M. V. BRAIMBRIDGE *ET AL.*: TRIPLE STARR VALVE REPLACEMENT

FIG. 1

FIG. 2

FIG. 3

FIG. 1.—Case 4. Excised valves. The aortic valve is above, the tricuspid below left, and the mitral below right. All these sets of valve cusps are fibrous, thickened, and shrivelled, and were causing marked incompetence.

FIG. 2.—Case 7. Posteroanterior chest radiograph. The three Starr valves are seen with the aortic valve above, tricuspid valve on patient's right, and mitral valve on left.

FIG. 3.—Case 7. Right lateral chest radiograph. The aortic valve is above, the mitral valve is posterior, and the tricuspid valve is anterior.

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FIG. 1A and 1B.—A firm additional thrust completed the rotation manipulation.

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FIG. 2.—Case 1. Before manipulation a concavity is seen in the contrast overlying the L 4-5 disc.

FIG. 3.—Case 1. After manipulation the concavity has almost disappeared.

FIG. 4.—Case 2. Before manipulation concavities are shown over the L 4-5, 3-4, and 2-3 discs.

FIG. 5.—Case 2. After manipulation the concavity over L 4-5 is much smaller. Concavities over L 3-4 and L 2-3 are replaced by a straight line.

sulphonamides they tested were less active when used alone against their organisms—for all of which the M.I.C.s were more than 100 $\mu\text{g./ml.}$ —than were the sulphonamides we used against our organisms. Nevertheless, they demonstrated enhanced inhibition of 5 of their 11 strains when sulphafurazole was used in combination with colistin. When sulphacetamide-colistin combinations were used enhancement was seen with only one strain. We used two active sulphonamides, sulphamethoxazole and sulphamethizole, and each in combination with colistin greatly enhanced its inhibitory effect on 19 of our 20 strains of *Pseudomonas*. With all four strains which were more fully investigated we clearly showed that the enhancement was not only bacteriostatic but also bactericidal. The one strain with which we failed to demonstrate potentiation was the only one which was resistant to high concentrations of each sulphonamide acting alone. With most of the other strains sulphamethoxazole by itself was more active than sulphamethizole.

Most of the antibiotics used in the treatment of pseudomonas infections are expensive, are of low activity, or have toxic side-effects, and the infections which frequently occur in patients who have previously been given antibacterial treatment may be extremely difficult to eradicate. Under these circumstances the potentiation of colistin by sulphamethoxazole or sulphamethizole could prove to be a valuable therapeutic aid, and a trial of combined treatment of infections caused by strains of *Pseudomonas* sensitive to these sulphonamides would certainly seem

to be justifiable. It must be emphasized here that the conditions of in-vitro tests of sensitivity to the sulphonamides and the potentiation of colistin by them must be rigidly controlled by using methods such as those described in this paper, for variations in such things as inoculum size or the type of medium can easily give rise to erroneous results.

Most strains of *Ps. aeruginosa* are resistant to trimethoprim, but pseudomonal urinary tract infections have been successfully treated with combinations of it with sulphamethoxazole (Grüneberg and Kolbe, 1969). We were able to demonstrate synergy with this combination on four strains, but high concentrations of trimethoprim were still required to produce a bactericidal effect.

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Preliminary Communications

Reduction of Lumbar Disc Prolapse by Manipulation

[WITH SPECIAL PLATE BETWEEN PAGES 692–693]

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Summary: In two patients with symptoms and signs characteristic of a mechanical lumbar spine disorder epidurography showed the presence of small disc prolapses. Treatment by manipulation relieved the symptoms of lumbago, and repeat epidurography showed that the prolapses were reduced in size. Reduction of disc prolapse by manipulation has not before been objectively demonstrated.

INTRODUCTION

Manipulation of the lumbar spine has been used as an empirical treatment of low backache since antiquity. The persistence and popularity of this type of treatment was based on the clinical impression that it is beneficial. By contrast, evidence that protrusion of an intervertebral disc could be responsible for low backache is comparatively recent. The first report of disc herniation was the post-mortem description by Virchow (1857), and the first clinical descriptions were those of Goldthwait (1911) and Middleton and Teacher (1911). The wider clinical importance of disc protrusions was emphasized by Mixter and Barr (1934), who reported patients with protrusions at cervical, dorsal, and lumbar levels. Most of their patients had a neurological lesion, and histology of the surgically removed lesions showed them to be disc protrusions rather than fibrous tumours.

The evidence that lesser degrees of the syndrome of lumbago and sciatica are due to lesser disc protrusions is circumstantial. The frequent accompaniment of acute onset low back pain by spinal deformity suggests a mechanical factor, and the accompanying abnormality of straight-leg raise or femoral stretch test suggests that the lesion impinges on the spinal dura mater or the dural nerve sheaths. That this clinical picture may advance to sciatica with neurological deficit, and be cured by surgical removal of a disc prolapse, indicates a common and sometimes progressive morbidity—a lumbar disc prolapse. Further evidence that the basic pathological lesion is closely related to the epidural part of the spinal canal is provided by the observation that epidural injections of local anaesthetic relieve the symptoms (Evans, 1930).

The controversy surrounding the mechanism of lumbago and its relief by manipulation led us to select patients thought likely to benefit from lumbar manipulation. Clinical features were correlated with those shown on radiographs taken after epidural injections of contrast medium (epidurograms).

METHODS

Patients were considered for this study if they had features thought by Cyriax (1962) to suggest a disc protrusion likely to be helped by manipulation. All patients had lumbago of rapid onset, which was of less than one week's duration and did not radiate below the knee. Limitation of lumbar movement and signs of dural irritation (abnormalities of straight-leg raise and femoral stretch tests) were recorded. Patients with a neurological deficit were excluded.

