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Review

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PERCUTANEOUS LASER DISK DECOMPRESSION- OUR EXPERIENCE WITH THE USAGE OF THE DIODE LASER

Krešimir Rotim, Robert Saftić, Goran Lakičević

Department of neurosurgery, University hospital Sestre milosrdnice,
Zagreb, Croatia

Summary

Introduction: PLDD (Percutaneous laser disk decompression) is a safe, non-destructive and successful surgical treatment for lumbar disk herniation. The purpose of this study was the evaluation of advantages in the procedure of percutaneous laser disk decompression in the treatment of lumbar disk herniation in comparison to open surgical methods on lumbar disk herniation like microdisectomy.

Patients: From June 2008 till July 2009 in the Clinical hospital "Sister of Mercy" Zagreb 91 patients have been treated with percutaneous laser disk decompression and 125 patients have been treated with microdisectomy.

Methods: The percutaneous laser disk decompression is done with the usage of a diode laser (LASE maR 1000), intensity of 1000 j, power 12 W and wave length 980 nm. Open surgical methods for lumbar disk herniation are performed with the surgical technique microdisectomy. The input criterion for the research was the adulthood of the examinee and advanced herniation of the intervertebral disk in the lumbar spine, which needed surgical treatment. The analysed parameters were: success of the surgical treatment; relapsing lumbar disk herniations; postsurgical complications; postsurgical stay in the hospital; time needed to return to every-day activities. The data achieved with the analyses of input and output parameters have been compared with the help of the MacNab criteria. There have not been found any statistically significant results in the comparison of data for age, sex and the stage of intervertebral disk herniation in both groups. This is a retrospective research and lasted 12 months.

Results: Patients treated with the percutaneous laser disk decompression had in 89,6 % (n=81) very good or excellent results and were satisfied with the success of the treatment. In the group of patients treated with microdisectomy the number of patients,

Corresponding author: Robert Saftić
e-mail: robert.saftic@gmail.com

which had very good or excellent results, is minor and numbers 81,2% (n=101). Postsurgical complications appeared in 2,5% (n=2) in the group of patients operated with percutaneous laser disk decompression. One patient had another percutaneous laser disk decompression and another patient had a MET-Rx interlaminectomy. In the group of patients treated with microdisectomy, the number of patients, where complications appeared, is higher and numbers 6,5% (n=8). As the research moved on the frequency of percutaneous lumbar disk decompression increased, so that this surgical method has been the most present in the last months of the research, while the presence of the microdisectomy was gradually decreasing.

Conclusion: The results of the conducted research have affirmed the comparative advantages of contemporary surgical methods in treating lumbar disk herniation in reference to classical treating methods.

Key words: disk decompression; percutaneous; laser; diode laser; intervertebral disc disease; chronic low back pain; disc herniation; disc protrusion; radiculitis; contained disc herniation.

INTRODUCTON

Mechanism of the inception of intervertebral herniation on the lumbar disk

In the process of statodynamic load on the spinal column, the intervertebral disk changes its shape, which has a very important role in the amortisation of load in the craniocaudal way. But an excessive static or dynamic load, leads to a disk deformation with a lateral protrusion and it is possible that an intervertebral disk herniation occurs.

By the younger population, the nucleus pulposus is clearly demarcated from the annulus fibrosus. But bin older age this delimitation gradually disappears and the lateral section gets an uniform structure. In the ageing process the fibrosus threads are becoming thinner and less elastic, so fractures in the annulus fibrosus can occur. This leads to a decrease of ability of the annulus fibrosus for fixating the nucleus pulposus, so that by major loads the gelatinous mass of the nucleus pulposus can rupture the annulus fibrosus. The disk also loses its ability to bind water, so that its amount is being reduced to even 70 %.

The nucleus pulposus does not have its own nerve endings so that nucleus pulposus injuries do not cause pain, except when nerve endings in the annulus fibrosus are irritated.

From the phatomorphological point of view the development phases of the inception of intervertebral herniation on the lumbar disk can be divided into three stages.

