Case report: Intradiscal oxygen ozone therapy in uncontained lumbar disc herniation [version 1; peer review: 1 approved, 1 approved with reservations]

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Abstract
Percutaneous intradiscal oxygen ozone (O$_2$O$_3$) for contained lumbar disc herniation (LDH) is used as a minimally invasive alternative to surgery. This article reports excellent benefit in two patients with uncontained LDH following treatment with minimally invasive percutaneous intradiscal injection of O$_2$O$_3$. There is an urgent need for more research and awareness into this less expensive non-surgical out-patient treatment.
Introduction

Symptomatic lumbar disc herniation (LDH) is common with a lifetime incidence of 2% with most occurring at the L4/5 level in the 30 to 50 age group. LDH affects mobility, function, quality of life and costs highly to society. Treatment options include simple analgesics, physical therapy and corticosteroid injections, as well as percutaneous and conventional discectomy. Long term outcomes, complications and occasionally suboptimal results of open disc surgery have lead to the development of percutaneous techniques. Percutaneous minimally invasive treatments for LDH aim for chemical, mechanical or thermal methods to decompress the disc. These are based on a study by Hjikja et al. (1975) that stated that, ‘reduction of intradiscal pressure reduced irritation of the nerve root and the pain receptors in the annulus and peridiscal area’. Reduction of intradiscal pressure reduces the size of the hernia, and the disc height. This supports the phenomenon of ‘chemical discectomy’. Percutaneous techniques are typically reserved for contained small to medium sized LDH. This report describes the use of minimally invasive percutaneous intradiscal oxygen ozone (O2O3) gas in two patients with severe low back pain and sciatica due to compressive uncontained LDH.

Case 1

A 46 year old, non-smoker, male plumber and gas fitter with body mass index (BMI) of 27.3, presented in January 2011 with discogenic type low back pain, left lower limb sciatica to the calf, lateral foot, toes and hyperalgesia to the sole of the foot, which were managed with manual therapy and oral analgesics. In June 2011 symptoms returned after he had been playing with his son and was admitted to the emergency department due to severe low back spasm. An MRI showed a large uncontained L4/5 disc herniation compressing the spinal canal and the left L5 root compatible with his symptoms (Figure 1a,b). He refused surgery and was referred for percutaneous intradiscal O2O3 treatment in June 2011 with an Oswestry Disability Index (ODI) of 24% suggesting mild to moderate disability. He had been on oral Tramadol 200mg BD and Naproxyn 500mg PRN. There was weakness to resisted left big toe dorsiflexion due to L5 nerve compression. Following written informed consent explaining the risks and outcomes, under CT guidance using a sterile technique, and local anaesthetic in a prone position, 20cc medical grade Oxygen Ozone (27µg/ml) was injected into the nucleus pulposus of the disc through a 22g spinal needle (Figure 1c,d). The needle was withdrawn out of the disc and Celestone Chronodose (5.7mg) was injected into the anterior epidural space. Two months post intradiscal O2O3, ODI was 8% (77% reduction from pretreatment) and at seven months his pain had completely resolved. He returned to normal activities with cessation of all analgesics. Mild paraesthesia of the left L5 distribution persisted with resumption of usual work and activities at this time. MRI at seven months showed dramatic resolution of disc herniation and decompression of the spinal canal (Figure 1e,f).

Case 2

A 30 year old mother with BMI of 30.1, lifelong non-smoker, suffered debilitating low back pain for about 8 years. Intermittent exacerbation of pins and needles and right lower limb sciatica were treated with spinal corticosteroids, nonsteroidal antiinflammatories and opiates. Acute episodes needed admission to emergency department. Prior to referral for consideration of percutaneous intradiscal O2O3 treatment as a last option, she had been reviewed by spinal surgery and chronic pain management. She was on Tramadol 200mg, Panadene Forte, Lyrica and OxyNorm. At presentation for percutaneous treatment, ODI was 66% (moderately severe disability), there were normal reflexes and power of lower limbs, dysaesthesia to right lateral foot and right paravertebral spasm. MRI showed a 12mm LDH with an extrusion compressing the right L5 root and L4/5 disc degeneration (see Figure 2). Following written informed consent explaining the risks and outcomes, under CT guidance, in a prone position using local anaesthetic and sterile technique, 10cc O2O3 (27µg/ml) gas was injected into the nucleus pulposus of the L4/5 disc through a 22G spinal needle. The needle was withdrawn and O2O3, followed by Triamnicalone (40mg), was injected around the right L5 nerve. At 4 weeks follow up there was dramatic improvement with no low back or radicular pain. At nine months telephone interview ODI was 4% (improved by 93% from pretreatment ODI), with complete cessation of all medications and the occasional niggling pain.

