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EFFICACY OF INTRADISCAL OZONE NUCLEOLYSIS IN IMPROVING PAIN AND FUNCTION IN PATIENTS WITH LUMBAR PROLAPSED INTERVERTEBRAL DISC

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ABSTRACT

Introduction: The prevalence rate of low back pain ranges from 22% to 65% in one year and the lifetime prevalence ranges from 11% to 84%. Different treatment modalities are available like nerve root block, epidural steroid injection, endoscopic discectomy, micro discectomy & classical laminectomy and discectomy. There are very few randomized control trials comparing ozone nucleolysis (ONL) with another treatment at present. In this study we therefore tried to find out the efficacy of ONL in improving pain as well as function in patients with lumbar herniated disc.

Materials and methods: A prospective study was conducted on 54 patients with low back pain due to lumber disc prolapse was carried out after obtaining permission from Research Ethics Board in the Department of Physical Medicine and Rehabilitation (PMR), Regional Institute of Medical Sciences (RIMS), Imphal.

Results and Observations: A total of 54 patients were recruited. The mean age of patients were found to be 37 years. Males were affected more than the female and among them labour class of persons are more affected. Following intra-discal ozone therapy the reduction from baseline VAS score 70.28±12.45 at two weeks was to 36.30 ± 15.18. The VAS scores improved to 22.80 ± 11.22 and 13.88±5.96 respectively at the end of the 3 months and 6 months respectively. Improvement of (Japanese Orthopaedic Association) JOA score from baseline to two weeks following ONL was 11.63±5.18 to 19.65±4.74, whereas after 3 months and 6 months post ONL the scores were 21.69±3.88 and 24.79±3.27 respectively. There was significant improvement of VAS and JOA score in all 3 grades of disc prolapse.

Conclusion: ONL is a new, minimally invasive procedure done under local anaesthesia. It has shown effective results in the treatment of intervertebral disc herniation with minimal side effects

KEYWORDS : Ozone nucleolysis, MRI, Lumbar prolapsed intervertebral disc, JOA score

INTRODUCTION

Low back pain is an extremely common condition encountered in our day to day practice. It is defined as the pain between costal margins and gluteal folds. The prevalence rate of low back pain ranges from 22% to 65% in one year and the lifetime prevalence ranges from 11% to 84%.[1] For disc induced low back pain the modalities of treatment are conservative mainly consisting of nerve root block, epidural steroid injection, endoscopic discectomy, micro discectomy & classical laminectomy and discectomy.

Ozone is a tri-atomic oxygen molecule, O3, with a different molecular structure from oxygen. Its name is derived from the Greek word "ozein" meaning "to smell". Ozone nucleolysis is a minimally invasive procedure used in the treatment of hydrated contained disc herniation because of its property to break down the proteoglycan bridges in the nucleus pulposus of disc along with an anti-inflammatory action.[2] Ozone nucleolysis (ONL) is currently available such technique which has shown promise for the relief of herniated disc related back pain. It has gained popularity because of minimal invasiveness, low cost, reduced recurrences and fewer side effects. Success rate has been found to be 80%. Many stu dies have been published in the literature on the O_3 treatment of disc herniation with satisfactory results in selected cases.[3,4]

Ozone has a dose-related biological action. At high concentrations (30-70µg/ml 02), it may cause alterations of tissue structure, at medium concentrations (20-30µg/ml 02) it modulate immune system and low concentrations (<20µg/ml 02) it improves the microcirculation.[5] The dose of ozone is very much crucial and it should not exceed the capacity of antioxidant enzyme and glutathione to prevent production of the superoxide anion and hydrogen peroxide, which has membrane degradation property.[6] The specific feature of oxygen ozone therapy noted in disc specimens was dehydration of the fibrillary matrix of the nucleus pulposus and signs of regression (Vacuole formation and fragmentation) -a sort of disk "mummification".[7,8] This leads to disc shrinkage and decompression of nerve roots. Ozone also has an anti-inflammatory and analgesic effect which may further help to improve pain and function.

