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Differentiated tactics of surgical treatment of intervertebral disc herniation complicated by spinal canal stenosis

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Objective: to conduct a retrospective analysis and evaluate the results of various methods of surgical treatment of patients with intervertebral disc herniation (IDH), which is complicated by spinal canal stenosis (SCS) of the lumbar spine.

Materials and methods: 80 patients (36 (45%) men and 44 (55%) women) with a diagnosis of IDH complicated by SCS took part in the study. The average age of patients is under 50 years. All patients were operated on in the neurosurgery department of Zaporizhzhya Regional Clinical Hospital between 2016 and 2020. Patients were divided into two groups depending on the area of the spinal canal and the method of surgical treatment. Group A (n=20) – relative SCS, area of the spinal canal – 75–100 mm², the presence of IDH >6 mm (according to magnetic resonance imaging). These patients underwent a standard microdiscectomy. Group B (n=60) – absolute SCS, spinal canal area <75 mm², the presence of IDH <6 mm (according to magnetic resonance imaging). This category of patients underwent surgery with wide decompression of the spinal canal and stabilization of the spinal motion segment using the method of interbody and transpedicular fixation of the corresponding spinal motion segment. The postoperative follow-up period is up to 6 months. A visual analogue scale was used to assess the pain syndrome in the lower limb and back and the degree of its reduction in the postoperative period. The impact of surgical treatment on the quality of life of patients with IDH complicated by SCS was assessed using the Oswestry Disability Index questionnaire (ODI).

Results. Before the operation in group B, an inversely proportional dependence of the pain syndrome level on the visual analogue scale on the age of the patients ($p < 0.05$) and the duration of the disease ($p < 0.05$) was recorded. No such dependence was found in group A. In both groups, a significant decrease in pain syndrome was noted at the end of the first day after surgery, with a further gradual decrease until the end of the observation period. When comparing groups at the end of the first day after surgery, after 3 and 6 months, no statistically significant differences were found ($p > 0.05$). In both groups, a significant decrease in the Oswestry index was registered immediately after surgery and its further decrease until the end of the follow-up period. When comparing the groups at the end of the first day after the operation, after 3 and 6 months, no statistically significant differences were found ($p > 0.05$), but preoperative Oswestry index was significantly higher in group B, ($p = 0.04$ according to the Mann–Whitney test).

Conclusions. In group A, the treatment effectiveness of patients reached 80–85%, in the observation period on the 3 and 6 months. In group B, the treatment effectiveness of patients was also high and amounted to 75–80%, in the observation period on the 3 and 6 months. Thus, taking into account the high variability of clinical and morphological changes in patients with IDH complicated by SCS, it is optimal to use differentiated surgical treatment tactics.

Key words: intervertebral disc herniation; spinal canal stenosis; surgical treatment

Introduction

Degenerative lumbar spinal stenosis (DLSS) is observed to occur in 40–60% of patients, mainly in middle-aged and elderly individuals. Structural and biomechanical changes of the spine lead to narrowing of the spinal canal due to hypertrophic facet joints,

ligaments, often as a result of intervertebral disc herniation (IDH) [1–3].

Lumbar spinal stenosis and IDH are the most common causes of chronic lumbar pain, which is a multifactorial and clinically complex condition and ranks second among medical problems affecting



quality of life and causing a significant socioeconomic burden [4, 5].

Conservative treatment is symptomatic and aimed mainly at alleviating pain symptoms. Degenerative lumbar spinal stenosis is one of the most common reasons for spinal surgery in patients over 65 years old [11, 13]. The primary goal of surgical treatment is decompression of the dural sac and neural structures by the method of reconstruction at the level of one or more spinal motion segments (SMS) of the spinal canal. Decompression surgery followed by spinal fusion is an effective method of surgical treatment of patients with absolute DLSS (grade C and D according to magnetic resonance tomographic classification of S. Shizas (2010)). Patients with relative stenosis (grade A and B) in the presence of IDH and relevant clinical findings are also indicated for surgical treatment [6–8]. There are various methods of spinal fusion, which are often used in the treatment of IDH complicated by spinal canal stenosis (SCS) [18]. According to the literature, fusion techniques have significant advantages when performing spinal decompression surgery [19]. By performing operations on the spine, not only the surgical technique, but also the choice of fusion technique is important. Thus, according to various authors, the TLIF (transforaminal lumbar interbody fusion) method compared to the PLIF (posterior lumbar interbody fusion) method is characterized by a shorter operation time and the volume of blood loss, so it should be preferred [20, 21]. There are many publications devoted to surgical treatment for DLSS, but there is no convincing evidence of the benefits of a particular method of treatment [14].

