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Evaluation Study

CHRONIC LOW BACK PAIN IN A PATIENT WITH MODIC1 OSTEOCHONDROSIS: TREATMENT WITH X-RAY-GUIDED OZONE IN THE INTERVERTEBRAL SPACE

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ABSTRACT

The definition of Low Back Pain (LBP) encompasses several vertebral pathologies. Vertebral bone marrow lesions recognizable as Modic modifications on magnetic resonance imaging (MRI) have high specificity for discogenic LBP. Furthermore, recent data indicate infectious and autoimmune etiologies in the genesis of Modic changes, both of which presuppose structural damage to the disc. In this study, we evaluate how much intradiscal/intervertebral oxygen-ozone can be a solution to this complex problem. We treated 69 patients that underwent intradiscal/intervertebral infiltration with an oxygen-ozone mixture at a concentration of 20 μg/ml under fluoroscopic guidance. The overall results were satisfactory, taking into account that a maximum of two oxygen-ozone administrations were made in 60 days. Furthermore, 70% of the patients evaluated two months after the last administration was satisfied with the treatment performed. In our opinion, the widely established and extremely safe technique justifies a more widespread use of ozone therapy and must stimulate additional applications which include more treatments with oxygen-ozone for each patient and systematic remote MRI control.

KEYWORDS: *oxygen, ozone, osteochondrosis, back, pain, Modic changes*

INTRODUCTION

Low back pain (LBP) is the most disabling pathological condition worldwide, with serious consequences for health services and essential work disability (1). Although the definition of LBP encompasses several vertebral pathologies, vertebral bone marrow lesions recognizable as Modic modifications on magnetic resonance imaging (MRI) have high specificity for discogenic origin (2).

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Recent data indicates infectious and autoimmune etiologies in the genesis of Modic changes, both of which presuppose structural damage to the disc. Clinical trials for novel non-surgical treatments of LBP associated with Modic changes have focused on suppressing inflammation/infection with intradiscal antibiotics or steroid injections (3-6). It is now widely recognized that Modic-like modifications are more than a simple discovery of random images in patients with LBP and instead represent an underlying disease that must be the real goal for more specific therapy.

In this study, we evaluate how much intradiscal/intervertebral oxygen-ozone can represent a solution to this complex problem.

MATERIALS AND METHODS

From October 2018 - August 2019, 69 patients between 32- and 81-years-old underwent intradiscal/intervertebral infiltration with an oxygen-ozone mixture at a concentration of 20 micrograms/ml under fluoroscopic guidance. The disc levels treated were 3 L2-L3, 7 L3-L4, 23 L4-L5, and 36 L5-S1. The patients were 34 male and 35 female; all complained of chronic LBP (over six months) without improvement with rest and, indeed, frequent nocturnal pain. In addition, all patients had on MRI a degenerative disc lesion (hernia or protrusion) associated with an alteration in the signaling of the bone marrow of the vertebral plate classifiable as Modic 1. The technique used for the local administration of the oxygen-ozone mixture is that commonly used for chemonucleolysis: preliminary identification of the disc space employing a fluoroscope, lateral intramuscular puncture with an angle of about 45°, lateral-medial direction up to the intervertebral space and subsequent injection of about 3-5 ml of oxygen-ozone. The patient was then left supine for about 10 minutes and asked to slowly assume a sitting and standing position (Fig. 1).

All patients were checked at 30 and 60 days after infiltration. An evaluation of changes in symptoms, overall improvement in the quality of life, and the level of autonomy was carried out. Unfortunately, a follow-up MRI scan performed approximately 90 days after oxygen-ozone infiltration was only possible in some patients.

RESULTS

The analysis of results are based on the information provided by a phone call with patients regarding an assessment of pain using a VAS-type scale, autonomy in carrying out daily chores, quality of night rest, the frequency of use of painkilling drugs. The overall results were satisfactory, taking into account that a maximum of two oxygen-ozone administrations were made in 60 days. 65% of the patients evaluated two months after the last administration was satisfied with the treatment performed. We found better results in the subgroup presenting moderate disc disease, with discs still somewhat hydrated and Modic 1 MR pictures confined to the anterior or posterior third of the involved somatic plates. (Fig. 2).

DISCUSSION

Modic modifications are alterations in the intensity of the MRI signal in the vertebral bone marrow that corresponds to lesions unrelated to medullary neoplasms or rheumatic disorders (7, 8). Almost all the degenerative bone changes

