



Interventional Spinal Procedures

C. ANDREULA

Neuroradiology and Radiology, Anthea Hospital Bari, Città di Lecce Hospital; Lecce, Italy

Key words: spine, interventional percutaneous procedures

Ipercutaneous Discolysis

Low back pain is the commonest condition affecting the lumbar spine, and is the most frequent cause of absence from work. Around 80% of the population in western countries will experience at least one episode of low back pain in their lifetime and 55% suffer from low back pain associated with radicular syndromes¹.

The most frequent pathogenesis of low back pain with nerve root compression is the disc disease.

The natural history of herniated disc is characterized by a disappearance of clinical symptoms in up to 50% of patients, with shrinkage of the disc herniation revealed by CT or MR scans within eight to nine months after the start of back pain, but not all patients can wait so long before symptoms improve¹⁻².

In the United States alone around 200.000 patients with lumbalgia or sciatica are treated surgically every year. The short-term success rate after surgery for lumbosacral disc herniation is around 95-98% with a 2-6% incidence of true recurrence of herniation. This percentage drops to around 80% in the long-term (more than 6 months) due to the onset of symptoms linked to Failed Back Surgery Syndrome (FBSS) characterised by recurrence and/or hypertrophic scarring with severe symptoms in 20% of patients and FBSS proper in 15%³.

Moreover the pathogenesis of lumbar pain is still under discussion⁴ and could be related to mechanical and inflammatory causes:

The mechanical factors are divided in direct:

- direct action of the hernia on the spinal ganglion;
- deformation of the ligaments and annulus, with stimulation of the nociceptors of Luschka's nerve of the posterior root of the spinal nerve and indirect;
- ischaemia due to compression on the arterial afferents;

– venous stasis.

The inflammatory factors are

- cell-mediated response to the disc protrusion (possibly related to segregation of the disc to the immune system);
- biohumoral factors like Phospholipase A2 (indirect inducer of pain mediators), Prostaglandin E2 (inflammatory inducer through Phospholipase A2), and Matrix metalloproteinases (MMPs)(inflammatory enhancers).

FBSS, the pathogenesis of lumbar pain, and the many specialists convinced that conservative treatment offers the same level of surgical results, if checked at late follow-up, have stimulated research into newer mini-invasive techniques to improve clinical results.

The interventional procedures by percutaneous techniques are decompressive such as chemodiscolysis with chymopapain, nucleodisectomy introduced by Onik, LASER discectomy, and recently nucleoplasty, and decompressive and direct antiinflammatory such as chemiodiscolysis with anOxygen-ozone mixture.

These techniques have minimized the invasive nature of surgery and avoid or decrease complications like infection linked to surgery.

Reducing intervertebral disc size by mechanical aspiration of a part of the disc or partially dissolving the herniation by drying reduces the conic pressure on the torn annulus and creates the space necessary for retropulsion whenever the circular fibres of the annulus regain a minimum capacity to contain the disc under tension. The proposed suggestion in these techniques is that a small change in volume produces large change in pressure.

All percutaneous procedures are minimally invasive entailing only a short hospital stay. By avoiding the spinal canal, these techniques also eliminate the risks of post-operative scarring linked to surgery which are often responsible for recurrence of pain. Percutaneous tech-

niques can also be repeated in the same patient without precluding recourse to traditional surgery if they should fail. The success rates reported in different studies vary from 65 to 80% of excellent or good results with chemonucleolysis and aspiration³.

Chemiodiscolysis with O₂-O₃ Mixture With Periradicular and Periganglionic Infiltration

Chemiodiscolysis with O₂-O₃ mixture with periradicular and periganglionic infiltration is a recent percutaneous technique widespread in Europe (Italy and Germany are the countries where the method is most widely applied⁶).

The choice of this technique is based on the hypotheses that the pain is related to a mechanical compressive component, along with the inflammatory radicular and ganglionic component.

Herniation of the nucleus pulposus is thought to trigger an autoimmune reaction, the proteoglycan component of its nucleus being segregated from the immune system after birth.

Moreover the nucleus pulposus can also give rise to an inflammatory process through a non-immune-mediated mechanism supported by histiocytes, fibroblasts of the reactive perihernial tissue, and chondrocytes in the disc protrusions able to produce cytokines (Interleukin-1 alpha, Interleukin 6 and TNF-alpha). This leads to an increase in phospholipase A2 leading to the release of prostaglandin E2, leucotrienes and thromboxanes found in larger quantities in non-contained disc herniations and patients presenting more severe symptoms.