Objective: to perform a retrospective analysis of the results of various surgical treatment methods for patients with intervertebral disc herniation complicated by spinal canal stenosis in the lumbar spine.

Research objective: to determine the factors on which the volume of decompression depends, to optimize the indications for the use of various surgical methods and evaluate the results in the postoperative period.

Materials and methods

Study participants

A total of 80 patients (36 (45%) men and 44 (55%) women) with a diagnosis of "IDH, complicated SCS" took part in the study. The average age of patients is under 50 years. It can be assumed that IDH significantly worsens the clinical picture of DLSS, which requires early surgical treatment. All patients were operated on in the neurosurgery department of Zaporizhzhya Regional Clinical Hospital between 2016 and 2020. Informed and voluntary written consent to participate in the study was obtained from all patients. The study was approved by the Committee on Ethics of the Institute of Neurosurgery named after Acad. A.P. Romodanov, Ukraine (Minutes № 3 dated November 22, 2021).

Inclusion criteria

Patients aged 25 to 75 years, the presence of an established diagnosis of "IDH, complicated by SCS",

standard microdiscectomy or wide decompression with SMS fusion using the method of interbody fusion and transpedicular fixation.

Exclusion criteria

Patients aged ≤ 27 years and ≥ 75 years, presence of oncological pathology, chronic subcompensated diseases, previous spinal surgery.

Characteristics of the group

Patients were divided into two groups depending on the area of the spinal canal in the area of stenosis (according to the formula of T.M. Stoll *et al.*, 2002) and the method of surgical treatment. Group A (n=20) - relative SCS, spinal canal area - 75–100 mm², presence of IDH >6 mm (according to magnetic resonance imaging). Such patients underwent a standard microdiscectomy. Group B (n=60) – absolute SCS, spinal canal area <75 mm², presence of IDH <6 mm (according to magnetic resonance imaging). This category of patients underwent surgery with wide decompression of the spinal canal with fusion of the SMS using the technique of interbody and transpedicular fixation of the corresponding SMS.

Visual analogue scale (VAS) was used to assess the pain syndrome in the lower limb and back and the degree of its reduction in the postoperative period. The impact of surgical treatment on quality of life of patients with IDH complicated by SCS was assessed using the Oswestry Disability Index (ODI) questionnaire [22].

The postoperative follow-up period is up to 6 months.

Study design

Analytical controlled retrospective single-center study was conducted in 2016–2022.

Group A underwent lumbar microdiscectomy according to the standard technique. The prone position lying on the abdomen– during surgery. Median approach with exposure of adjacent vertebral arches on one side. The performance of partial or complete flavotomy depended on the patient's anatomical features. In group B, patients with absolute SCS underwent a standard median approach or a Wiltse approach, wide resection of the vertebral arches, complete facetectomy, foraminotomy and discectomy. Stabilization of the SMS was performed by the method of interbody and transpedicular fixation of the corresponding SMS. The criterion for the presence of disco-radicular conflict was dislocation or deformation of the nerve root and dural sac and the absence of pulsation of the nerve root as a result of compression by the intervertebral disc fragment and degenerative stenosis. The outcome of decompression was evaluated according to the following criteria: mobility and pulsation of the nerve root and dural sac in the area of surgical intervention.

Statistical methods of data processing

Statistical data analysis was performed using non-parametric methods and the Statistica 13 software (license number JPZ804I382130ARCN10-J). Data are presented as median and interquartile range (Me (Q25; Q75)). Independent group results were compared according to the Mann-Whitney test. Spearman's

This article contains some figures that are displayed in color online but in black and white in the print edition.

correlation coefficient was used to assess the relationship between the indicators. The results were considered statistically significant at the significance level ($p < 0.05$).

Results and discussion

Before the operation in group B, the dependence of the pain syndrome level on the age of the patients was recorded (lower limb pain ($r = -0.32$), back pain ($r = -0.27$), $p < 0.05$) and the duration of the disease (lower limb pain ($r = -0.36$), back pain ($r = -0.26$), $p < 0.05$). Negative values were obtained, i.e. the older age and the longer duration of the disease, then the lower level of pain syndrome was registered. Pain reduction with increasing disease duration may lead to loss of function and disability. These correlations were not detected in group A (Tables 1 and 2).

