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Abstract

Yevgeniy I. Slynko[1],
Olexandr O. Potapov[2],
Yuriy V. Derkach[1],
[1]Department of Spinal Neurosurgery, Romodanov Neurosurgery Institute, Kyiv, Ukraine;
[2]Department of Neurosurgery and Neurology, Medical Institute, Sumy State University, Sumy, Ukraine

THE RESULTS OF SURGICAL TREATMENT IN PATIENTS WITH VERTEBRAL METASTASES

Study Objectives. The study was conducted to analyze and compare different types of surgical access in the treatment of patients with metastatic vertebral lesions to improve the outcome of surgery.

Materials and Methods. The study included 108 patients with vertebral metastases who were operated on at the Romodanov Neurosurgery Institute of the National Academy of Medical Sciences of Ukraine in 2015–2019.

Results. The choice of surgical access depended on a few factors such as tumor location relative to the dura mater, bones, and nerve structures and was as follows: posterior access was used to resect tumors located posteriorly and posterolaterally to the brain; lateral access was used for tumors located laterally to the brain; anterior access was used to resect tumors located in front of the spinal cord.

In Group I (73 patients), posterior access was used in 49 cases (67%), anterior access – in 19 cases (26%), and lateral access – in 5 cases (7%). In Group II (35 patients), only posterior access was used.

Discussion. Selection of adequate surgical access for vertebral tumor resection in order to minimize nerve structure injury significantly improved the results of surgical treatment. Anterior and lateral access for ventral and ventrolateral tumors operation made it possible to completely resect the tumor, reduce the traction of nerve structures, and obtain sufficient visual control of the operating field during the surgery, which in turn had a positive effect on regression of pain and conduction disorders.

Conclusions. A differential approach to the choice of surgical access reduces the neurological deficit in the postoperative period and allows radical resection of the tumor, which in turn helps to significantly reduce the number of tumor recurrences in the long-term period.

Keywords: vertebral tumor resection, features of surgical treatment of vertebral tumors, secondary vertebral lesions.

Corresponding author:
Yuriy V. Derkach, Department of Spinal Neurosurgery, Romodanov Neurosurgery Institute, Kyiv, Ukraine
e-mail: 290986@ukr.net

Резюме

РЕЗУЛЬТАТИ ХІРУРГІЧНОГО ЛІКУВАННЯ ХВОРИХ ЗІ ВТОРИННИМИ УРАЖЕННЯМИ ХРЕБЦІВ

Матеріали та методи. В дослідження включено 108 пацієнтів із метастазами в хребті, які отримували хірургічне лікування в Інституті нейрохірургії ім. акад. А. П. Ромоданова НАМН України в період з 2015 року по 2019 роки.

Результати. Вибір хірургічного доступу залежав від таких факторів: розташування пухлини відносно твердої мозкової оболонки і нервових структур, кісток та був такий: задній доступ використовували для видалення пухлин, які займають задній та задньо-боковий простір по відношенню до мозку; боковий доступ ми використовували для видалення пухлин розташованих латерально від мозку; передній доступ ми використовували для видалення пухлин, розташованих спереду від спинного мозку.

В І групі спостережень ми використовували задні доступи в 49 спостереженнях, передні доступи – в 19 спостереженнях, бокові доступи – в 5 спостереженнях. В ІІ групі спостережень використовували лише задні групи доступів.

Обговорення. Вибір адекватного хірургічного доступу до пухлини хребців, який мінімізує травму нервових структур під час видалення пухлини, значно покращує результати хірургічного лікування. Використання передніх та бокових доступів при вентральних, вентролатеральних локалізація пухлин дає змогу тотально видалити пухлину, зменшити тракцію нервових структур та отримати достатній візуальний контроль операційного поля під час видалення пухлини, що в свою чергу позитивно впливає на регрес больового синдрому та провідникових порушень.

Висновки. Диференційний підхід до вибору доступу для видалення пухлини зменшує неврологічний дефіцит в післяопераційному періоді, дає змогу максимально радикально видалити пухлину, що дозволяє у віддаленому періоді значно зменшити кількість рецидивів пухлин.

Ключові слова: видалення пухлин хребців; особливості хірургічного пухлин хребців; вторинне ураження хребців.

