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Research Paper

Treatment of herniated lumbar disc by percutaneous laser disc decompression combined with synchronous suction technique through syringe

Dhir B. Gurung[a], Gaojian Tao[b], Hongyi Lin[b], Yanning Qian[a], Jian Lin[b,*]

[a]*Department of Anesthesia, the First Affiliated Hospital of Nanjing Medical University, Nanjing 210029, China;*
[b]*Department of Pain management, Drum Tower Hospital, Nanjing, 210008, China*

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Abstract

Objective: To compare the outcomes of percutaneous laser disc decompression (PLDD) and PLDD with synchronous suction through syringe in the patients with herniated lumbar disc(HLD). **Methods**: Forty-two patients with HLD on MRI and those who did not respond to conservative treatment for 6 weeks were randomly divided into group A and group B. In group A, the patients were treated with PLDD and those in group B with PLDD and synchronous suction through syringe. GaAIAS diode laser at 810 nm was used for the ablation in both groups. The treatment effect was evaluated by modified MacNab's criteria on the 7th, 30th and 90th day. **Results**: Evaluated by modified MacNab's criteria, the percentages of the excellent and good cases in total patients treated for group B and A were 80.95% and 57.14% on the 7th follow-up day, 85.71% and 66.67% on the 30th follow-up day, and 95.24% and 71.43% on the 90th follow-up day, respectively. **Conclusion**: Synchronous suction technique through syringe during PLDD improves the overall outcome in the treatment of herniated lumbar disc.

Keywords: percutaneous laser disc decompression; herniated lumbar disc; synchronous suction

INTRODUCTION

Minimally invasive treatment combined with a well-tolerated, low-cost procedure in the treativent of HLD (hemiated lumbar disc) has been developed to offer good clinical results . Percutaneous laser disc decompression (PLDD) is one of the minimally invasive treatments currently available. The role of PLDD for the treatment of contained herniation has been widely assessed[1-3]. Choy first reported PLDD in 1984 for minimally invasive therapy of lumbar disk hernia[4,5]. Lasers vaporize a small portion of the intervertebral disk, thereby reducing the volume and pressure of the affected disk.

Successful rates of PLDD in larger studies vary from 75% to 87%[6,7]. Because of insufficient improvement of symptoms or recurrent herniation, 4.4% to 25% of the patients received additional surgical treatment[2,3]. In order to increase the therapeutic effect of PLDD we combined PLDD with synchronous suction through syringe. The aim of this study was to compare the outcomes following PLDD and PLDD with synchronous suction through syringe.

Materials and methods

Patients

From April 2005 to April 2006, 42 patients (26M, 16F, 21-77 years old) with diagnosis of herniated lumbar disc(HLD) were enrolled in the study. Demographic data about the patient was given in ***Tab 1***.

Patients were included if they had image-documented contained HLD, radiculopathy of affected disk hernia and no improvement after six-week conservative therapy. Patients were excluded if they had previous surgery at the indicated level, disc extrusion, and spinal stenosis.

Signed consent was obtained from each patient.

*Corresponding author.
E-mail address: linjian419@hotmail.com.

Tab 1 **Demographic data about the patient**

	Group B	Group A
Number	21 (13 males, 8 females)	21 (13 males, 8 femals)
Age rangeyrs	21-77 (mean 47.6 yrs)	23-69 (mean 49.1 yrs)
Disc treated: total	30	33
L3-4	6	6
L4-5	15	16
L5-S1	9	11

Enrolled patients were randomly divided into two treatment groups. The patients in group A were subjected to PLDD therapy, and those in group B treated with PLDD combined with synchronous suction through syringe.

In group A, the patient was placed in prone position on CT table. In order to open up the posterior aspect of the disk space, a soft pillow was positioned under the abdomen of each patient to place the lumbar spine in a semi-flexed position .The puncture point and the pathway were determined by CT scanning. Following infiltration with 2% lidocaine, a 15 cm, 18-gauge needle was inserted 8 cm deer in the midline, pointing toward the centre of the disc. When the needle was in place, its correct position was verified by CT imaging. After removal of the stylet of the needle, 400 nm optical fiber was inserted into the disc. The laser procedure, delivered from 810 nm GaAIAs diode laser machine (Surgi-Las, Sino-Germany joint venture Lingyun photoelectronic system Co; Ltd) was initiated with 10 watts, 1000 ms pulses and, 5-10 seconds intervals depending on patients comfort(***Fig 1***).

In group B, the laser procedure was combined with the aspiration of gas, evolved during laser ablation. 10cc syringe connected to a Y-connector was used for this purpose. Aspirate untill slight resistance was met and continue to aspirate through out the entire procedure untill the needle was pulled out of the target disc. All operations were performed by the same doctor(***Fig 2***).

Postoperative treatment

After operation, patients were advised to take strict bed rest for 1 day, and semi-bed rest for 3 days. All patients received mannitol and antibiotic therapy for 3 days. Patients were instructed to avoid heavy lifting, heavy exercises and long time sitting or standing for 3 months. All patients underwent follow-up examinations on the 7^{th}, 30^{th}, and 90^{th} day.

Outcome measurements

Clinical outcome was assessed on 7^{th}, 30^{th}, 90^{th} day after treatment by modified MacNab's criteria (***Tab 2***)[8,9]. We used single-blind method, i.e. people who did evaluation of outcomes were blind to patient distribution between the two groups.