In both groups, there was a significant decrease in pain syndrome at the end of the first day after surgery, with a further gradual decrease until the end of the follow-up period. When comparing groups at the end of the first day after surgery, on the 3 and 6 months, no

statistically significant differences were found ($p > 0.05$) (Figs. 1 and 2).

The results of surgical treatment show an equal reduction in pain syndrome in both groups and confirm the effectiveness of the selected methods of surgical treatment.

In order to assess the impact of surgical treatment on the quality of life of patients with IDH complicated by SCS, a questionnaire based on the Oswestry Disability Index was conducted. In both groups, a significant decrease in the Oswestry index was registered immediately after surgery and a subsequent decrease until the end of the follow-up period. Comparing the groups at the end of the first day after surgery, on the 3 and 6 months, no statistically significant differences were found ($p > 0.05$), but the preoperative Oswestry index was significantly higher ($p = 0.04$ according to the Mann-Whitney test) (Fig. 3).

Consequently, no statistically significant difference in treatment outcomes was found between groups according to VAS and the Oswestry questionnaire. The

Table 1. Dynamics of pain syndrome regression in the lower limb according to VAS, score

Group	Before surgery	After surgery	After 3 months	After 6 months
A (n=20)	7,5 (7,0; 9,0)	0,0 (0,0; 1,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)
B (n=60)	7,5 (6,0; 9,0)	1,0 (0,0; 2,0)	0,0 (0,0; 1,5)	0,0 (0,0; 1,0)
Mann-Whitney p-value	0,40	0,44	0,71	0,99

Table 2. Dynamics of back pain regression according to VAS, score

Group	Before surgery	After surgery	After 3 months	After 6 months
A (n=20)	6,0 (0,0; 8,0)	0,0 (0,0; 1,0)	0,0 (0,0; 0,0)	0,0 (0,0; 0,0)
B (n=60)	8,0 (6,5; 9,5)	0,0 (0,0; 1,5)	0,0 (0,0; 1,0)	0,0 (0,0; 1,0)
Mann-Whitney p-value	0,006	0,50	0,15	0,22

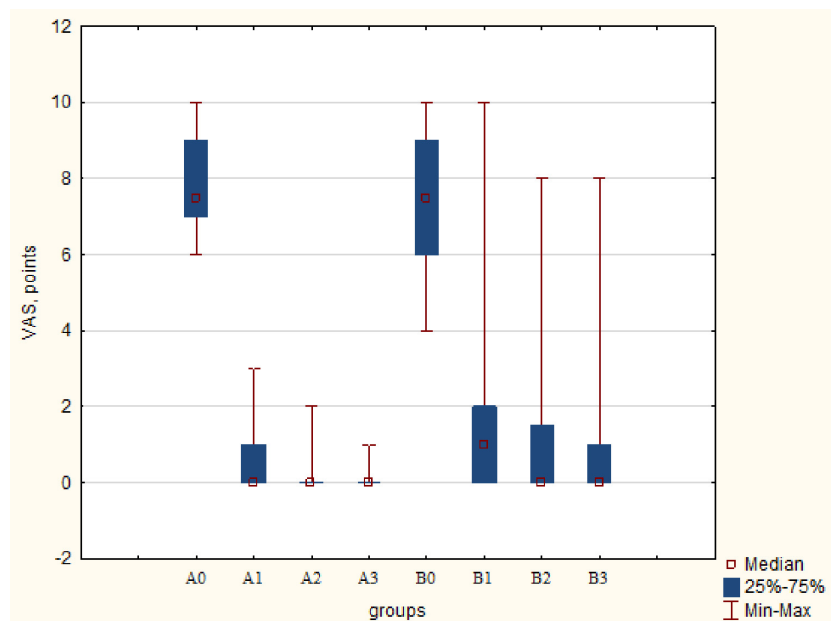


Fig. 1. Comparison of the pain level in the lower limb according to VAS in groups: A0 and B0 - before surgery; A1 and B1 - after surgery; A2 and B2 - after 3 months; A3 and B3 - after 6 months

