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LUMBAR DISK HERNIATIONS - CLINICAL STATUS, DIAGNOSIS, IMAGING, SURGICAL TREATMENT AND GLOBAL OUTCOME

A comprehensive study of 1000 consecutive cases treated in two neurosurgical centers.

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Abstract

Surgery for lumbar disk herniation (LDH) is one of the most frequently performed surgical interventions worldwide. In the United States alone, low back pain and implicitely LDH are considered to be the second most frequent cause of consulting the general practitioner. The authors present their personal experience of 1000 surgical interventions for lumbar disk herniations, consecutively diagnosed and treated in 2 university neurosurgical centers between January 2009 and January 2014. We excluded the patients who were treated or diagnosed in other hospitals. The age of the patients ranged between 18 and 65 with a mean age of 44. The male patients represented 53.7% of all the patients (537 cases) while females accounted for 46.3% of the population with 463 cases. The follow up period ranged between 4 months and 5 years averaging 3.9 years. In all the studied cases we noticed the presence of low back pain and inferior limb irradiation in 863 cases (86.3%). Motor defficit was noticed in 589 cases (58.9%). Lasegue's sign was noticed in 764 cases (76.4%); sensory defficit was noticed in 853 cases (85.3%). Cauda equina syndrome (which is a neurosurgical emergency) was diagnosed in 42 cases. (4.2%). All the cases were preoperatively examined using Computed Tomography (CT) and Magnetic Resonance Imaging (MRI). We noticed lumbar disk herniations at the level of L5-S1 in 614 cases (61.4%); L4-L5 disk herniations were present in 357 cases (35.7%). In 29 cases (2.9%) we noticed multiple disk herniations and other-level disk herniations. Intraoperatively the authors used C-ARM Roentgen imaging for the correct identification of the lesion and the spinal level. All the cases were operated using the same official protocol – microsurgical discectomy, with the resection of the herniated disk and the decompression of the neural elements with the preservation of the spinal anatomy and functionality. Postoperatively, the authors decided whether to use an epidural drainage of the surgical wound for 24 hours. The patients were discharged after 72 hours postoperatively and kinesitherapy was begun. The postoperative results recorded after 4 months were qualified as excellent in 298 cases (29.8%), very good in 463 cases (46.3%), good in 146 cases (14.6%), acceptable in 75 cases (7.5%), with a moderate defficit in 18 cases (1.8%), and no case remained with a severe defficit. Open microsurgical discectomy with the complete resection of the degenerated or herniated disk fragments is a time-proven technique with reduced morbidity and very good results which allows the patient to begin physical rehabilitation as soon as possible.The major concern of the neurosurgeons is the rate of relapse for this pathology and discitis which requires a long therapy which is hard to accept by the patients. Under these circumstances, the authors advocate that

classical microsurgical discectomy is the best therapeutical option available for lumbar disk herniation. Neurorehabilitation is a crucial step in the postoperative period and such facilities should be at the disposal of any neurosurgical center involved in the treatment of lumbar disk herniations.

Keywords: *Lumbar disk herniation, microdiscectomy, MRI, CT, outcome, neurorehabilitation.*

Introduction

Lumbar discectomy is the most common surgical intervention performed by neurosurgeons on the spine[1]. In the United States of America, Lumbar Disc Herniation (LDH) occurs in approximately 40% of the active population, around the third or fourth decade of life.[2,3,4] Approximately 95% of all lumbar disc herniations occur at the level of the L5-S1 or L4-L5 vertebras, quickly followed by a percentage of approx. 5% at the level of L3-L4. Other locations in the lumbar spine (L1-L2 or L2-L3) are considered to be rare.[5]

LDH usually appear in active individuals, generally around the age of 30. Most of the times, the patients answer positively when asked about doing repetitive and/or heavy lifting, twisting, playing strenous sports or, quite the opposite, they may have a sedentary behavior without any physical activity whatsoever. Such patients are usually overweight, heavy smokers and work in offices in front of computers. Smoking, obesity and lack of physical activity are risk factors constantly connected to lumbar disk hernias.[4,5]