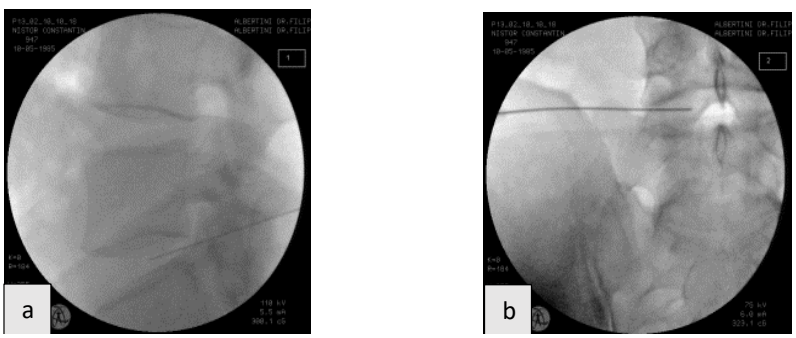

Fig 1. *A: lateral projection; B: front projection. The technique used for the local administration of the oxygen-ozone mixture.*

are localized at the disc-vertebral junction. The underlying mechanism of degeneration is chronic repeated trauma that alters the interbody disc and the opposing vertebral plates. The modifications induced by this mechanism are highlighted in an alteration of the spongy tissue of the vertebral bodies. Three types of Modic have been described based on their appearance in T1-weighted and T2-weighted images. Modic type 1 changes are hypointense in T1 and hyperintense in T2 (Fig. 3). Those of type 2 (Modic 2) is hyperintense in T1 and hyper- or isointense in T2 (Fig. 4). Finally, Modic type 3 changes are hypointense in T1 and T2 (Fig. 5).

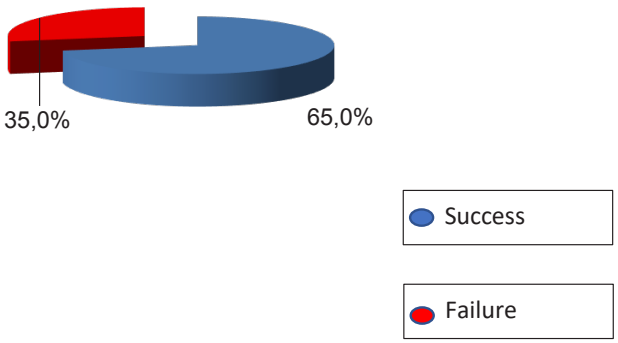

Fig. 2. *Analysis of the results obtained.*

Fig. 3. *In MODIC TYPE 1 it is possible to highlight a reduction in the MRI signal in T1 (A) and an increase in the intensity of the signal in T2 (B) which reveal the presence of edema in the cancellous tissue associated with micro-fractures of the trabeculae.*

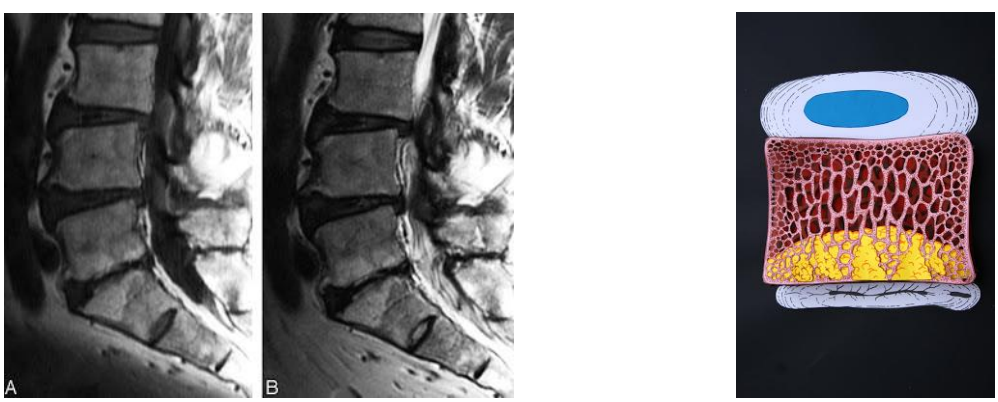

Fig. 4. *MODIC TYPES 2 and 3 indicate chronic alterations. TYPE 2 is characterized by an increase in the MRI signal in T1 (A) and an increased signal in T2 (B). The bone marrow is replaced by adipose tissue that infiltrates the trabeculae.*

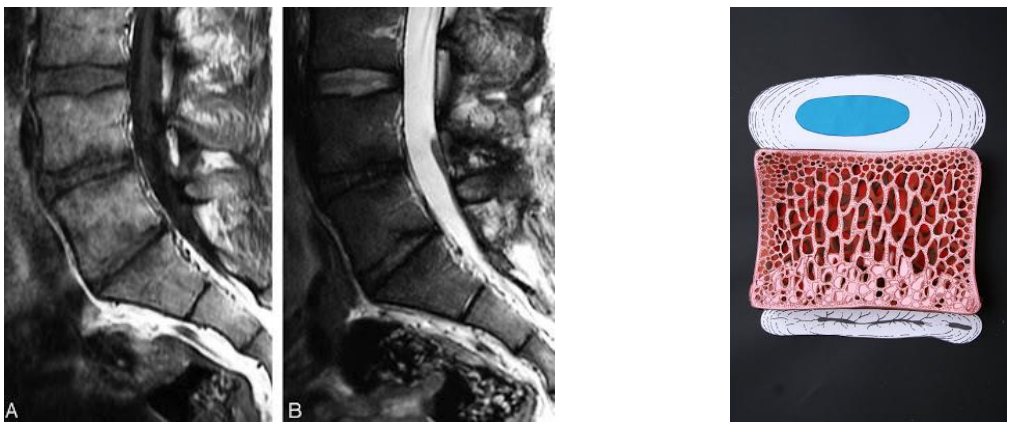

Fig. 5. *MODIC TYPE 3 shows a reduction in signal intensity in both T1 (A) and T2 (B) and is an expression of bone sclerosis.*