Євгеній І. Слинько[1], **Олександр О. Потапов**[2], **Юрій В. Деркач**[1],

[1]*Відділення патології спинного мозку, Інститут нейрохірургії ім. акад. А. П. Ромоданова НАМН України, м. Київ, Україна;* [2]*Кафедра нейрохірургії та неврології медичного інституту Сумського державного університету, м. Суми, Україна*

Автор, відповідальний за листування:
Юрій В. Деркач, відділення патології спинного мозку, Інститут нейрохірургії ім. акад. А. П. Ромоданова, м. Київ, Україна
e-mail: 290986@ukr.net

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Introduction/Вступ

Vertebral metastases are the most common type of secondary involvement of the vertebral spine with a prevalence of 30–70% in cancer patients; in 5–10% of cases, metastases cause epidural compression of the spinal cord, leading to conduction disorders, pain, and reduced quality of life [1].

In order to relieve pain and improve spinal cord function and the quality of life of patients, surgery is increasingly performed, including minimally invasive surgery, palliative surgery, or radical surgery. In turn, most studies report a significant clinical effect with carefully selected surgical methods in patients with vertebral metastases [2]. Flavio Tancioni et al. used minimally invasive surgery, resulting in clinical remission of pain (in

96% of cases) and improvement of neurological deficit after 2 weeks (in 88% of cases) [3]. Masuda et al. evaluated the surgical outcomes of 44 patients who underwent spinal cord decompression and spine stabilization and reported that all patients presented with improved scores by the Frankel Scale and ECOG Scale of Performance Status after surgery [4].

However, there are still some issues in the treatment of spinal metastases. Complications such as perioperative bleeding and spinal cord injury should be considered after surgery. Along with the rapid development of immunotherapy, endocrine therapy, radiation therapy, and chemotherapy (especially targeted therapy), multidisciplinary combination treatment in patients with malignant vertebral tumors has become a trend [5]. Therefore, the indications and contraindications for the surgical treatment of spinal metastases should be clearly understood.

Accordingly, this study was conducted to analyze and compare different types of surgical access in the treatment of patients with metastatic vertebral lesions to improve the outcome of surgery.

Materials and methods

The study included 108 patients with malignant vertebral tumors who were operated on at the Romodanov Neurosurgery Institute of the National Academy of Medical Sciences of Ukraine in the period from 2015 till 2019. The inclusion criteria were as follows: patients diagnosed with spinal metastases using clinical and instrumental examinations (CT, MRI, or PET-CT); patients with hematologic malignancies of the spine, including lymphoma and myeloma; patients with spinal cord disorders, such as primary spinal tumors, spinal tuberculosis or degenerative spine conditions.

Among the patients included in this study, Group I comprised 42 men (55.4%) and 36 women (44.6%). Group II included 16 men (53.3%) and 14 women (46.6%).

Neurological deficits were evaluated using parameters of pain syndrome and conduction disorders before and after surgery.

Pain syndrome was assessed according to a 5-point scale (0 – no pain, 5 – the maximum level of pain). Motor and sensory functions were assessed using the Frankel scale.

To objectify the degree of spinal cord compression, the epidural spinal cord compression scale (ESCC, 2011) was used, which was based on the assessment of axial T2-weighted MRI images of the most severe compression site. This classification includes 4 stages: stage 1 – no compression of the spinal cord; stage 2 falls into: 2a – involvement of the epidural space without deformation of the dural sac, 2b – involvement of the epidural space with deformation of the dural sac and no signs of spinal cord compression, 2c – deformation of the dural sac with signs of spinal cord compression; stage 3 – spinal cord compression with intact extra-axial fluid spaces; stage 4 – spinal cord compression with affected extra-axial fluid spaces.

In order to resect the tumor completely, patients underwent radical surgery, including total or partial vertebrectomy, with subsequent stabilization of the spine, if necessary.

All observations were divided into two groups. In Group I (73 observations), a differential approach to the choice of surgical access was used depending on the direction of vertebral tumor growth and epidural component. In group II (35 observations), the posterior access was exclusively used to resect vertebral tumors.

The minimum post-surgery follow-up duration was 2 weeks, the maximum – 72 months. The duration of the post-surgery follow-up period averaged 24.4 ± 1.2 months.

Results

In Group I, thoracic spine was most commonly involved – 22 observations (30%); lumbar spine was involved in 20 cases (27.5%), cervical spine – in 18 cases (24.7%), and sacral spine – in 13 cases (17.8%). Tumors affecting more than two parts of the spine were observed in 6 cases. At the same time, 14 patients with only one affected part of the spine had more than one vertebra involved (Fig. 1).