There are very few randomized control trials comparing ONL with other forms of conservative treatment for lumbar PIVD. ONL has shown success rate in the range of 65%-85% and complications as low as 0.1%. ONL has shown mixed results and no study actually predicts the functional improvement apart from pain. Most studies failed to clearly state the MRI grade of prolapse that actually responding to ONL. In this study we therefore tried to find out the efficacy of ONL in improving pain as well as function in patients suffering from lumbar herniated disc.

AIMS AND OBJECTS

To find out the efficacy of intra-discal Ozone nucleolysis in improving pain and function in patients suffering from lumbar prolapsed intervertebral disc

MATERIAL AND METHODS

This study was carried out after obtaining permission from Research Ethics Board between May 2016 to October 2017 in the Department of Physical Medicine and Rehabilitation (PMR), Regional Institute of Medical Sciences (RIMS), Imphal, Manipur. Fifty-four patients with low back pain due to lumber intervertebral disc prolapse were included in this study. The independent variable considered were age, sex, occupation, duration, marital status, BMI (Basal body mass), associated factors and MRI (Magnetic resonance imaging) confirmed diagnosis.

Inclusion criteria:

1. Low back and/or nerve root pain resistant to previous medical treatment for a period of not less than two months.
2. MRI: evidence of small and medium-sized herniated discs correlating with the patient's symptoms without degenerative disc disease
3. VAS score ≥ 5
4. Positive SLR(straight leg raising) test

Exclusion criteria:

1. Coagulopathy
2. MRI evidence of grade IV prolapse with symptoms of motor and/or sphincter disturbance
3. MRI showing spinal canal stenosis
4. Local and systemic infection
5. Current spinal fracture
6. Spinal deformity
7. G6PD deficiency
8. Uncontrolled diabetes
9. Pregnancy
10. Patient refusal

Procedure

The patient was taken to the operation theatre lying on prone position with a pillow under lower abdomen. The area was prepared and draped in sterile manner. The procedure was done usually under local anaesthesia. Single dose intravenous antibiotic ceftriaxone 1G given 30minutes before the procedure. The procedure was done under C-arm guidance. C-arm first focused to a pure anterior-posterior view to localise the diseased disc. Then C-arm was cranially or caudally tilted to obtain squaring of vertebra. Then C-arm was given an ipsilateral oblique tilt 25-40° such that that facet joint come at the centre of the end plates. On the side of maximum pain, the needle entry point was marked just lateral to the superior articular process near the centre of the disc. Local anaesthetic 2% Lignocaine (preservative free) is infiltrated, and then 22 G spinal needle was introduced with an 'end on view' into the diseased disc under fluoroscopic guidance. Radiopaque dye (Iohexol) is injected and position of needle tip was confirmed in AP & lateral view. The ozone oxygen mixture gas was collected from the ozone generator at a concentration of 30µgm ozone in a 20 cc syringe. Initial 10 to 15 cc is injected with needle placed just in front of midline. As Ozone gas is injected in the disc, the disc appears radiolucent and illuminated. Syringe was held in place under pressure for 10 min and after that the stylet is placed back. Then needle was removed and patient is advised bed rest for 2 hrs.

All patients were discharged on the same day evening, and were advised to gradually resume daily activity. All patients underwent follow-up examination at two weeks, one month, three months and six months after the procedure. Complications of post procedure were minimal and included transient muscle spasm and burning pain which resolved in 24 hrs. However one patient developed severe increase in back pain with fever. Provisionally diagnosed as a case of discitis post ozone nucleolysis, He was managed conservatively with antibiotics and rest. He was discharged with spinal immobilization and recovered from symptoms in later follow up at 6 weeks.

The outcome measures considered in this study were
1. Visual Analog Scale (VAS) 2. Japanese Orthopaedic Association (JOA) Clinical Symptom Score

1. Visual Analogue Scale (VAS)[9] for pain is a 100 cm horizontal line on which the patient's pain intensity is represented by a point between the extremes of "no pain at all" and "worst pain imaginable". The patient marks on the line the point that they feel represents their perception of their current state. The VAS score is determined by measuring in centimeters from the left hand end of the line to the point that the patient marks.

