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ON VASCULAR INJURY IN LUMBAR DISC SURGERY

By

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In operations on prolapsed intervertebral discs in the lumbar region attention is usually concentrated primarily on the visible operation field. Thus, nerve roots and the spinal dura are treated with the utmost care and efforts are made to avoid lesion of the vessels of the vertebral canal. The removal of the interior parts of the disc takes place, however, out of sight and the location of the instrument in the disc cannot be observed. Less thought is given to the vulnerable structures, in the form of the major vessels that pass immediately anterior to the disc.

What then is the anatomical setting for vascular damage? The abdominal aorta lies directly to the left of the mid-line, on the upper four lumbar vertebrae. It divides, in 75 per cent of cases, at the lower border of L.4 or at the disc between L.4 and L.5, reportedly more distally in women than in men (7). From the bifurcation the common iliac arteries pass the promontory and divide at the proximal sacroiliac joint into the internal and external iliac branches. The vena cava runs immediately to the right of the aorta. The junction of the common iliac veins is directly distal and to the right of the aorta bifurcation, consequently, as a rule, at the upper border of L.5 or at the disc between L.4 and L.5. Immediately anterior to the junction runs the right common iliac artery. The anterior aspect of the vertebral bodies is largely covered by the strong anterior longitudinal ligament which attaches more firmly to the vertebral bodies than to the discs. Sagittally, L.5 measures approx. 3.5 cm, and each of the lumbar bodies is a few millimetres smaller than the one below it (8).

We have confirmed these anatomical relationships by studies on cadavers. It is easy to observe (Figs. 1 and 2) that the discs L.3–L.4 and, in particular, L.4–L.5 are in close relationship to the great vessels. The disc L.5–S.I is not related to nearly the same extent.

Fig. 1.
Cadaver specimen.
The relations between the great vessels and lumbar discs.
The metal pins mark the disc L.4–L.5. V = V. cava. A = Aorta.

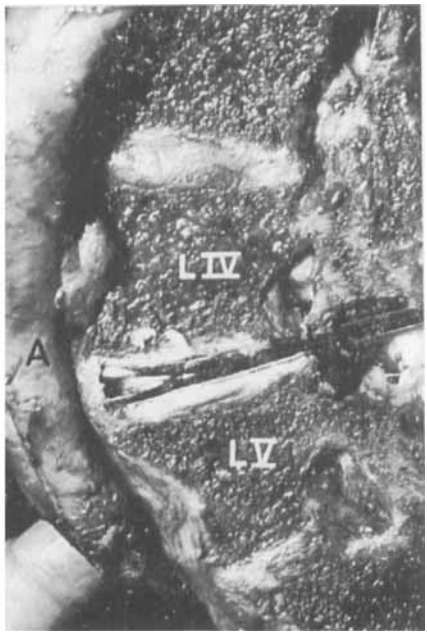

Fig. 2.
Cadaver specimen.
The conchotome in the disc L.4–L.5.
The aorta is visible to the left.
A = Aorta.
L.IV, L.V = vertebral bodies.

Another striking observation was that the vessels, contrary to the information in current literature, were moderately free in relation to the front of the spine. The region between the vessels and the vertebral bodies with their discs was found to consist of a thin layer of loose fat and connective tissue, which did not afford any rigid fixation. It is possible that the vessels are less free under physiological pressure-conditions.

If an instrument perforates the anterior wall of the disc there is therefore an imminent risk of damage to the major vessels. A careful search through the literature does not give a clear picture of how frequently such injury occurs. The first case was published by *Linton & White* (1945), *i.e.* after about 10 years of lumbar disc surgery. This time lag may be connected with the fact that, at first, only the prolapsed portion was removed, while later the operation was extended to include removal also of interior parts of the disc.