In Group II, cases with regard to involved part of the spine were distributed as follows: cervical spine – 11 observations (31%), thoracic spine – 12 observations (33.9%), lumbar spine – 7 observations (20%). In 5 cases (15.1%), vertebral tumors affected two or more parts of the spine (Fig. 1).

The primary tumor sites in Group I were: renal cancer – 21 cases (28.8%), prostate cancer – 17 cases (23.3%), lymphoma and multiple myeloma – 10 cases (13.7%), lung cancer – 10 cases (13.7%), metastases of mesenchymal sarcoma – 5 cases (6.9%), thyroid cancer – 4 cases (5.5%), liver cancer – 2 cases (2.7%), gastrointestinal cancer – 2 cases (2.7%), unknown primary site – 2 cases (2.7%) (Fig. 2).

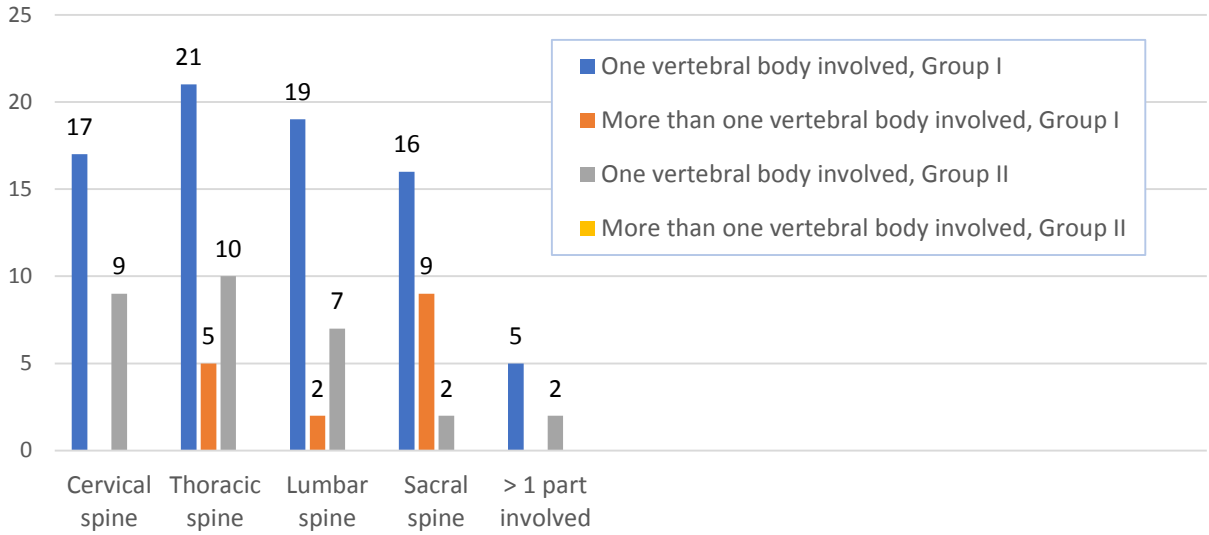


Figure 1 – Distribution of cases with regard to the involved part of the spine

The primary tumor sites in Group II were: renal cancer – 12 cases (34.2%), prostate cancer – 9 cases (25.7%), lymphoma and multiple myeloma – 5 cases (14.3%), lung cancer – 5 cases (14.3%), metastases of mesenchymal sarcoma – 2 cases (5.7%), thyroid cancer – 1 case (2.9%), unknown primary site – 1 case (2.9%) (Fig. 2).

In all observations, the epidural spinal cord compression scale (ESCC, 2011) was used (Fig. 3).