Tab 2 **Modified MacNab´s criteria for assessing clinical outcomes**

Outcome	Descriptions
Excellent	Disappearance of symptoms
	No restriction of mobility
	Able to return to normal work and activities
Good	Occasional episodes of pain
	No limitation of occupational activities
	No need of drugs to ease pain
Fair	Improvement of symptoms
	Intermittent episodes of pain limiting daily activities
	Require drugs to ease pain
Poor	No improvement of symptoms, medication abuse

Statistical analysis

Statistical analysis was performed by using logistic regression with time as covariance. A value of $P<0.05$ was considered statistically significant.

Results

A total of 42 patients were enrolled in this study. The patient population was predominantly male (61.9%). Evaluated by modified MacNab's criteria, the numbers of the excellent and good cases in group B and A were 17(80.95%) and 12(57.14%) on the 7^{th} follow-up day, 18(85.71%) and 14(66.67%) on the 30^{th} follow-up day, and 20 (95.24%) and 15 (71.43%) on the 90^{th} follow-up day, respectively. Treatment outcomes of the patients were shown in ***Tab 3***.

Tab 3 **Treatment outcomes**

Follow-up day	Group	No of cases	Success cases	Success rate (%)
7^{th}	B	21	17	80.95
	A	21	12	57.14
30^{th}	B	21	18	85.71
	A	21	14	66.67
90^{th}	B	21	20	95.24
	A	21	15	71.43

Complications

Almost all patients had local pain at puncture site that was more significant (lasting more than 2 weeks) in 3 patients of group A. 2 patients in group A and 1 patient in group B showed minimal or no improvement on follow-up and required surgery.

DISCUSSION

Percutaneous removal of the nucleus pulposus of

an intervertebral disc has been performed by a variety of chemical and mechanical techniques [10-14]. Choy and colleagues pioneered PLDD in 1984 [4,5]. The treatment principle of PLDD is based on the concept of the intervertebral disk being a closed hydraulic system. This system consists of nucleus pulposus, containing a large amount of water, surrounded by inelastic annulus fibrosus. An increase in water content of the nucleus pulposus leads to a disproportional increase of intradiscal pressure. Experiments in vitro have shown that an increase of intradiscal volume of only 1.0 mL can cause the intradiscal pressure to rise by as much as 312 kPa (2340 mm Hg)[15]. On the other hand, a decrease of intradiscal volume causes a disproportionally large decrease in intradiscal pressure. The radicular pain that characteristically accompanies lumbar disk herniation is the result of nerve root compression or stimulation by the herniated portion of nucleus pulposus. A reduction of intradiscal pressure causes the herniated disc material to recede toward the center of the disc, thus leading to reduction of nerve root compression and radicular pain. In PLDD, this mechanism is exploited by application of laser energy to evaporate water in the nucleus pulposus. Apart from evaporation of water, the increase in temperature also causes protein denaturation and subsequent renaturation. This causes a structural change of the nucleus pulposus, limiting its capability to attract water and therefore leading to a permanent reduction of intradiscal pressure by $\leqslant 57\%$[15].

A small amount of tissue is ablated from the nuclear part of the disc, which is believed to exert an effect on a noncontiguous portion of nucleus that is

Fig 1a group B PLDD with negative suction disc puncture under CT control

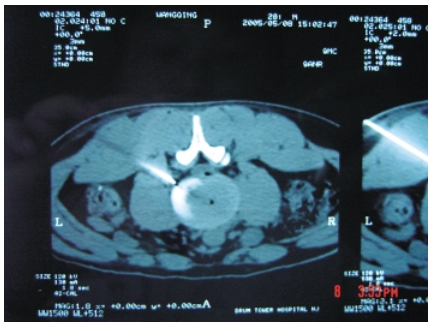

Fig 1b group B PLDD with negative suction reduction of herniation, gas inside disc

Fig 1c group B PLDD with negative suction gap between herniated disc and dura sac

Fig 2a group A PLDD disc puncture under CT control

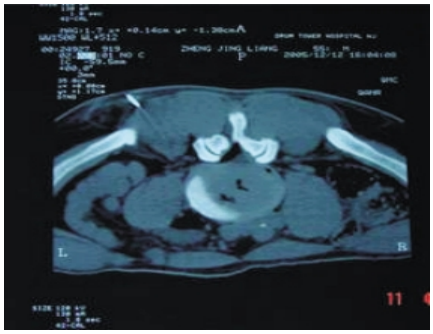

Fig 2b group A PLDD laser vaporization, gas inside disc herniation

protruding through the annulus fibrosus. The cavity created by laser is believed to allow the proturded muclear to move back within the disc.

Choy and Altman in 1995 reported greater than 50% reduction of intradiscal pressure in response to load following treatment with 1000 j of Nd:YAG laser energy[16].

We assume that suction during PLDD procedure results in further reduction of intradiscal pressure, which allows herniated disc material to come back more rapidly within the disc. But in this study intradiscal pressure was not recorded before, during and after suction since the instrument was not available. However, the CT scan done immediately after the procedure proved our assumption. Significant reduction of herniation immediately after PLDD was detected and gap between the reduced herniated disc and dura sac was observed in patients treated with PLDD combined with synchronous suction.

In this study, we can say that the difference in the outcomes between two the groups was statistically significant (P=0.004). We can see the outcome of group B was better than that of group A. Although the results remain encouraging, the widespread integration of this technique into clinical practice does, however, await the completion of large-scale comparative outcome studies.

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