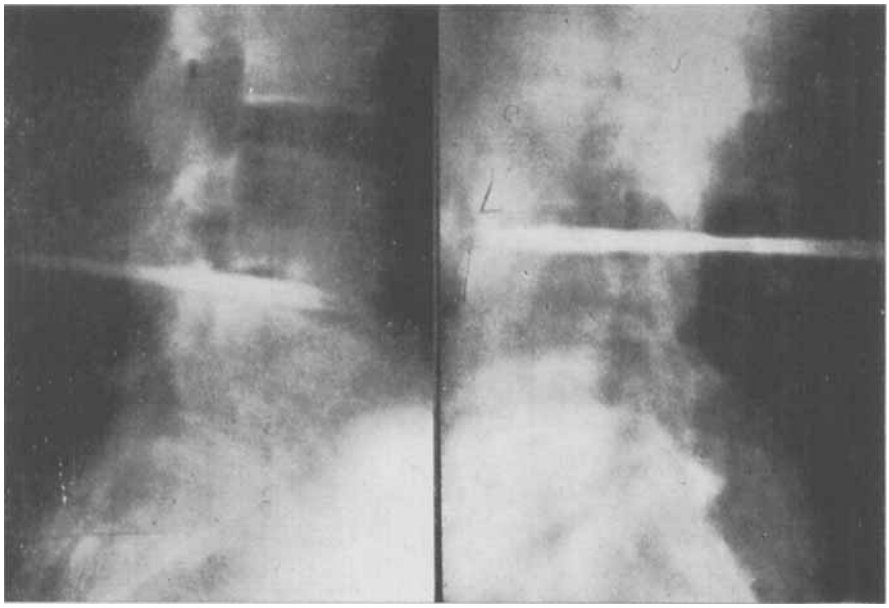

Fig. 3.
X-ray during surgery. The conchotome is in the disc L.4–L.5 (left), L.3–L.4 (right).

Several major surveys have subsequently been published on injuries of the major vessels in lumbar disc surgery *e.g.* by *Harbison* (1954) 25 cases, *De Saussure* (1959) 106 cases, and *Hohf* (1963) 59 cases. These reports are based on questionnaires sent by the authors to American orthopedic surgeons and neurosurgeons. The sources are not fully documented, however, and there is probably a certain amount of duplication between the reports. At all events, even a cautious assessment gives at least 106 cases of injuries to the great vessels in lumbar disc surgery in the U.S.A. In addition, there are several reports of a minor amount of cases from other parts of the world. The injuries described include damage to single vessels as well as the formation of arterio-venous fistulas (1, 3, 5, 10, 11, 12, 15, 17, 18).

The majority of injuries occurred in operations on the disc L.4–L.5 (6, 9, 16), but cases exist of injury at all the levels in question. As a rule it was the common iliac artery which was damaged, less often the vena cava, the aorta, or the external and internal iliac arteries. Arterial injuries are thus well in the majority. Considering that the veins should be equally liable to injury, it seems likely that many venous haematomas have escaped clinical registration.

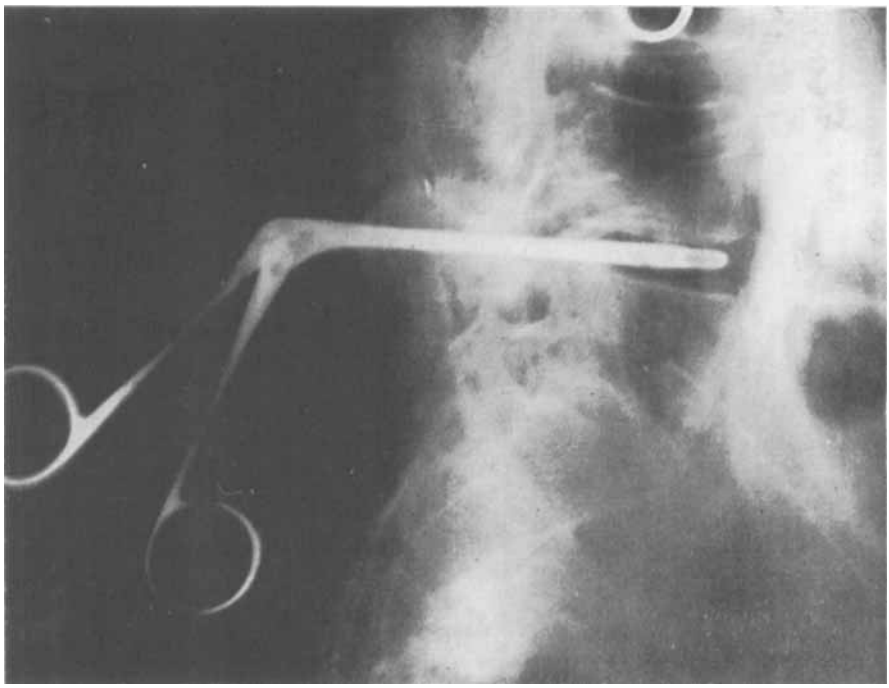

Fig. 4.
X-ray during surgery, lateral projection.
The conchotome in the disc L.4–L.5; the aorta filled with contrast.