The first stage is the protrusion of the nucleus pulposus. The disorder of accepting and binding water causes a decrease of the water content, loss of elasticity and nucleus pulposus softening. Further, the nucleus pulposus dilapidates into many parts, so it can be told that it is a aseptic necrosis of the nucleus pulposus. The increase of the hydrostatic pressure conditions the anomalous force transmission towards periphery, with an emphatically load of the annulus fibrosus in which fractures develop. Because of the increased pressure inside the nucleus, the degenerative parts of the nucleus pulposus are injected into these fractures, and so develops the intervertebral disk protrusion.

The second and third stages are prolaps and extrusion of the nucleus pulposus. In this stage, the degeneration of the nucleus pulposus is even more noticeable and leads to denaturation and loss of elasticity. The integrity of the annulus fibrosus is disrupted, and the rear longitudinal connection wanes (*lig. Longitudinal post.*), so that the disk protrudes even more to the spine.

Depending on the disruption of the integrity of the annulus fibrosus we speak about prolaps, when the annulus structure is only partially disrupted, or we speak about extrusion of the intervertebral disk, when the annulus is completely ruptured.

There are three stages of indications for a surgical treatment:

Urgent indication exists in the caud equina syndrome with a urinary bladder and rectum disorder. Absolute indication is based on three indicators:

Existence of paresis of some muscles or muscle groups, and especially after a long period of pain, when the pain suddenly disappears and nerve root paresis simultaneously develops

Existence of intense radicular pain (radiculitis), which is not reduced in spite of conservative treatment with a radiologically proven intervertebral disk herniation

Existence of frequently returned low backache with a radiologically proven impaction of neural roots.

A relative indication occurs by patients with a nerve roots injury which is proven by clinical, radiological and other examinations, by patients with persistently occurring low backache and sciatica, with senses disorder or weakened reflexes, and patients with transient improving after conservative treatment.

A special problem are relapsing lumbar disk herniations on the same or on a new level, immediately after the first surgery or some time after the first surgery.

By analysing patients with relapsing disk herniation we note that the cause for the repeated difficulties can be adhesion, osteochondrosis or stenosis of the vertebral column with a new herniation of the disk material.

Through the last decade the world's leading neurosurgeons have realised the imperfection of classical surgery methods and they are trying to introduce surgery methods with a minimal damage on the neuromuscular structures on the spine during the surgery. This leads to a development of minimally invasive neurosurgical methods on the spine. Minimally invasive neurosurgical spine surgeries include neuromodulating procedures, percutaneous intradiskal decompression surgeries, and the so called "key-hole" spine surgeries. The realisation of these surgeries imply excellent knowledge of the spinal column neuroanatomy, detailed surgery planning of neurosurgeon and constant usage of the fluoroscopic control (RTG-device). Because of the above mentioned conditions and according to the world's literature data, a small number of neurosurgeons does the minimally invasive neurosurgical treatment.

PLDD (Percutaneous laser disk decompression) is a safe, non-destructive and successful surgical treatment for lumbar disk herniation. The first percutaneous laser disk decompression was done by Peter Ascher and Daniel Chay in February 1986. PLDD is based on the use of laser beams of the Hd:Yag laser, intensity 1000 j. This surgery is based on many basic principles, which include the reduction of intradiskal mass and decrease of intradiskal pressure by using appropriate laser devices. This is achieved by applying central vaporisation of the nucleus pulposus, adequate annular fenestration and neuromodulation. Percutaneous lumbar disectomy is indicated by patients, who have disk herniation inside the annulus fibrosus or under the rear longitudinal ligament.

A very important characteristic of the minimally invasive surgery methods or lumbar disk herniation and especially for percutaneous laser disk decompression is the realisation under local or spinal anaesthesia, while classic methods are done under general endotracheal anesthesia which aggrandises the surgical risk for patients and contributes to major postsurgical complications. Also, after minimally invasive surgical methods for lumbar disk herniation, especially after percutaneous laser disk decompression, the postsurgical stay in a hospital is significantly shortened (one day), there is also a significantly minor blood loss, which is important for older patients and patients with cardiorespiratory diseases, and the scars are also minor. Patients treated with minimally invasive methods, especially percutaneous laser disk decompression, are faster capable for physical rehabilitation and return to every-day activities. From the economic point of view and considering the reasons of the above mentioned part, contemporary surgical methods for lumbar disk herniation significantly contribute to the decrease of treatment expenses. This is generally very important for health services, considering the data that patients with discoradicular conflicts and low

