High-Tech Neurosurgical Treatment and Quality of Life Assessment in Patients of The Navoi Region

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Abstract: This article presents the historical aspects of the development and organization of neurosurgical care worldwide, neurosurgical treatment of trigeminal neuralgia, modern methods of neurosurgical treatment of brain tumors, a review of the effectiveness of modern methods for treating lumbar intervertebral disc herniations, and a differentiated approach to the treatment of neurosurgical patients. Quality of life and pain syndrome are assessed using questionnaires. Determining the effectiveness of surgical treatment and its impact on patients' quality of life.

Keywords: Trigeminal neuralgia, surgical treatment, brain tumors, intervertebral disc herniation, complicated monitoring, differentiated approach.

Introduction: Over the past decades, neurosurgical robotics has significantly transformed the methods of performing surgical interventions, providing new opportunities for increasing the precision and safety of operations. The use of modern robotic systems allows neurosurgeons to perform even the most complex manipulations with exceptional precision, which contributes to improved clinical outcomes and shortens patient recovery times. This has become possible thanks to progress in the development of robotic solutions, sensor systems, and artificial intelligence technologies [1,2,3,8,9,10,11,12]. Today, artificial intelligence and machine learning algorithms play a key role in the formation of new approaches in the field of robotic neurosurgery. In the future, it can be expected that neurosurgical practice will increasingly use high-precision automated technologies, which will significantly expand the possibilities for the treatment of severe pathologies of the central nervous system [1,2,3,8,9,10]. Conventional neuronavigation and neurovisualization technologies involve the use of two-dimensional images to guide surgical planning and neuronavigation. However, the integration of preoperative and/or intraoperative magnetic resonance imaging (MRI), computed tomography (CT), angiography, and tractography images into a real surgical environment provides neurosurgeons with an enriched, three-dimensional (3D), semi-immersive experience designed to improve surgical planning [1, 2, 3].

The primary tools for determining the quality of life of neurosurgical patients are questionnaires containing questions to which the patient must give one specific answer defining their feelings [3, 5, 6, 7].

The goal is to improve the results of neurosurgical treatment and the quality of life of patients through a differentiated approach and the use of high-tech neurosurgical care.

METHODS

This scientific study presents the results of an analysis of observations of 314 patients with neurosurgical diseases in the period 2018-2024, undergoing inpatient treatment at the regional multidisciplinary medical center of the Navoi region.

Our differentiated approach to treatment tactics was based on the clinical presentation, objective instrumental examination findings, the severity of neurological signs, and assessment of patient consciousness using the Glasgow Coma Scale and other methods. To assess quality of life, we used the EuroQol-5D European Quality of Life Questionnaire and the Visual Analogue Scale (VAS) to determine pain intensity, both of which had undergone a standard validation procedure.

RESULTS AND DISCUSSION

In our study, 314 patients were divided into four groups based on their clinical presentation for ease of comparison.

The first group included 117 patients (37.3%), including 97 (31%) patients with brain tumors for the first time and 20 (6.4%) with spinal cord tumors who had undergone surgery to remove their brain and spinal cord tumors.

(see Fig. 1).

The second group included 82 patients (26.1%) with degenerative spinal diseases who had undergone surgery to remove a herniated disc.

The third group included 57 patients (18.1%), including 46 (14.6%) with spinal cord injury sequelae and 11 (3.5%) with traumatic brain injury sequelae requiring rehabilitation.

In their studies, functional and other diseases were classified in the fourth group of 58 patients (18.5%). These included trigeminal neuralgia (16 patients (5.1%), vascular diseases of the brain and spinal cord (14 patients (4.4%)), as well as congenital Arnold-Kiari anomalies (1 in 25 cases), brain cysts (2), and spinal scoliosis (1), which accounted for 28 (8.9%) of the total number of observations.