In general, the prevalence of Modic-like changes is high in patients with low back pain: 43% median prevalence, compared to only 6% median prevalence in the asymptomatic population (9). Furthermore, of the different types of Modic type 1 is the one more associated with LBP than the others (2, 10); Modic-like modifications are also commonly associated with disc degeneration (11), the severity of degeneration (12), and herniated discs (13).

Many studies have examined the correlation between Modic's categories and LBP. However, understanding the etiology of Modic changes is hampered by the different clinical presentations and multifactorial pathophysiology. Modic 1 and Modic 2 are interconvertible over time and can be converted into Modic 3 (10, 11, 12). Risk factors for Modic-like changes can be classified into disc / subchondral surface damage (disc degeneration, herniated disc, subchondral surface damage), systemic factors (smoking, aging, male sex, genetics), and overburden (obesity, spinal deformities, high occupational burden) (13,14). The non-ascertained and multifactorial nature is particularly true for Modic1; however, Modic 2 is mainly associated with hyperload and systemic factors (15-17).

The relationship between bone reaction and disc degeneration is still being studied; it is not clear whether the bone reaction follows or precedes disc degeneration. However, microfractures of the subchondral cancellous bone and cartilage have been frequently found even in the absence of disc degeneration. This would demonstrate how a degenerative process of the vertebral plate can be established before any disc degeneration. Two mechanisms can justify disc degeneration due to bone damage: 1) lack of diffusion of disc nutrients due to subchondral damage and 2) destructive action of releasing proteinases from inflammation with discolysis.

There is also a plausible infectious etiology deriving from the anaerobic environment of the disc. Common damage to the peripheral disc annulus could allow access to low virulence skin microorganisms that would find the absence of immune surveillance and low oxygen tension inside the disc. This context provides an ideal environment for bacterial growth, with the development of a slow-growing occult discitis and the consequent production of increasing amounts of bacterial metabolites and cytokines as the disc cell responds to infection (18). Chronic inflammation of the adjacent bone marrow can thus develop (19). However, there is only limited evidence to support a relationship between the presence of bacteria, LBP, and Modic Type 1 (20).

Finally, the possible autoimmune etiology should be remembered; after embryological disc formation, the nucleus pulposus no longer comes into contact with the systemic circulation, and subsequent peripheral damage to the disc can expose the nucleus pulposus to the immune system, where it is recognized as "non-self" and triggers an autoimmune response (21, 22).

There is a very strong correlation between Modic's type 1 sign and LBP (23). It has been shown that patients with signs of Modic 1 on MRI have different symptoms from those who do not have them. They often present with constant and persistent LBP, which does not improve with rest. During the 24 hours, pain intensity may fluctuate, but the patient is never asymptomatic. Seventy-five% of these patients suffer night pains, forcing them to get up and walk to relieve the symptom.

Recent studies show that the presence of Modic type 1 with chronic LBP is associated with poor outcomes of

conservative treatment (24, 25). Furthermore, it is evident that treating these patients is very difficult. Magnetotherapy, administration of bisphosphonates (clodronate), steroids, antibiotics, and the surgical solution through arthrodesis have been proposed and evaluated.

Considering the complex pathogenesis, based above all on inflammation, autoimmune reaction, and bacterial persistence with local infection, it is legitimate to hypothesize a conservative solution based on intradiscal/intervertebral oxygen-ozone treatments that can act on these factors. The biochemical mechanisms of ozone which counteract both cell-mediated inflammation (inhibition of the release of proteinases from macrophages and neutrophils and increased release of immunosuppressive cytokines) and biohumoral inflammation (inhibition of prostaglandin synthesis) have been known for some time (26).

CONCLUSION

The results obtained with one or two treatments may lead to considering the X-ray-guided administration of oxygen-ozone in the intervertebral space as a useful and effective technique in treating LBP associated with Modic 1 modifications to MRI.

A late control MR finding, unfortunately, evaluated only in some cases, are not of univocal interpretation. A clinical improvement does not always correspond to attenuating the inflammatory phenomena (reduction of edema) present in the initial examination. Therefore, it will be necessary to perform late MRI checks on a more significant number of treated patients to better interpret the clinical/radiological relationship of improvement.

In our opinion, however, the widely consolidated and extremely safe oxygen-ozone technique justifies a more widespread use as a valid alternative to more invasive methods or drug therapy. In addition, it must stimulate other works that include a greater number of treatments with oxygen-ozone for each individual patient and systematic late MRI control.

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Conflict of Interest

The authors declare no conflict of interest.

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