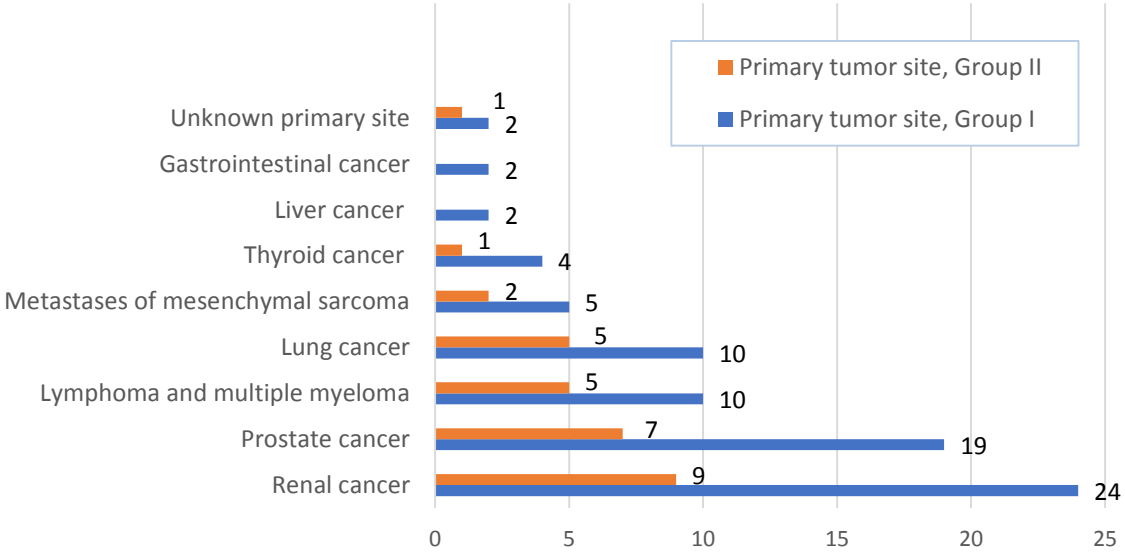


Figure 2 – Distribution of cases with regard to the primary tumor site

Pain syndrome (PS) in Group I before surgery scored 4.2 ± 0.3 and after surgery it was 2.4 ± 0.4 ($p < 0.05$) (Fig. 4). PS in Group II equaled 4.3 ± 0.3 before surgery and 3.1 ± 0.2 after surgery ($p < 0.05$) (Fig. 4).

The frequency of conduction disorders (motor and sensory segmental disorders), which were assessed using the Frankel scale before surgery and after surgery in Groups I and II, is presented in Fig. 5. Comparison of conduction disorders in Group I showed the average score of 2.12 ± 0.21 in the preoperative period and 1.13 ± 0.14 – in the postoperative period ($p < 0.05$). Motor segmental disorders (MD) in Group I amounted to 3.13 ± 0.31 before surgery and 1.9 ± 0.23 after surgery, respectively ($p < 0.05$). Sensitive segmental disorders (SD) amounted to 3.23 ± 0.33 before surgery and 2.12 ± 0.24 in the postoperative period ($p < 0.05$).

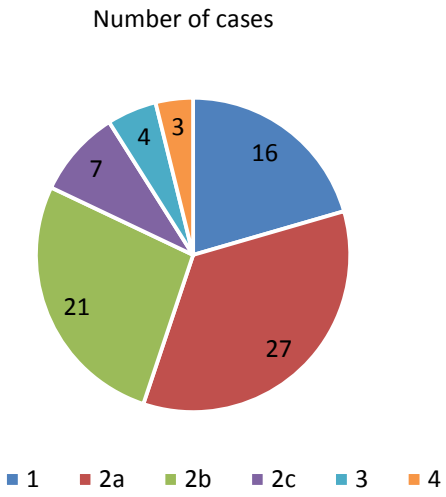


Figure 3 – Distribution of cases by the epidural spinal cord compression scale (ESCC, 2011)

In Group II, the values were as follows: 2.34 ± 0.23 before surgery and 1.67 ± 0.19 in the postoperative period ($p < 0.05$). MD equaled 3.23 ± 0.32 before surgery and 2.45 ± 0.26 after surgery. SD amounted to 3.55 ± 0.36 before surgery and 3.22 ± 0.24 in the postoperative period ($p > 0.05$) (Fig. 5).

The choice of surgical access depended on a few factors such as tumor location relative to the dura mater, bones and nerve structures and was as follows: posterior access was used to resect tumors located posteriorly and posterolaterally to the brain; lateral access was used for tumors located laterally to the brain; anterior access was used to resect tumors located in front of the spinal cord.

In Group I, posterior access was used in 49 cases (67%), anterior access – in 19 cases (26%), and lateral access – in 5 cases (7%). In Group II, only posterior access was used (Fig. 6).

The analysis of quality of life indicators showed that patients in Group I significantly more often ($p = 0.035$) had a satisfactory condition in the early and long-term postoperative period vs. patients in Group II: 33 cases (45.4%) in Group I and 7 cases (18.7%) in Group II in the early period and 35 cases (48%) in Group I and 12 cases (33.3%) in Group II in the long-term period.