2. The Japanese Orthopedic Association (JOA) score[10] developed a score for evaluating patients with low back pain syndrome. This can be used to evaluate the patient initially and to measure the effect of interventions. Parameters are (1) lower back pain (subjective symptom), (2) leg pain and/or tingling (subjective symptom), (3) sensory disturbances (clinical sign), (4) motor disturbances (clinical sign). Higher the score less severe the syndrome.

Statistical analysis

Data was collected in a pre-tested proforma. Analysis was done using Statistical Package for the Social Sciences, SPSS 21 version. For descriptive statistics, mean and standard deviation was used. The paired t-test was used for detection of improvement of VAS pain and JOA score over time. ANOVA test was used to evaluate the improvement of VAS pain and JOA score in relation to various grades of MRI prolapse and p-value < 0.05 was taken as significant.

RESULT

Table 1 shows the baseline characteristics of the study participants. The study consisted of thirty-nine (39) males and fifteen (15) females. The mean age was found to be 37.70±13.38 years. The majority of the patients were from the age group of 26-35 years comprising of (29.6%) followed by the age group of 36-45 years accounting for (24.1%). Majority of the patients were Hindu by religion (81.48%) followed by Christians (14.81%). Majority of the patients in the study were labourers accounting to (33.3%) followed by housewives (22.2%). Most of them belong from urban area comprising of (55.6%) and most of them are married accounting (79.6%).

Table 2 shows smoking was the most common associated factor accounting (61.1%) followed by alcohol intake (22.2%), hypertension (7.4%) and trauma (5.6%). Majority of the patients came with grade 2 prolapse comprising (48.1%) followed by grade 1 (37.0) and grade 3 prolapse (11.1%). Most of the patients having chronic low back pain accounting (46.3%) and most of them are having normal BMI (61.1%) followed by (35.5%) overweight. (61.1%) patients presented with moderate VAS pain score followed by severe pain score (39.9%). None presented with mild VAS pain score.

Table 3 shows there was significant decrease in mean VAS score at 2 weeks (36.30±15.18), 1 month (27.96±12.94) , 3 months (22.80±11.22) and 6 months (13.88±5.96) post-ONL.

Table 4 shows there was significant decrease in mean JOA scores at 2 weeks (19.65±4.73), 1 month (20.52±3.73), 3 months (21.69±3.88) and 6 months (24.79±3.27) post-ONL.

Discussion

The mean age of patients were found to be 37 years which is in accordance with the study of Tiwari et[11] al who claimed that age ≥35 years have 9 times more risk as compared to age <35 years. Another study by Salvetti et[12] al showed that the maximum patients affected with low back pain were more than 46 years. This demarcation can be explained by degeneration of spine with increasing age.

Males were affected more than the female and among them labour

class of persons are more affected. In a study by Gupta G[13] et al 83% housewives were affected by low back pain. The difference of findings most probably because of males are engaged with more heavy works which consisting of heavy weight lifting, repeated bending, pulling which leads to more load in the spine.

Following intradiscal ozone nucleolysis, patients were followed-up for six months. A significant improvement was observed in the functional status of the patients and severity of pain was also significantly reduced. The reduction of VAS pain score from baseline to two weeks following treatment was 70.28±12.45 to 36.30 ± 15.18 and at three months and six months after treatment 22.80 ± 11.22 and 13.88±5.96 (based on 0 to 100 scale) respectively. Patil VS[5] et al also found significant improvement of VAS pain score after 2 weeks (7.58±0.86 to 2.75) and 3 months (2.41±1.74) after ozone therapy in their study based on 0 to 10 scale. .

Improvement of JOA score from baseline to two weeks following ONL was 11.63±5.18 to 19.65±4.74 and after 3 months and 6 months it was 21.69±3.88 and 24.79±3.27 which was significant. In the study of Das G[14] et al found that there was significant out come after two weeks and 3 months post ozone nucleolysis.

No early and late neurological complication has been reported following ONL. There was 75 to 80% success rate compared with other modalities. Injection can be repeated and there were no major side effects.