backache syndrome are a big part of the population which uses health services. Until 2008 there were no realisations of the above mentioned surgical methods in Croatia. Only after the return of leading Croatian neurosurgeons from a training in the USA, minimally invasive methods for lumbar disk herniation are being done in Croatia and experience their full success in the Clinical hospital "Sestre Milosrdnice" in Zagreb. Besides that, the Clinical hospital "Sestre Milosrdnice" in Zagreb is the only health centre in Croatia and the region where minimally invasive surgical methods for treating lumbar disk herniation are being done.

Purpose

The purpose of this study was the evaluation of advantages in the procedure of percutaneous laser disk decompression in the treatment of lumbar disk herniation in comparison to open surgical methods on lumbar disk herniation like microdisectomy. Having access to the world's neurosurgery literature we have found out that the percutaneous laser disk decompression is becoming an appropriate substitute for microdisectomy in surgical treatments of patients in cases of lumbar disk herniation.

Material or subjects

From June 2008 till July 2009 in the Clinical hospital "Sister of Mercy" Zagreb 91 patients have been treated with percutaneous laser disk decompression and 125 patients have been treated with microdisectomy.

Outcome Measures: With this article we try to represent our experiences and results, which we have achieved by treating patients with lumbar disk herniation with PLDD procedures in contrast to patients treated with microdisectomy.

Methods

The percutaneous laser disk decompression is done with the usage of a diode laser (LASE maR 1000), intensity of 1000 j, power 12 W and wave length 980 nm. Open surgical methods for lumbar disk herniation are performed with the surgical technique microdisectomy. The input and output criteria were the same for both groups of patients.

The input criterion for the research was the adulthood of the examinee and advanced herniation of the intervertebral disk in the lumbar spine, which needed surgical treatment. Examinees with incomplete medical documentation, patients who continued their treatment in another hospital, and patients who were

not controlled in the Clinic for neurosurgery “Sestre Milosrdnice” in Zagreb, were excluded from the research.

The analysed input parameters were: number of operated patients with lumbar disk herniation; age and sex of the examinees; level of the intervertebral disk herniation; way of radiological diagnosis; way of surgical treatment; duration of the surgery.

The analysed parameters were: success of the surgical treatment; relapsing lumbar disk herniations; postsurgical complications; postsurgical stay in the hospital; time needed to return to every-day activities.

Parameters in the criteria for the evaluation of the success of surgical treatments are based on the number and time of postsurgical control checkups, and the state of every single examinee was determined by clinical checkups, insight to medical documentation and the method of oral or written opinion.

The data achieved with the analyses of input and output parameters have been compared with the help of the MacNab criteria. There have not been found any statistically significant results in the comparison of data for age, sex and the stage of intervertebral disk herniation in both groups. This is a retrospective research and lasted 12 months.

Results

Patients treated with the percutaneous laser disk decompression had in 89,6 % (n=81) very good or excellent results and were satisfied with the success of the treatment. In the group of patients treated with microdisectomy the number of patients, which had very good or excellent results, is minor and numbers 81,2% (n=101). Postsurgical complications appeared in 2,5% (n = 2) in the group of patients operated with percutaneous laser disk decompression. One patient had another percutaneous laser disk decompression and another patient had a MET-Rx interlaminectomy. In the group of patients treated with microdisectomy, the number of patients, where complications appeared, is higher and numbers 6,5% (n=8). As the research moved on the frequency of percutaneous lumbar disk decompression increased, so that this surgical method has been the most present in the last months of the research, while the presence of the microdisectomy was gradually decreasing.

The average surgery duration of microdisectomy patients was 52, 0±5 minutes and was statistically significantly longer than 25, 0±7 minutes what is the average PLDD surgery duration.