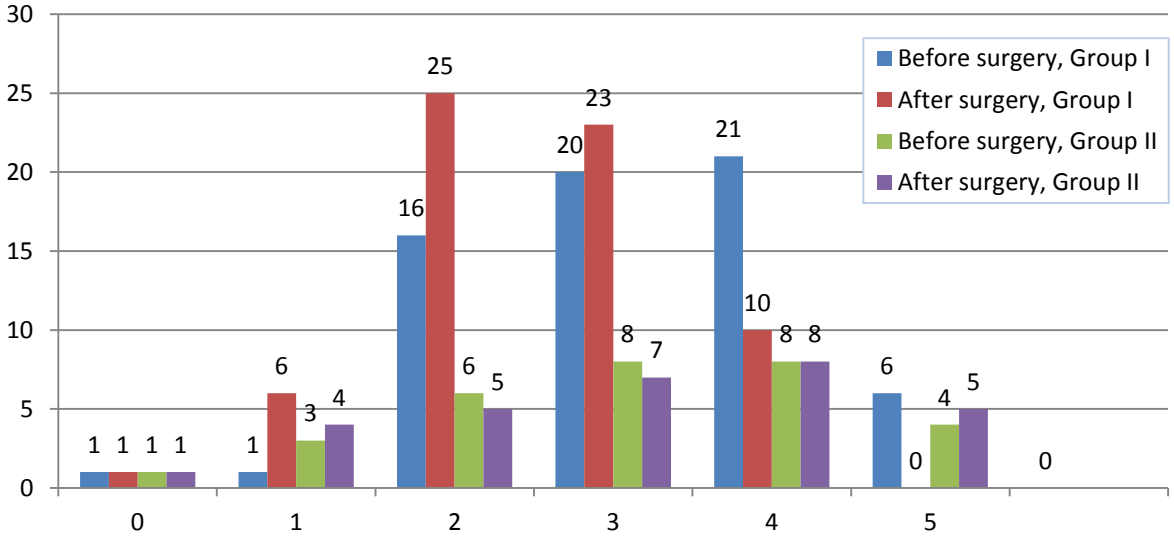


Figure 4 – Pain syndrome before and after surgery

Discussion

In contrast to primary tumors of the spine, spinal metastases were operated in order to improve the general condition of patients and maintain a good quality of life. That is, surgeons must take into account the somatic state of health of patients, instrumental study results, and the existing neurological deficit. In all cases, patients were first consulted in oncology centers and referred for further neurosurgical treatment.

The multifactorial approach to the differentiated selection of patients eligible for surgery allows improving the results of combined treatment in patients with vertebral metastases.

The degree of epidural compression according to the epidural spinal cord compression scale (ESCC, 2011) has a direct correlation with neurological disorders. Significant regression of pain and conduction disorders was observed in patients with stages 1, 2a, and 2b. Possible regression of pathological symptoms was reported in patients with stages 2b and 3. There was almost no regression of conduction disorders in patients with stage 4.