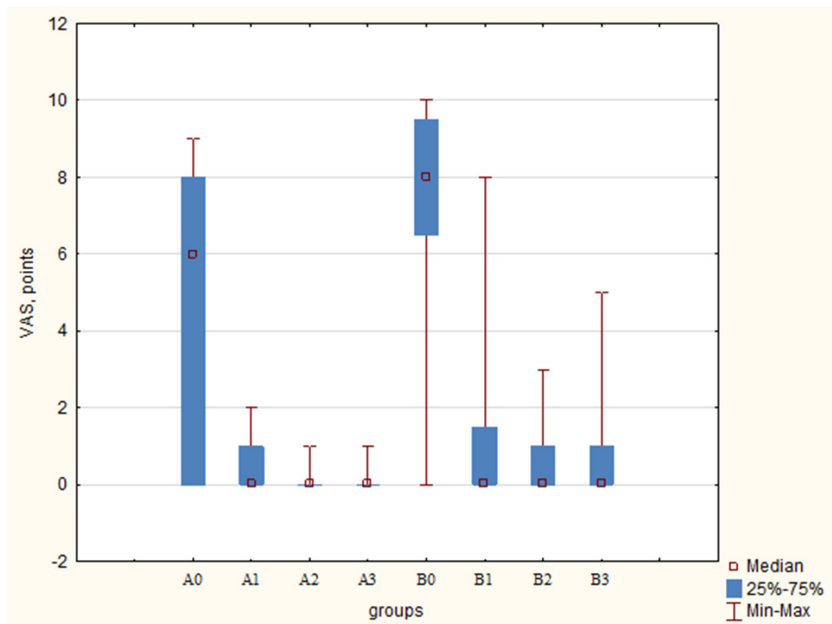


Fig. 2. Comparison of the back pain level according to VAS scores in groups: A0 and B0 - before surgery; A1 and B1 - after surgery; A2 and B2 - after 3 months; A3 and B3 - after 6 months

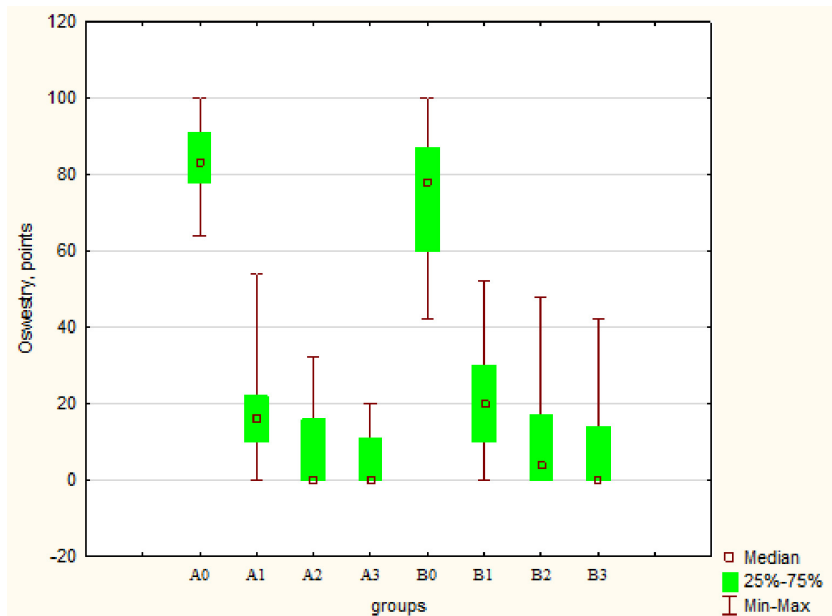


Fig. 3. Comparison of the Oswestry index in groups: A0 and B0 - before surgery; A1 and B1 - after surgery; A2 and B2 - after 3 months; A3 and B3 - after 6 months

clinical and neurological symptoms together with the results of the instrumental examination play a decisive role in the choice of surgical treatment.

Conclusions

1. Patients with IDH >6 mm and relative SCS (spinal canal area – 75–100 mm²) underwent standard microdiscectomy. The treatment efficacy in this group of patients was 80–85% at 3 and 6 months after surgery.

2. Patients with IDH <6 mm and absolute SCS (spinal canal area <75 mm²) underwent surgery with wide decompression of the spinal canal and interbody and transpedicular fusion of the corresponding SMS. The treatment efficacy in this group of patients was 75–80% at 3 and 6 months after surgery.

3. Given the high variability of clinical and morphological changes in patients with IDH complicated

by SCS, the use of differentiated surgical treatment tactics is optimal.

Information disclosure

Conflict of interest

The authors declare no conflict of interest.

Ethical approval

All procedures performed on patients comply with the ethical standards of institutional and national ethics committees, the 1964 Declaration of Helsinki and its amendments or similar ethical standards.

Informed consent

Informed and voluntary written consent to participate in the study was obtained from each patient.

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