Materials and Methods

Regarding local anatomy, the fibrocartilaginous intervertebral discs are attached superiorly and inferiorly to vertebral bodies. At their anterior and posterior poles the intervertebral discs are reinforced by the anterior longitudinal ligament and the posterior longitudinal ligament. The intervertebral discs are responsible for the support of 60% of all the compressive loads on the spine.[4,5] Intervertebral discs are composed of an outer ring-like structure made of 10-15 layers of fibrocartilage which is called the *anulus fibrosus* (fibrous ring) and an inner elastic and semiliquid core named the *nucleus pulposus.*

The pathophysiological mechanism of LDH starts with the degeneration of the intervertebral discs which become dehydrated. The main cause of this problem is usually physical (repetitive movements, heavy lifting, obesity) but chemical compounds from cigarettes also play a crucial part.[6] Thus, the nucleus pulposus (the jelly-like core of the intervertebral discs) begins to lose its elasticity. The degenerative process continues and usually some fibers in the *annulus fibrosus* get torn – generating a disc protrusion. As the process advances, the *annulus fibrosus ruptures* completely and the *nucleus pulposus* may pass through the rupture to position itself against the *ligamentum flavum* or to become free in the spinal canal – this is called an extrusion. (See Figure 1)

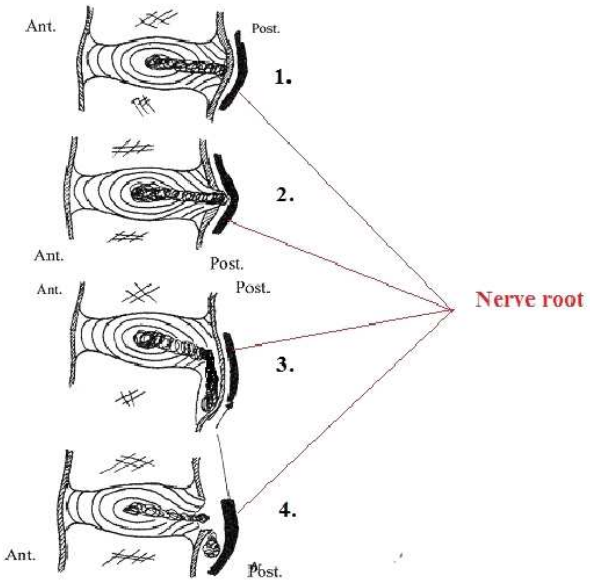

Figure 1 - Evolution of lumbar disc herniation. 1. Lumbar disc bulging about to extrude through the annulus fibrosus, 2. Lumbar disc extrusion through the annulus fibrosus and compressing the nerve, 3. Migrated lumber disc herniation, 4. Lumbar disc fragment which broke off and compresses the nerve Adapted with permission from Ciurea AV. Tratat de neurochirurgie, vol. 2. Editura Medicala Bucharest, 2010[5].

When a posterolateral disc herniation occurs, the homolateral spinal nerve root will become compressed at its exit from the dural sac. This generates radiculopathy along the distribution of that nerve.

There is an entire array of diseases which present with low back pain. A well taken history and careful physical examination will lead to the correct diagnosis when corroborated with the appropriate investigations. Vascular claudication generates leg pain which is relieved by rest. Neurogenic claudication is caused by assuming the erect position. In this circumstance, pain is relieved by sitting or bending. Osteoarthritis of the hip joints is usually associated with joint stiffness and can be confirmed by a plain X-ray. Pain from a metastatic disease or cauda equina tumors is generally worse during the night when the patient lies on his/her back and is relieved when the patient sits. Peripheral neuropathies such as in diabetes should be also considered. Tethered cord, infection and trauma should also be suspected. Renal collicative pain must always be excluded. A correct neurological examination will indicate the level of the lesion while a magnetic resonance imaging scan (MRI) – which is the golden standard – will almost always indicate the correct diagnosis. (See Figure 2)