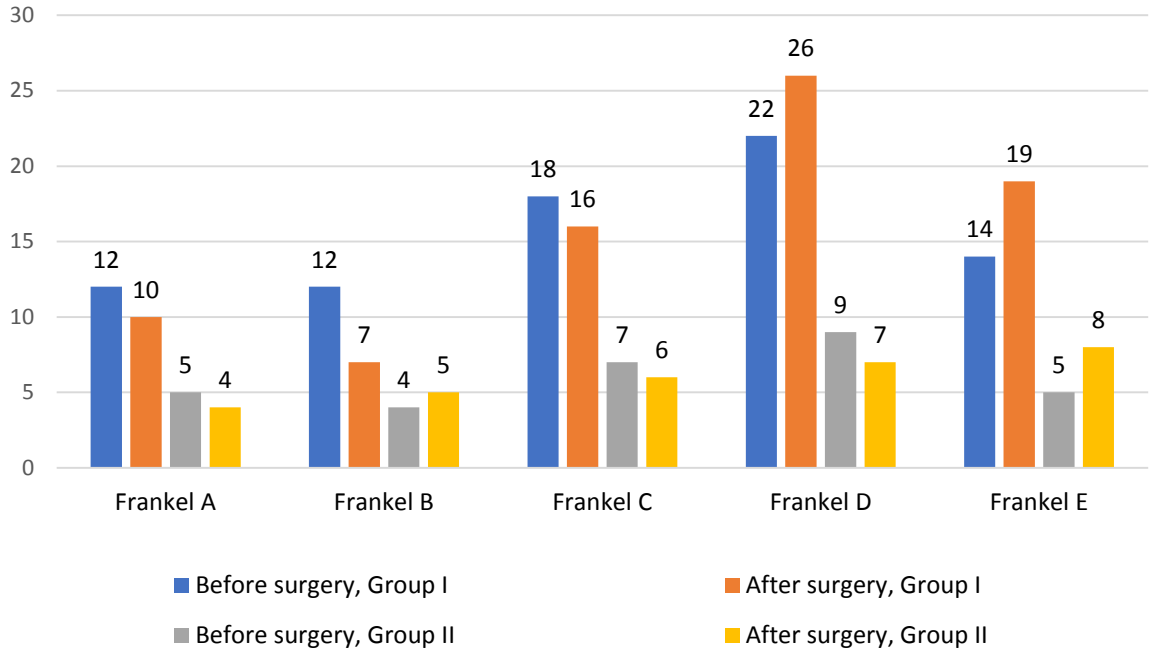


Figure 5 – Changes in neurological deficit by the Frankel scale

Selection of adequate surgical access for vertebral tumor resection in order to minimize nerve structure injury significantly improved the results of surgical treatment. Anterior and lateral access for ventral and ventrolateral tumors operation (Fig. 7, 8) made it possible to completely resect the tumor, reduce the traction of nerve structures, and obtain sufficient visual control of the operating field during the surgery, which in turn had a positive effect on regression of pain and conduction disorders.

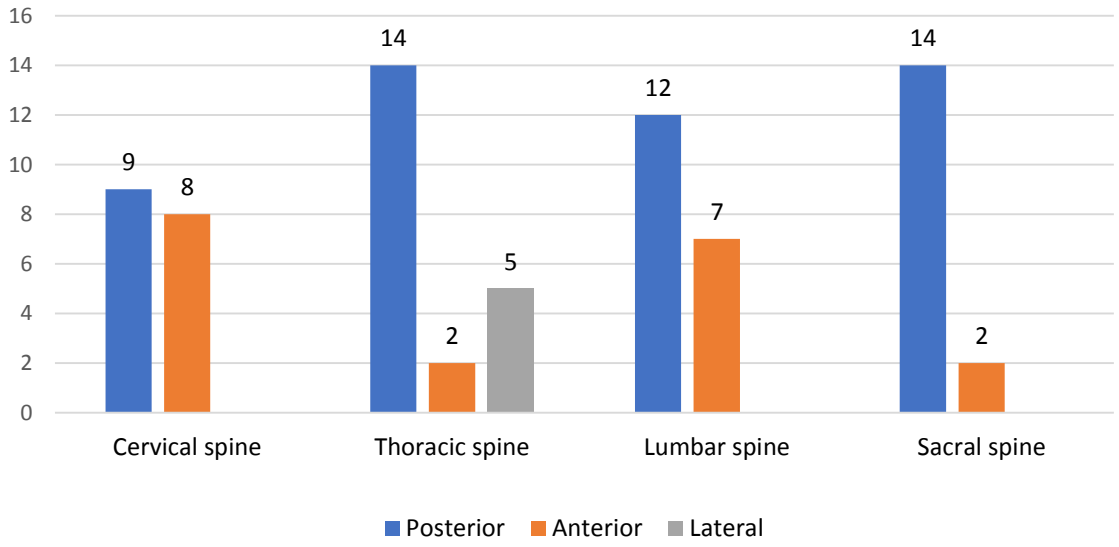
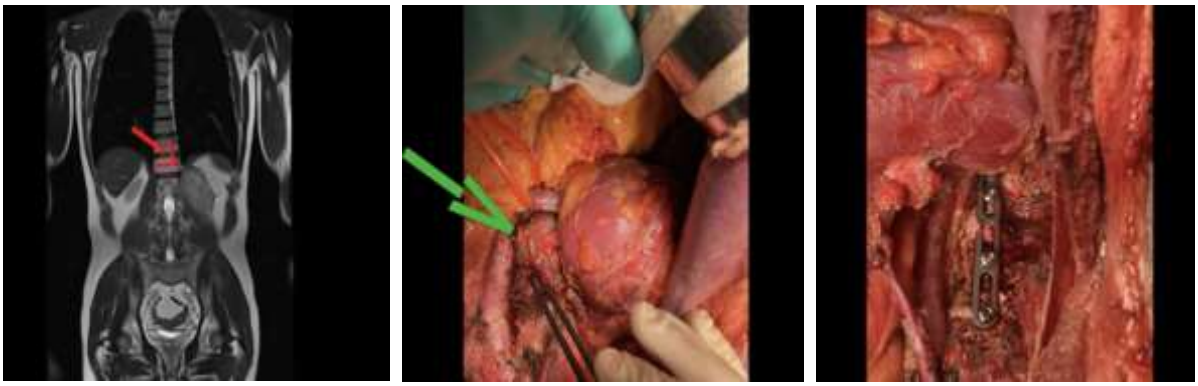