Ozone not only alleviates nerve root compression by reducing the size of the disc, it also helps to reduce venous stasis which is caused by compression of vessels and thereby improves the microcirculation and oxygen supply. The reduction of pain also associated with neuronal hypoxia. Ozone has analgesic and anti-inflammatory effects as it inhibits synthesis of proinflammatory prostaglandins, release of bradykinins. Ozone also exerts antagonistic property against proinflammatory cytokines.

Nowadays, ozone therapy is a genuine alternative treatment method in discogenic low back pain. It has been found in various literatures that up to 85% of disc surgeries can be avoided with these non-surgical interventions. Success rate is about 88% which is comparable to surgical discectomy (50% to 90%). Complications are remarkably low and much less than any other surgery.

There are several study limitations. Small numbers of subjects were included in the study and the follow up period was also short. The effectiveness of ozone therapy was not compared with the other standard treatment modalities. Further studies may be needed to compare the effectiveness of ozone therapy with standard treatment protocol to observe the long term benefit of ozone nucleolysis for discogenic low back pain.

CONCLUSION

Ozone nucleolysis is a new, minimally invasive procedure done under local anesthesia. It has shown effective results in the treatment of intervertebral disc herniation with few side effects. Ozone therapy is a good alternative to treat lumbar disc herniation which are failed to respond to any conservative management. More over in our study we found that ozone therapy has long term beneficial effect compare to other conservative management.

ANNEXURE

Table 1: Table showing background characteristics of the study participants

Characteristics		Frequency	Percentage
Age (in years)mean±(SD)		37.70±13.38	
Age group (in years)	15-25	9	16.7
	26-35	16	29.6
	36-45	13	24.1
	46-55	11	20.4
	56-65	4	7.4
	66-75	1	1.9
Gender	Male	39	72.2
	Female	15	27.8
Religion	Hindu	44	81.48
	Muslim	2	3.70
	Christian	8	14.81
Occupation	Labour	18	33.3
	House wife	12	22.2
	Cultivator	2	3.7
	Student	6	11.1
	Teacher	5	9.3
	Defence personal	3	5.6
	Others	8	14.8
Domicile	Rural	24	44.4
	Urban	30	55.6
Marital status	Married	43	79.6
	Unmarried	11	20.4

Table2. Table showing baseline charecterisrics of the study participants

Characteristics		Frequency	Percentage (%)
Duration	Acute	17	31.5
	Sub-acute	12	22.2
	Chronic	25	46.3
MRI grade	Grade 1	20	37.0
	Grade 2	26	48.1
	Grade 3	8	14.9
BMI grade	Under weight (<18.5)	2	3.7
	Normal weight (18.5-24.99)	33	61.1
	Over weight(25.00-27.99)	19	35.2
VAS	Mild (0-3)	0	0
	Moderate (4-7)	33	61.1
	Severe (8-10)	21	39.9

Table 3: Mean VAS at baseline, 2 weeks, 1 month and 3 months after treatment

VAS score	Baseline	2 weeks	1 month	3 month	6 month	p value
	70±12.45	36.30±15.18	27.96±12.94	22.80±11.22	13.88±5.96	<0.00

Table 4: Mean JOA score at baseline, 2 weeks, 1 month and 3 months after treatment

JOA score	Baseline	2 weeks	1 month	3 month	6 month	p value
	11.63±5.19	19.65±4.73	20.52±3.73	21.69±3.88	24.79±3.27	<0.00

Table 5: Correlation between mean VAS pain improvement with MRI grading of prolapsed disc at 2 weeks, 1 month and 3 months after treatment

VAS score	Baseline	2 weeks	1 month	3 month	6 month	p value
MRI Grade 1	64.50±13.56	30.25±14.37	23.00±12.18	17.55±8.52	12.50±4.44	<0.001
MRI Grade 2	74.61±9.89	41.34±14.80	31.92±11.66	27.69±12.10	15.38±7.06	<0.001
MRI Grade 3	70.62±12.65	35.00±14.14	27.50±15.81	20.00±7.55	12.50±4.62	0.001