Figure 2 - MRI Image showing a L4-L5 disc extrusion. From the personal collection of Prof. AV. Ciurea

The back of a patient with a herniated disk may present some tilting of the trunk and flexion of the hip and knee on the affected side. Movement of the lumbar spine will result in pain which is typical in regard to the anatomical level of the lesion. Paravertebral muscle spasm may appear. Lasegue's sign will be present as a result of the nerve being stretched and also compressed by the herniated disc fragment. Neurologic defficits may be noticed along the distribution of an involved nerve root and serve to localize the level of the prolapse. This may present as a reduction or loss of sensation in the teritory of the nerve or a reduction or loss of force in the relevant muscle groups.[4][7]

The surgical procedure for microdiscectomy must always be employed only as a last resort, after the pharmacological treatment has failed. During the preparation for surgery, the imaging of the patient's lesion must be double checked. The level or levels of the lesion / lesions must be confirmed again and the correct side of the lesion (left or right) must be determined (Eg.: L5-S1, Right side hernia). The patient should receive a thorough systemic preoperative check-up. Plain X-rays (thorax, abdomen and hip) and an ECG will generally be performed to exclude kidney stones, coxarthrosis, tuberculosis, various respiratory diseases or possible heart diseases.

The decision to operate must be carefully assessed and should be considered when the patient's pain is intractable and incapacitating; the pharmacological treatment is without any result for 4-6 weeks; the cauda equina syndrome occurs; sphincteric dysfunction, motor and/or sensory impairment occur; lower limb weakness or foot drop appears.

Anesthesia can be spinal or general. Antibiotic therapy must be given prior to operation so that a maximum concentration of antibiotic will be present in the bloodstream at the time of the surgery[8]. The patient is usually placed in the knee-chest position, however surgeons may select other positions. The authors' protocol advocates for general anesthesia and the knee-chest position. Thus, an optimal „spreading" of the laminae is achieved and reaching the intervertebral disks is far easier. This position also reduces the pressure exerted on the abdomen of the patient and reduces bleeding.

A midline skin incision is performed which is deepened through the subcutaneous tissue and fascial layers using monopolar and bipolar coagulation. The spinous processes and the interspinous ligaments are reached and exposed. A dissection is performed which strips the muscles off the spinous processes and the laminae, thus exposing the facets. At this moment the authors use a narrow instrument such as a spinal needle which is placed in the surgical wound. C-arm fluoroscopy confirmed the correct anatomical level. Preferrably the surgeons will expose the side with the most herniated disc. The exposure is then maintained using a self-retaining retractor. Once preparation has taken place the surgeon uses a Kerrison punch rongeur to remove the lower edge of the superior lamina (related to the disc protrusion). Adequate exposure is key to correct identification of the disc and preservation of the dura and nerve root. In special circumstances a hemilaminectomy or a complete laminectomy may be required, however such cases are very rare.[4][9]

Once exposed, the *ligamentum flavum* will be incised and cottonoid will be passed through the opening to protect the underlying dura mater which will be partially exposed. A small Kerrison punch will then be used to remove the rest of the ligamentum flavum. Under strict microscope visualization a blunt dissector will be used to dissect the lateral edge of the dura and the nerve root of the herniated disk fragment. Both on the dura and the nerve root medial traction will then be gently applied with a nerve hook and protected. When herniated disk fragments are present in the angle made by the nerve root and the medulla (axilla of the nerve) a pituitary rongeur can be used to gently remove herniated disk tissue so that medial retraction might be possible. Further exploration of the surgical field is mandatory for the lateral recessus of the spinal canal and under the dural sack. Saline irrigation is needed and great care must be taken so that all the veins in the area are preserved. [4][9]

