and the result was assessed as fair.

DISCUSSION

Many articles which describe the clinical results of chemonucleolysis have been published (McCulloch 1980; Sutton 1983). Some state that, in general, the result achieved after two or three months does not subsequently improve (Dabezies and Brunet 1978; Benoist et al. 1982). In this prospective study, therefore, we have assessed the objective CT changes as seen after three months and correlated the clinical result at that time with these changes.

In general we found good correlation in the appearances at disc level between lumbar myelography and computerised tomography, although there was disparity in three of the 30 patients. While a reduction in the size of the herniated disc was seen in 23 CT-positive patients, the reduction in compression (of the dural sac or nerve root), judged on the CT scan, was to some degree offset by a diffuse increase in annular bulging in the majority of cases. The observed increase or de novo development of diffuse bulging of the annulus can be explained by the rapid loss of disc height (McRae 1956) in the cases affected by the chymopapain. It is our opinion, therefore, that chemonucleolysis is not indicated in the treatment of dural sac or nerve root compression due to annular bulging alone, as this is only increased by such treatment.

While there was good correlation between the degree of reduction in compression and the clinical result, we also found in some cases that only a slight decrease in compression produced a good clinical result. Evidently in some cases a slight reduction in compression can alleviate clinical symptoms (Barr 1977). Another possible explanation is that a relaxation in nerve root tension may be produced by the diminished disc height (Bertolino, Miller and Spencer 1982) and that this is in itself sufficient to relieve the clinical situation. Considerable speculation is possible as to the consequences of the disc height reduction on the form of the spinal and intervertebral canals and possible subsequent secondary degenerative changes. We were not able to demonstrate these within the three-month follow-up and these possible changes would be better identified by sagittal computer reconstruction images which were not performed in this study.

No evidence of epidural fibrosis was seen in this series. This appears to be a major advantage of chemonucleolysis, as epidural fibrosis is a recognised complication of disc surgery and as such a cause of recurrent symptoms (Macnab 1977; Benoist et al. 1980; Mall and Kaiser 1982).

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REFERENCES

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