Prostaglandins cause pain. In small amounts, they enhance sensitivity of the nerve roots and other pain-producing substances like bradykinin. Experimental studies have shown that an oxygen-ozone gas mixture at the concentrations used for intradiscal treatment have the same effect as steroids on inhibiting cytokine production and hence the pain induced by the same⁷.

The oxygen-ozone mechanisms of action are currently being investigated and include

- 1) Intra- and trans-tissue oxygenation in the disease site with reduced hypoxia and venous stasis;
- 2) reduction of the cell-mediated process inhibiting proteinase release and an increase of the immunosuppressor cytokines;

- 4) inhibition of inflammatory inducers (PPL) and pain-producing mediators

Direct effect of ozone on the mucopolysaccharides making up the nucleus pulposus of the intervertebral disc with rupture of water molecules and shrinkage of the disc exerting compression on the nerve roots. This effect was confirmed by histologic disc specimens removed during surgical microdiscectomy, previously treated with intradiscal O₂-O₃ mixture injection, with features of nucleus pulposus fibrillary matrix dehydration and signs of regression (so called "disk mummification").

The following selection criteria were adopted for enrolment:

- 1) *clinical*: low back and/or nerve root pain resistant to previous medical treatment, physiotherapy and other therapies (manipulation, acupuncture, etc.) for a period of not less than one month;
- 2) *psychological*: a firm resolve on the part of the patient to recover with a commitment to cooperate and undergo subsequent physiotherapy with postural and motor rehabilitation;
- 3) *neurological*: paresthesia or hypoesthesia over the dermatome involved, mild muscle weakness and signs of root-ganglion irritation
- 4) *neuroradiological* (CT and/or MR):

a) evidence of small and medium-sized herniated discs correlating with the patient's symptoms with or without degenerative disc-vertebra disease complicated by intervertebral disc changes (protrusion, herniation);

b) residue of surgical (micro)-discectomy with herniation recurrence and/or hypertrophic fibrous scarring.

The exclusion criterion was:

CT/MR evidence of disc herniation corresponding to clinically severe motor deficit and/or sphincter disturbance.

The indications for O₂-O₃ treatment were extended to FBSS patients when it was understood that the ozone mechanisms of action could be exploited to treat the chronic inflammation and venous stasis present in FBSS.

Technique

The approach to the disc is the same as that used for both discography and other percutaneous intervertebral disc procedures. The needle used is a 18-20 G Chiba needle inserted from a posterior paravertebral oblique approach under CT or fluoroscopic guidance. The L5 S1 space is not always an easy target to

reach and may require a further 30° craniocaudal inclination of the needle. Once the needle has been positioned in the centre of the disc, the gas mixture is injected into the disc and into the epidural and intraforaminal spaces at a concentration of 27-30 mcg/ml of an O₂-O₃ mixture: this concentration was calculated from experimental studies as the amount best suited to dry out the nucleus and minimize inflammation.

Discography is no longer performed before percutaneous treatment as the procedure adds no further diagnostic information needed for treatment. CT guidance was adopted instead of the well-tested radiological monitoring by isocentric angio suite with double arm due to the need for meticulous positioning of the needle within the nucleus pulposus. In addition, CT avoids the use of intradiscal contrast administration which even in low doses reduces the discal absorption of ozone and the space available and hinders the search for the site of intraforaminal injection of the O₂-O₃ mixture. A CT scan is done before therapy to rule out the presence of a retrosoic bowel loop.

In our personal experience based on more than 3000 patients, the results adopting the modified MacNab method are:

In patients with degenerative disease complicated by herniation:

- 1) excellent in 40%,
- 2) good or fair in 40%,
- 3) mediocre or poor in 20%.

In patients with L4 L5 or L5-S1 herniated discs:

- 1) excellent in 64%,
- 2) good or fair in 13%,
- 3) mediocre or poor in 23%.

In patients with multiple disc herniations:

- 1) excellent in 58%,
- 2) good or fair in 11%,
- 3) mediocre or poor in 31 %.

In FBSS patients:

- 1) excellent in 45%,
- 2) good or fair in 20 %,
- 3) mediocre or bad in 35%.

No early or late neurological or infectious complications have been reported following O₂-O₃ injection.

The results are virtually the same as those of other percutaneous techniques (75-80% success rate), injections can be repeated if necessary, and there are no side effects. However, the low costs of this O₂-O₃ therapy make this the method of choice in the percutaneous treatment of herniated lumbar disc.

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C. Andreula, MD
Neuroradiology and Radiology, Head
Anthea Hospital Bari
Via Rosalba Camillo, 35
70124 Bari
Italy