Standard lateral radiographs, taken with the patient prone, were used throughout. Urografin 50%, 10–20 ml., was injected

into the epidural space through a caudal cannula. The technique of injection was modified from that described by Yates (1965) and Luyendijk and van Voorthuisen (1966), and is similar to that used by Mathews (1968). A modified gauge 16 Tuohy epidural needle was first inserted through the sacral hiatus, its stylet removed, and a modified Portex flexible nylon epidural cannula threaded through its lumen. The needle was then removed and the cannula strapped to the buttock.

The manipulations were performed without anaesthetic by the rotation techniques described by Cyriax (1965). The lumbar spine was rotated away from the painful side to the limit of its range, the buttock or thigh of the painful side being used as a lever; a firm additional thrust was made in the same direction (Special Plate, Figs. 1A and 1B). This manoeuvre was repeated until abnormal symptoms and signs had disappeared, progress being assessed by repeated examination. Control volunteer subjects in whom epidurograms were being performed for diagnostic purposes, and whose radiographs showed similar appearances, underwent a similar series of manoeuvres, but omitting the thrust of manipulation.

RESULTS

PATIENTS

Fourteen patients were selected for examination. In nine either the injection failed to produce satisfactory contrast to delineate a disc protrusion or the premanipulation and post-manipulation radiographs were not strictly comparable. In five patients apparent reduction of lumbar disc protrusions was demonstrated. Two of these are presented in detail, and in the other three the findings were similar.

Case 1.—The patient, a woman of 45, worked part-time in a baker's shop. While dressing the window she was smitten with low back pain, and noticed that she was unable to stand upright. The next morning she awoke with the pain extending to the left buttock, and was unable to get out of bed. She remained in bed that day, and the following morning was examined at the hospital. Both forward and left lateral flexion of the lumbar spine were limited, straight-leg raise was limited to 60° on the left, and femoral stretch test produced some discomfort in the back. After 12 ml. of Urografin had been injected a concavity was seen in the contrast medium overlying the L 4-5 disc (Special Plate, Fig. 2). At this stage the pain disappeared and the straight-leg raise test returned to normal. Three rotation manipulations were performed, and the lumbar spine movement returned to normal. A comparable radiograph (Special Plate, Fig. 3) then showed almost complete disappearance of the concavity in the contrast medium over the L4-5 disc. Five weeks later this patient had a similar episode of lumbago, treated successfully by manipulation.

Case 2.—A man of 45 developed acute right lumbago, which continued for six days before he came to hospital. He had had many previous similar episodes. Both forward and left lateral flexion of the lumbar spine were reduced and painful. The straight-leg test was reduced to 80° on the right, and right femoral stretch test gave back pain. After 15 ml. of Urografin had been injected concavities were seen over the L 4-5, L 3-4, and L 2-3 discs (Special Plate, Fig. 4). Four rotation manipulations relieved the pain, the straight-leg raise and femoral stretch tests became normal, and lumbar movements were almost full. A further radiograph (Special Plate, Fig. 5) showed a much-reduced concavity over the L 4-5 disc, while the contrast over the L 3-4 and L 2-3 lies along a straight line. This patient has remained symptom-free.

CONTROLS

Of the five control subjects, two showed concavities in the contrast medium similar to those seen at the L 4-5 level in the two patients illustrated. In neither subject was the concavity altered by the control series of manoeuvres.

Four of the control subjects showed multiple concavities. In three of these the control manoeuvres did not alter the appearance, but in one the concavities were replaced by a straight line, a change similar to that seen at the L 3-4 and L 2-3 levels in Case 2.

DISCUSSION

In both Cases 1 and 2 the epidurograms showed a reduction in the size of disc protrusions, represented by concavities in the contrast medium, following manipulation. This effect had not previously been demonstrated. Chrisman, Mittnacht, and Snook (1964) examined 39 patients by conventional intrathecal myelography, and the 26 with myelographic abnormalities failed to show any reduction in the size of disc protrusions following manipulation. The severity of symptoms and signs in their patients, however, suggests larger and more lateral protrusions than those in the present study. Their 13 patients with normal myelograms fared rather better with manipulation, and it may be that their disc protrusions were too small to be detected by conventional myelography. There is evidence to suggest that epidurography is more efficient than conventional myelography at demonstrating small protrusions. Luyendijk and van Voorthuisen (1966) found epidurograms more accurate in preoperative localization of lesions in the lumbar spinal canal.

In the two cases illustrated a concavity in the contrast overlying the L 4-5 disc had diminished in size during manipulation. In the two control subjects with similar epidurographic findings the control manoeuvres were not associated with diminution in the size of the concavities. It therefore seems likely that the reduction effect is due to the manipulating thrust used.

In Case 2 the two concavities at the L 3-4 and L 2-3 levels were replaced after manipulation by a straight line. Of the four control subjects with this multiple type of concavity, three did not show any change in appearance with control manoeuvres, but one did show replacement by a straight line. It is not clear whether this type of change represents flattening of multiple disc bulges, shift of contrast, or a combination of the two effects.

Rotation manipulations apply a torsion stress throughout the lumbar spine. If the posterior longitudinal ligament and the annulus fibrosus are intact some of this torsion force would tend to exert a centripetal force, reducing prolapsed or bulging disc material. There is no reason to suppose this effect would be confined to one level.

The results of this study suggest that small disc protrusions were present in patients presenting with lumbago and that the protrusions were diminished in size when their symptoms had been relieved by manipulation.

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