Interventional Spinal Procedures

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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 syndromes.

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 improve.

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%.

Moreover the pathogenesis of lumbar pain is still under discussion 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 chimopapain, nucleo-discectomy introduced by Onik, LASER discectomy, and recently nucleoplasty, and decompressive and direct antinflammatory such as chemiodiscolysis with an Oxygen-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 pa-
tient 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 chemonu-
cleolysis and aspiration.

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 applied).

The choice of this technique is based on the
hypotheses that the pain is related to a me-
chanical 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
segretaged 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 perih-
ernal tissue, and chondrocytes in the disc protru-
sions able to produce cytokines (Interleukin-1
alpha, Interleukin 6 and TNF-alpha). This lead
to an increase in phospholipase A2 leading to
the release of prostaglandin E2, leucotrenes
and thromboxanes found in larger quantities in
non-contained disc herniations and patients p-
resenting more severe symptoms.

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

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 in-
hibiting proteinases release and an increase of
the immunosuppressor cytokines;
3) inhibition of inflammatory inducers (PPL)
and pain-producing mediators

Direct effect of ozone on the mucopolysaccha-
rides making up the nucleus pulposus of the in-
tervertebral disc with rupture of water mole-
cules and shrinkage of the disc exerting com-
pression on the nerve roots. This effect was
confirmed by histologic disc specimens re-
moved during surgical microdiscectomy, previ-
ously treated with intradiscal O₂-O₃ mixture in-
jection, with features of nucleus pulposus fib-
rillary matrix dehydration and signs of re-
gression (so called “disk mummification”).

The following selection criteria were adopted
for enrolment:
1) clinical: low back and/or nerve root pain re-
sistant to previous medical treatment, physio-
therapy 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 co-
operate and undergo subsequent physiother-
apy 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 her-
niated 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)-discetomy
with herniation recurrence and/or hypertrophic
fibrous scarring.

The exclusion criterion was:

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

The indications for O₂-O₃ treatment were ex-
tended to FBSS patients when it was under-
stood that the ozone mechanisms of action
could be exploited to treat the chronic inflam-
mation and venous stasis present in FBSS.

Technique

The approach to the disc is the same as that
used for both discography and other percuta-
aneous intervertebral disc procedures. The nee-
dle used is a 18-20 G Chiba needle inserted
from a posterior paravertebral oblique ap-
proach under CT or fluoroscopy 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 retropsoic 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.
References


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