Usually the disc protrusion is visible between the vertebral bodies. This should always be confirmed by palpation. Hemostasis is achieved using bipolar coagulation. With a sharp scalpel the bulging disk will be incised (with great care regarding the relationship between the blade and the dura) and afterwards the degenerated disc will be removed from the intervertebral space using curettes and rongeurs. When removing the intervertebral disc, great care must be taken not to penetrate the anterior longitudinal ligament due to risk of injury to the aorta or abdominal viscera. For this specific reason the authors choose not to remove the disc completely. Additional surgical field exploration is mandatory in the cranial and caudal direction to detect any additional disk fragments. The nerve root is then followed into the foramen and with an angled narrow instrument – usually an angled ball hook - the foramen is checked for the presence of additional disc fragments.

All the surgical gestures must be accompanied by intense irrigation with saline. Irrigation will contribute to dislodging the disk fragments in the intervertebral space. The cottonoids are then removed from the surgical field and the final exploration is performed. The dura mater and the nerve should be seen pulsating once the discectomy is adequately performed, otherwise, the surgeon should check for additional retained fragments. The surgical wound closure should be done observing the anatomic planes. Drainage is generally not needed but the surgeon can choose it if intraoperative hemostasis is not satisfactory. The general duration of the surgery is usually of no more than 90-120 minutes. Two hours after the patient was taken out of the operating theatre he/she is woken up. The patient should be able to sit 4 hours after the surgery, and 6 hours postoperatively he/she should be able to move. After 12 hours postoperatively the patient has to be able to go to the toilet by himself/herself. Hospital discharge usually is performed after 72 hours postoperatively. This fast track regimen helps the patient by rushing rehabilitation therapy and prevents the appearance of postoperative depression which develops in about 60% of all the patients. Familly support and a good doctor-patient relationship are essential.

Rehabilitation should be commenced immediately. Special gymnastics is mandatory to obtain a correct outcome. Reintegration will be performed step-wise. The patient can go back to work one month after the operation (with some restrain). Three months after the operation the patient should be 100% functional and autonomous. Professional drivers will be able to work only after 6 months from the operation.

Results

Our experience is based on 1000 consecutive cases which were diagnosed and treated between January 2009 and January 2014 in two neurosurgical centers using the same protocol. The first neurosurgical center was in Oradea, in the Bihor County Emergency teaching hospital. The second center was the "Bagdasar-Arseni" Emergency Clinical Hospital of Bucharest. The „Bagdasar-Arseni" neurosurgical center was replaced starting with 1 January 2013 with the „Sanador Medical Center" Hospital due to personal reasons of the surgical team. The modifications regarding the surgical centers had no impact on the follow-up of the patients.

All the patients were operated on under surgical microscope. The authors advocate the use of microsurgery which enables the surgeon to clearly identify the nature of the tissue he is manipulating. The authors chose not to completely remove the degenerated disk due to the vital risks for the patient. Anesthesia was general and the patient was placed in a knee-chest position for the above mentioned reasons.

There were 537 male patients accounting for more than half of all cases (53.7%) and 463 female patients (46.3%). The patients were followed up for a period which ranged between 4 months and 5 years averaging 3.9 years.

The clinical onset for these patients was clearly dominated by low back pain with inferior limb irradiation which was noticed in 863 patients (86.3%). This was followed by the presence of a sensory defficit which was encountered in 853 patients (85.3%), positive Lasegue's sign in 764 cases (76.4%), motor defficit in 589 cases (58.9%) and the cauda equina syndrome in 42 cases (4.2%).

All the cases were examined using Computed Tomography (CT) and 1T Magnetic Resonance Imaging (MRI). The certainty diagnosis was confirmed using MRI. We noticed lumbar disk herniations at L5-S1 level in 614 cases (61.4%); L4-L5 disk herniations were present in 357 cases (35.7%). In 29 cases (2.9%) we noticed multiple disk herniations and other-level disk herniations. Intraoperatively the authors used C-ARM fluoroscopy for correct the identification of the lesion.