The average hospital treatment time by microdisectomy patients was 3, 0±5 days and was statistically significantly longer than the average hospital treatment time for PLDD patients which was 1, 0±3 days. The average recovery time needed to return to every-day activities by microdisectomy patients was 45, 0 ±20 days and was statistically significantly longer in comparison to the average recovery time of PLDD patients which is 12, 0±0 days.

Conclusion

The percutaneous laser disk herniation is a safer, more simple and more effective method in treating patients with lumbar disk herniation in relation to open methods of treating lumbar disk herniation like microdisectomy.

The advantages of the contemporary treatments by intervertebral disk herniation by using PLDD are manifested in shorter surgeries, better success of the treatment, shorter postsurgical stay in a hospital, and a faster beginning with the physical treatment, minor number of relapsing herniations and postsurgical complications, and the patients' faster return to every-day activities.

The results of the conducted research have affirmed the comparative advantages of contemporary surgical methods in treating lumbar disk herniation in reference to classical treating methods.

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Sažetak

Perkutana laser disk dekompresija – naša iskustva s upotrebom diodnog lasera

PLDD (Perkutana laser disk dekompresija) siguran je, nedestruktivan i uspješan kirurški zahvat kod lumbalne diskus hernije. Cilj ove studije je bio evaluacija prednosti procedure perkutane laser disk dekompresije u tretmanu lumbalne diskus hernije naspram otvorenih operacijskih metoda slabinske diskus hernije tipa mikrodiskektomije.

Od lipnja 2008.god do srpnja 2009 god. u Kliničkoj bolnici Sestara milosrdnica, 91 bolesnik je tretiran uz pomoć perkutane laser disk dekompresije i 125 bolesnika tretiranih uz pomoć mikrodiskektomije.

Perkutana laser disk dekompresije sec.Choy je rađena uz uporabu diodnog lasera (LASE maR 1000) jačine 1000 j, snage 12 W i valne duljine 980 nm. Kriterij uključivanja u istraživanje bio je odrasla životna dob ispitanika i uznapredovala hernijacija intervertebralne ploče slabinske kralježnice, koja je zahtijevala kirurško liječenje. Analizirani izlazni parametri bili su: uspješnost operacijskoga liječenja; recidivirajuće slabinske diskus hernije; poslijeoperacijske komplikacije; dužina poslijeoperacijskoga boravka u bolnici; vrijeme potrebno za povratak svakodnevnim aktivnostima. Podatke dobivene analizom ulaznih i izlaznih parametara smo uspoređivali uz pomoć Macnab kriterija. Usporedbom podataka za dob, spol, razinu hernijacije intervertebralne ploče u obje skupine bolesnika nisu nađeni statistički značajni rezultati. Ovo je retrospektivno istraživanje u trajanju od 12 mjeseci.

Bolesnici kojim je urađena perkutana laser disk dekompresija su u 89,6% imali dobre ili odlične rezultate i bili su zadovoljni uspjehom liječenja. U skupini bolesnika tretiranih uz pomoć mikrodiskektomije broj bolesnika koji su imali dobre ili odlične rezultate nakon operacijskog zahvata i bili zadovoljni uspjehom istog je manji i iznosi 81,2%. Poslijeoperacijske komplikacije su se pojavile kod 2,5% bolesnika operiranih perkutanom laser disk dekompresijom. Od toga je jedan bolesnik ponovno operiran perkutanom laser disk dekompresijom a drugi uz pomoć MET-Rx interlaminektomije. Broj bolesnika sa komplikacijama kod kojih je rađena mikrodiskektomija je znatno veći i iznosi 6,5%.

Kako je istraživanje odmicalo učestalost se perkutane lumbalne dekompresije diska povećavala, tako da je ova operacijska metoda bile najzastupljenija u zadnjim mjesecima istraživanja, dok se učestalost mikrodiskektomije postupno smanjivala.

Rezultati provedenoga istraživanja afirmirali su komparativne prednosti suvremenih operacijskih metoda liječenja slabinske diskus hernije u odnosu na klasične metode liječenja.

Ključne riječi: dekompresija diska; perkutani laser; diodni laser; bolest intervertebralnog diska; sindrom bolnih križa; hernijacija diska; protruzija diska; radikulitis; ispučjenje intervertebralnog diska.