Several reports draw attention to how easily vascular injury can happen. In one case the complication arose just as the surgeon was warning his assistants about it (10). On the other hand it is striking that in about 50 per cent of the cases the injury did not in fact show up in the form of visible bleeding during the operation (6). Even when only a single vessel was involved, the operation could be completed without anything unusual being noticed. Instead, the symptoms first appeared as post operative shock, the correct diagnosis often came too late and as a result the mortality in this group was at least 50 per cent (6). In the case of arterio-venous fistulas, the symptoms appeared weeks or months later and the mortality was considerably lower. In one case the fistula was diagnosed 7 years after the operation (11). Most of these cases were reported by vascular surgeons exemplifying reconstructive vascular surgery.

It would seem that most lumbar disc operations are done with the patient in the prone position. During removal of the disc-content the

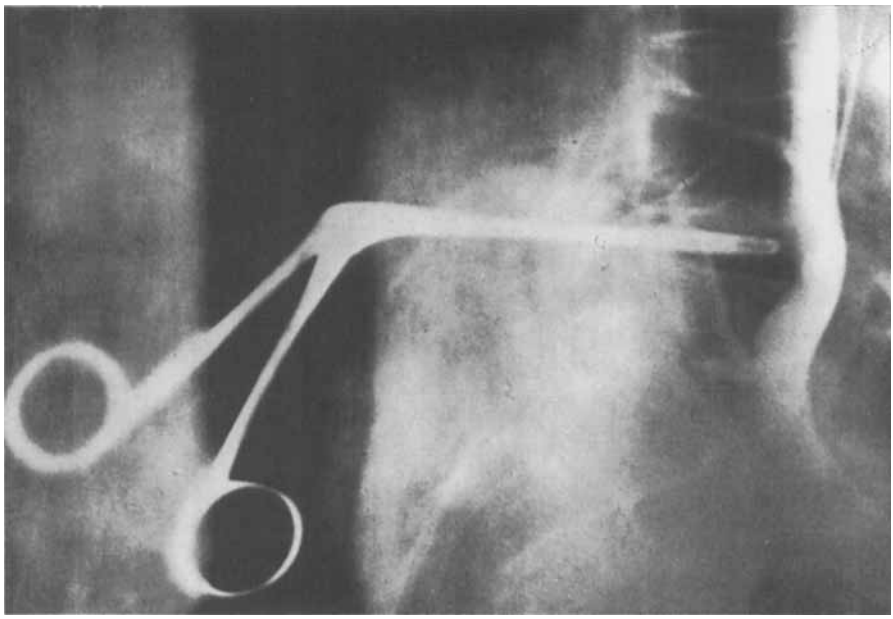

Fig. 5.
X-ray during surgery, lateral projection.
The conchotome in the disc L.4–L.5; the vena cava filled with contrast.
(The bulge in the vessel is not caused by the instrument
but corresponds to the confluence).

lumbar spine is kept as kyphotic as possible. Such factors may well affect the anatomical picture. We have therefore tried to document the actual situation during an operation, with the help of anatomical X-ray studies.

Fig. 3 shows the position of the conchotome after a typical operation for prolapsed disc. No attempt has been made to penetrate the depths of the disc, the picture simply illustrates routine procedure. It is clear that the point of the instrument is very close to the anterior ligament.

These somewhat startling pictures led to some angiographic studies during operations for herniated lumbar discs. Plastic catheters were introduced percutaneously into the femoral artery and vein and led up into the abdominal aorta and the vena cava respectively. The relative positions of the vessels could then be observed after giving a contrast injection.[1]

[1] The late professor *Knut Lindblom*, Head of the X-ray Department, Karolinska sjukhuset, gave us kind and valuable help in performing this part of the study.

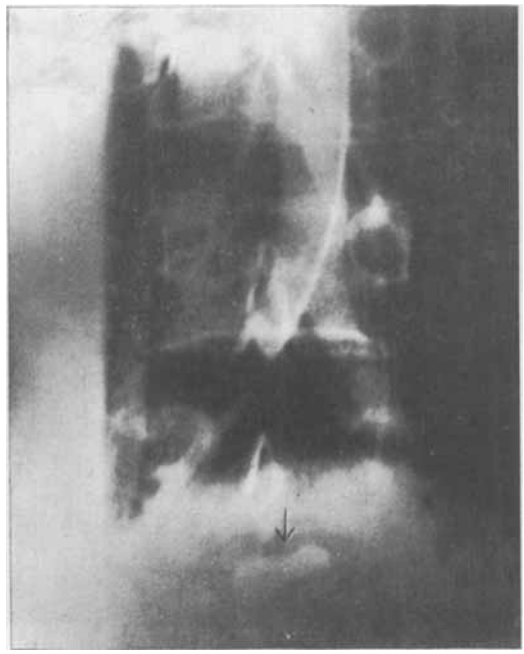

Fig. 6.
X-ray during surgery, frontal projection.
The conchotome in the disc L.5–S.1. (arrow).