Discussion

Minimally invasive percutaneous intradiscal injection of O2O3 has been widely used in Europe for LDH since 1996. It is proposed that O2O3 acts by ‘mummifying’ the disc reducing disc volume with an effect of a discectomy. The chemical properties of oxygen ozone, by way of reaction of the hydroxyl radical with carbohydrates and amino acids leading to the breakdown of nucleus pulposus with rapid disappearance of herniated disc material, may explain this phenomenon of ‘chemical discectomy’. The MRI in Figure 1 shows reduction in disc height and marked resolution of the herniated disc material after O2O3 treatment. This supports the phenomenon of ozone induced chemical discectomy. O2O3 also down-regulates amino acids leading to the breakdown of nucleus pulposus with reduction in disc height and marked resolution of the herniated disc material after O2O3 treatment. This supports the phenomenon of ozone induced chemical discectomy. O2O3 also down-regulates amino acids leading to the breakdown of nucleus pulposus with rapid disappearance of herniated disc material after O2O3 treatment. This supports the phenomenon of ‘chemical discectomy’. The MRI in Figure 1 shows reduction in disc height and marked resolution of the herniated disc material after O2O3 treatment. This supports the phenomenon of ‘chemical discectomy’.
ozone at least 70% achieved excellent or good outcome. In addition, a combined intradiscal oxygen ozone and concomitant periganglionic cortisone and oxygen ozone injection achieved a cumulative effect that enhances overall outcome of treatment of pain caused by disc herniation with a satisfactory therapeutic outcome in 78% of patients at six months follow up in 300 patients. Muto et al. showed that between 1996 and 2003 of 2200 patients with low back pain or sciatica due to LDH, CT guided intradiscal oxygen ozone injection achieved an 80% success in 1750 patients at 6 months follow up. Success rate dropped to 75% in 1400 patients followed up to 18 months. Reduction in size of herniated disc was seen in 63% of followed up patients. Failure was mostly due to calcific herniated disc, spinal canal stenosis, recurrent disc herniation and multilevel degenerative disease. A meta-analysis of twelve studies showed that oxygen ozone treatment in herniated discs is an effective and extremely safe procedure, with impressive improvement in pain and function in view of the broad inclusion criteria of patients ranging from 13 to 94 years with all types of disc herniations. It also showed that pain and function outcome scores were similar for LDH treated with surgical discectomy but the complication rate is much lower (<0.1%)2. A randomized controlled trial is underway comparing microdiscectomy and percutaneous O2O3 intradiscal therapy. 

Lu et al. showed that percutaneous ozone injection is safe in large LDH in 58 patients with overall efficacy of 91.4% with excellent and good outcome in 63.8% and 27.6% respectively. Wu et al. used a combination of O2O3 with collagenase injection and compared this with surgery for uncontained LDH and followed them up for 12 months. They showed non-statistically significant difference between the two groups at 3 and 12 months, though the surgical

Figure 1. Case 1, 1a: Pretreatment sagittal T2 weighted MRI shows large left paracentral uncontained disc herniation at L4/5 compared with normal disc margin at the levels above and below, 1b: Pretreatment axial T2 weighted MRI with arrow pointing to posterior displacement and compression of thecal sac due to the disc herniation, 1c&d: CT guided intradiscal O2O3 injection in another patient illustrates needle placement in the nucleus pulposus of disc and distribution of O2O3 in the disc, epidural and paraspinal spaces, 1e&f: follow up MRI seven months after intradiscal O2O3 injection shows complete resolution of disc herniation, note the reduction in disc height and hydration in 1e compared to 1a and restoration of normal thecal sac margin highlighted by the arrow in 1f in comparison to 1b.
group had a statistically significant greater improvement in the first few weeks\textsuperscript{15}.

The total health care cost for disorders of intervertebral discs and bones in the spinal column was estimated at US$ 25.8 billion\textsuperscript{16}. Cost per procedure of intradiscal O\textsubscript{2}O\textsubscript{3} is free from recurring operative instrumental consumable cost. Oxygen Ozone is procured from inexpensive medical grade oxygen that is processed through an oxygen generator, obtained as a one off capital non-recurring expenditure. Percutaneous intradiscal treatment is an outpatient procedure that attracts far less expense compared to procedures that require hospitalization. There are other cost savings for the individual, community and health systems due to reduced recuperation time.

In summary, Oxygen ozone is a minimally invasive, effective, low risk treatment for refractory LDH with potential to reduce health care costs and there is an urgent need for more research and awareness into this non surgical outpatient treatment.

**Consent**

Consent was obtained from both patients to publish this anonymized case report.

**Competing interests**

I Dr Doss have no competing interests in this paper to any agency or third party. I have not received any financial or non financial incentives in relation to this article.

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**References**

assurance guidelines for percutaneous treatments of intervertebral discs. 
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Case reports should be used to publicise unusual or rare events that for epidemiological reasons cannot be reported in better, more informative formats such as case series and controlled trials.

There is nothing new or unusual about ozone therapy for disc herniation. There is already an abundant literature, with many case series, that describes this intervention. A report of two cases does nothing to enhance this literature. The science of this intervention can be advanced only by a randomised controlled trial.

Competing Interests: No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Wally Kos
Dalcross Hospital, Sydney, Australia

I think the case report(s) are fine, the treatment methods complying with standard practice &
reflecting sound & safe practice.

Whilst not a scientific paper, it brings attention to a therapy which is poorly understood in the major part of the English speaking world. It could open up personal inquiry to the many papers published out of Europe & India.

**Competing Interests:** No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

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