Table 6: Correlation between mean JOA score improvement with MRI grading of prolapsed disc at 2 weeks, 1 month and 3 months after treatment

JOA score	Baseline	2 weeks	1 month	3 month	6 month	p value
MRI Grade 1	10.60±5.32	18.80±6.24	19.95±4.51	21.35±4.36	24.30±4.09	<0.001
MRI Grade 2	12.07±5.04	20.07±3.71	20.73±3.45	21.53±3.85	24.84±2.97	<0.001
MRI Grade 3	12.75±5.54	20.37±3.37	21.25±2.43	23.00±2.61	25.87±1.35	0.001

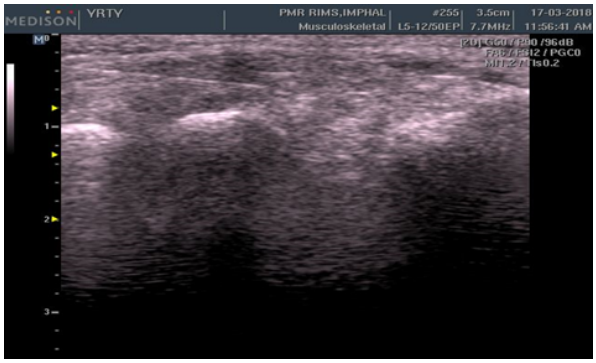

Figure 1: Ultrasound image showing needle position

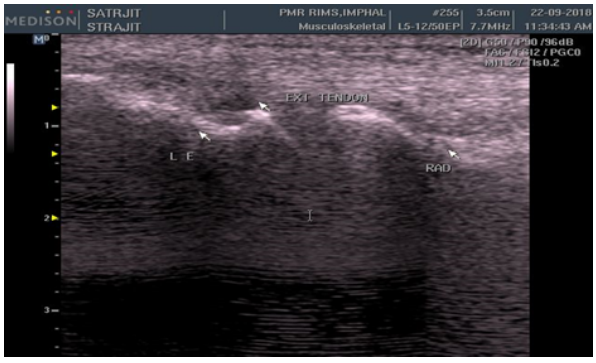

Figure 2: Ultrasound image of lateral epicondyle

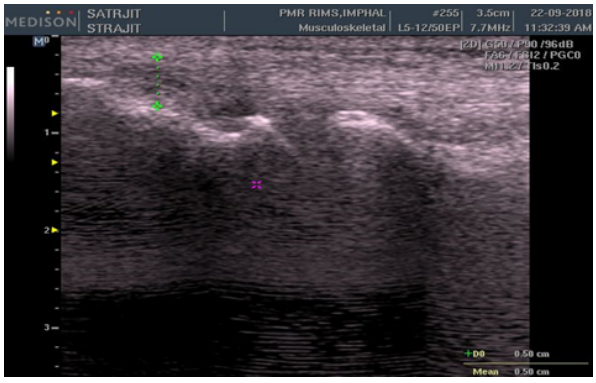

Figure 3: Measurement of tendon thickness

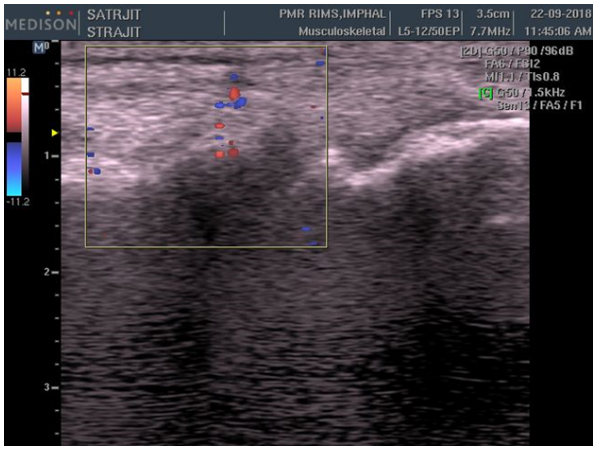

Figure 4: Ultrasound image showing neovascularization

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