Figure 6 – Surgical accesses chosen for surgical treatment of patients

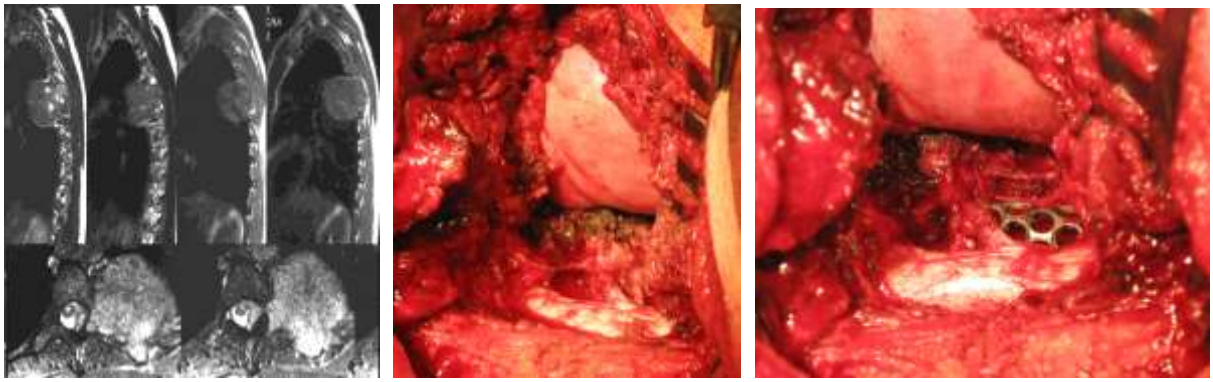
Thus, evaluation of positive changes in performance status of patients with account of regression of neurological deficit in the early and long-term postoperative period demonstrated that the differentiated choice of surgical access to remove metastatic vertebral tumors provided a better quality of life in patients of Group I vs. Group II.



a *b* *c*

Figure 7 – Recection of L3 vertebral tumor using anterior access

a. MRI frontal image (red arrow indicates tumor location);
b. Intraoperative photo of tumor resection;
c. Intraoperative photo after tumor resection and spine stabilization



a *b* *c*

Figure 8 – Resection of Tn5–Tn7 vertebral tumors using anterior-lateral transthoracic access

a. MRI sagittal view image of a patient with a tumor of Tn5–Tn7 vertebrae;
b. MRI axial view image of a patient with a tumor of Tn5–Tn7 vertebrae;
c. Intraoperative photo of tumor resection; c. Intraoperative photo after tumor resection and spine stabilization

Conclusions/Висновки

A differential approach to the choice of surgical access depending on tumor location in patients with vertebral tumors led to a reduction (38.7 ± 1.1 months in Group II; 18.5 ± 1.3 months in Group I) of neurological deficit and pain regression in the postoperative period.

Anterior and lateral access for ventral and ventrolateral tumors operation made it possible to completely resect the tumor, reduce the traction of nerve structures, and obtain sufficient visual control of the operating field during the surgery.

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Conflict of interest/Конфлікт інтересів

The authors declare no conflict of interest.

Information about the authors/Відомості про авторів

Слинько Євгеній Ігорович – завідувач відділення патології спинного мозку, Інститут нейрохірургії ім. акад. А.П. Ромоданова НАМН України, м. Київ, Україна;

Потапов Олександр Олександрович – завідувач кафедри нейрохірургії та неврології медичного інституту Сумського державного університету, м.Суми, Україна;

Деркач Юрій Володимирович – лікар-нейрохірург відділення патології спинного мозку, Інститут нейрохірургії ім. акад. А.П. Ромоданова НАМН України, м. Київ, Україна