The patients's preoperative and postoperative pain was evaluated using the Oswestry Low Back Pain Scale. This tool – which is considered to be the golden standard in assessing the patient's quality of life - focuses on the intensity of pain, the ability to care for oneself, the ability to walk, the ability to sit, the sexual function, the ability to stand, social life, sleep quality, and the ability to travel. Each topic has 6 coresponding sentences noted from 0 to 5. The patient has to choose the sentence most appropriate to his/her situation. The general score ranges from 0 – minimum disability to 100 – maximum disability. The recorded results (1 January 2014) were qualified as excellent in 298 cases (29.8%), very good in 463 cases (46.3%), good in 146 cases (14.6%) acceptable in 75 cases (7.5%), there was a moderate defficit in 18 cases (1.8%) but no case remained with a severe or permanent defficit.

Regarding the postoperative complications, due to correct asepsy and antisepsy only 5 wound infections occurred (0.05%). A second reason for which the authors chose not to remove all the degenerated disk is to avoid discitis. The classical technique for lumbar discectomy meant that complete disc excision had to be undertaken, followed by surgical bone rasping which generated bleeding and represented a risc factor for discitis. Discitis is a very serious complication which causes excruciating pain for the patient and serious morbidity. In our series no case of discitis was encountered as no bone rasping was performed. No dural tear was seen and no lumbosacral nerve injury was detected. A major risc exists when removing the anterior part of the intervertebral disc – as the aorta, vena cava or iliac arteries can be damaged.

Recurrence was the main concern of the authors, either at the same level – 41 cases (4.1%) or at a different level – 76 cases (7.6%). Other patients still have persistent low back pain following surgery – a disease usually reffered to as „failed back syndrome". This may be generated by poor patient selection, inappropriate surgical indication or remaining disc fragments. A new set of investigations has to be ordered and fragments, other level protrusion or different pathologies need to be excluded.

Conclusions

- To conclude, LDH is an extremely frequent pathology in the active population which has the best treatment success rate when operated using microdiscectomy. The main causes for lumbar disc hernias include repetitive hard labor and a sedentary lifestyle. The surgical indication for lumbar disc herniations must be correctly determined by a correct clinical examination which is corroborated with magnetic resonance imaging. An electromyography will prove radicular suffering.

Microdiscectomy is a time-proven surgical technique which leads to minimum bleeding, has minimum complications and allows the patient to be reinserted in his social environment as soon as possible.

References

[1] Desai A. Bekelis K. Perry A. Spine Patient Outcomes Research Trial: Do Outcomes Vary Across Centers for Surgery for Lumbar Disc Herniation? Neurosurgery: 71; 4: 833–843

[2] Hardy RW Jr. Lumbar Disc Disease. New York, NY: Raven Press, 1982.

[3] Simeone FA. Lumbar Disc Disease. In: Wilkins RH, Rengachary SS, eds. Neurosurgery. New York, NY: McGraw-Hill:2250-2259, 1985.

[4] Mahmoud MR. Lumbar Disc Surgery. In Kalangu K. Kato Y. Dechambenoit G, eds. Essential Practice of Neurosurgery, 2nd Edition. Acces Publishing, Nagoya, 2009.

[5] Ciurea AV. Tratat de Neurochirurgie, Vol II. Editura Medicala Bucuresti, 2010.

[6] An HS[1], Silveri CP, Simpson JM, File P, Simmons C, Simeone FA, Balderston RA. Comparison of smoking habits between patients with surgically confirmed herniated lumbar and cervical disc disease and controls. J Spinal Disord. 7;5:369-73.

[7] Arseni C. Simionescu M. Patologia Vertebro-medulara neurochirurgicala. Editura Medicala, Bucharest, 1968

[8] Ellenbogen R. Abdulrauf S. Sekhar L. Principles of Neurological Surgery, Saunders-Elsevier, Philadelphia 2013.

[9] Jandial R. McCormick P. Black P. Core techniques in operative neurosurgery. Saunders-Elsevier, Philadelphia 2011.