In Figs. 4 and 5, which exemplify the anatomical situation as seen in lateral X-rays, the conchotome is in the disc L.4–L.5. In Fig. 4 the aorta is filled with contrast, in Fig. 5 the vena cava. In both cases it is clear that the forward part of the instrument is extremely close to the great vessels. In evacuation of the disc L.5–S.I, contrast filling of the aorta (Fig. 6) shows that there is not so much danger of the vessel being damaged at this level; the common iliac vessels run away laterally from the disc.

DISCUSSION

Clearly then, anatomical conditions do exist for damage to the major vessels in surgery of the lumbar discs. Of the discs usually involved in prolapse cases, the risk is greater to the disc L.4–L.5, since here the vessels form a wide belt. The arrangement of the vessels is such that the danger is considerably less at the level of L.5–S.I. At higher levels it is mainly the aorta which is liable to damage.

Considering the large number of disc operations performed, it is surprising that so few cases of damage to the vessels have been described. There must obviously be other factors, besides the actual anatomy, which help to create such complications. It is possible, for instance, that the surgeon uses too much force in penetrating the depths of the disc, though in studies on cadavers we have found that the force required for the conchotome to perforate the anterior wall of the disc is considerably in excess of that usually used in disc removal. This is also in agreement with *Friberg* (1954), who found that in the lower lumbar discs the degenerative process was most marked in the posterior part of the discs. In the upper lumbar discs, however, the disintegration was more evenly distributed.

Another possibility is that the disc has some anterior defect. *Cloward* (1952) has described a case where a large anterior protrusion of the disc could be observed in preoperative discography. At operation, it was found that the prolapsed disc had caused depressions on the anterior longitudinal ligament and worn this thin. *Lindblom* too, has reported that, in rare cases, the contrast medium has leaked anteriorly in discography. During anatomical X-ray studies we were able to establish that the ability of the conchotome to penetrate the depths of the disc was a function of the degeneration in the disc: when large, complete sections had been removed, the instrument sank easily down to the anterior wall; when minor prolapses were evacuated the anterior part of the disc formed a protective barrier. This has reinforced our opinion that a defect, or at least weakness, in the anterior part of the disc is a prerequisite for the conchotome reaching and perforating the major vessels.

The instrumental technique for the removal of the disc may also be important. Many surgeons scoop out the contents of the disc and warn against the use of biting instruments of the conchotome type (6, 16). However, if the disc does happen to be perforated, the scoop type is just as likely to damage the vessels as the conchotome type. Personally, we simply warn against the use of long chonchotomes.

Finally, it should be emphasised that the symptoms of any vascular injury will not necessarily appear during the operation. Close postoperative supervision of patients operated for prolapsed disc is therefore imperative in order that vascular surgery may be performed without delay, should the need arise.

SUMMARY

A short survey is given of the literature of cases of injury to the great vessels in lumbar disc surgery. The authors give their anatomical findings from an investigation in the relationships between the vessels and the ventral aspect of the lumbar discs. These findings are derived in part from angiography during surgery for prolapsed discs. There follows a discussion of the various circumstances leading to vascular injury in this context.

RESUME

Il est donné un compte rendu succinct de la littérature sur les cas de lésion des grands vaisseaux dans la chirurgie du disque lombaire. Les auteurs présentent les trouvailles anatomiques d'une enquête sur les rapports entre les vaisseaux et l'aspect ventral des disques lombaires. Ces trouvailles proviennent en partie de l'angiographie pratiquée durant l'opération pour la hernie discale. Suit une discussion des différentes circonstances donnant lieu à une lésion vasculaire dans ce contexte.

ZUSAMMENFASSUNG

Eine kurze Übersicht der Literatur bezüglich Fällen von Beschädigung der grossen Gefässe anlässlich lumbaler Zwischenwirbelscheibenchirurgie wird gegeben. Die Verfasser zeigen ihre anatomischen Befunde im Zusammenhang mit einer Untersuchung der Beziehungen zwischen den Gefässen und der ventralen Oberfläche der Lendenwirbelscheiben. Diese Befunde wurden teilweise mittels Angiographie während des chirurgischen Eingriffes wegen prolabierten Scheiben erhalten. Eine Besprechung der verschiedenen Umstände, die in diesem Zusammenhang zur Gefässbeschädigung führen, folgt.

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