The fourth group, along with functional neurosurgical diseases, also included congenital developmental anomalies of Arnold Chiari-1 y-25, brain cysts and congenital scoliosis of the spine (1 case of observation)
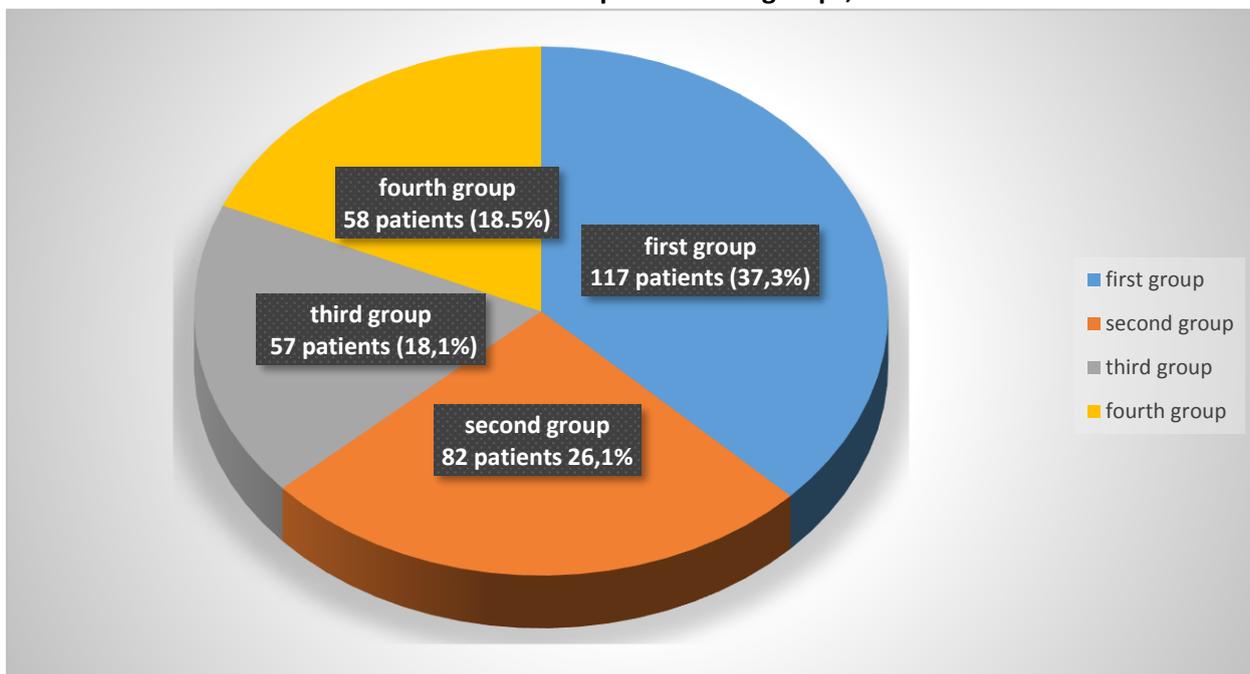
Distribution of studied patients into groups, n=314

Fig. 1. Distribution of patients by groups, n=314

In our study of 314 patients in all four groups, treatment was differentiated based on the clinical manifestations of neurosurgical diseases, using high-tech interventions.

During the epidemiological phase of the study, it is necessary to clarify the specific geographic location and demographic situation in the region.

In patients with primary brain tumors, the clinical presentation is diverse and is associated with the development of both focal and general cerebral symptoms. The onset of symptoms depends on the intensity of spread and the location of the lesion, which often leads to late detection of the disease.

By age, patients were distributed according to the WHO

classification, which provides for the following age groups: young age (14-19 years); younger middle age (20-44 years); older middle age (45-59 years); elderly age (60-74 years); old age (75-89 years); In our observations, patients ranged in age from 24 to 79 years. Given this, the distribution of patients by age group is as follows.

In the first group, the age and gender distribution of 117 patients (37.3%), including 97 (31%) with brain tumors and 20 (6.4%) with spinal cord tumors, showed that women predominated among the patients (71 (60.6%)), while men accounted for 46 (39.4%), which is 1.5 times less than women. The majority of patients (48 (41.0%) were middle-aged or elderly, with the largest number of patients (36 (30.7%)) in the 50-64 age group, consistent with data from international researchers.

In the second group, the age and gender distribution of 82 patients (26.1%) with degenerative diseases complicated by lumbar disc herniations showed that men predominated among the patients (58 (70.7%)) while women accounted for 24 (29.3%). This is due to the physical strain men experience during work. The majority of patients (34 (41.5%) were middle-aged or elderly, with the highest number of patients (25

(30.5%)) in the 50-64 age group, consistent with data from international researchers.

In the third group, the age and gender distribution of 57 (18.1%) patients requiring rehabilitation care showed that men predominated among the patients, with 40 (70.2%) and women 17 (29.8%), a finding related to the physical strain men experience during work. The majority of patients (23 (40.3%) were middle-aged or elderly, with the highest number (18 (31.6%)) in the 50-65 age group, consistent with data from international researchers.

In the fourth group, the age and gender distribution of functional and other neurosurgical diseases in 58 (18.5%) patients revealed that men predominated among the patients, with 41 (70.7%) and 18 (31.0%) women, which is related to the physical strain men experience during work.

A physical examination revealed that among the 314 patients, 121 (38.5%) had somatic pathology, manifested as arterial hypertension in 98 (31.2%) patients and ischemic heart disease in 23 (7.3%) patients. Diabetes mellitus was noted in 35 (11.1%) cases, liver pathology in 8 (2.5%) patients, and renal failure in 3 (0.9%) patients (see Fig. 2).

Indicators of concomitant somatic pathology in patients, n=314
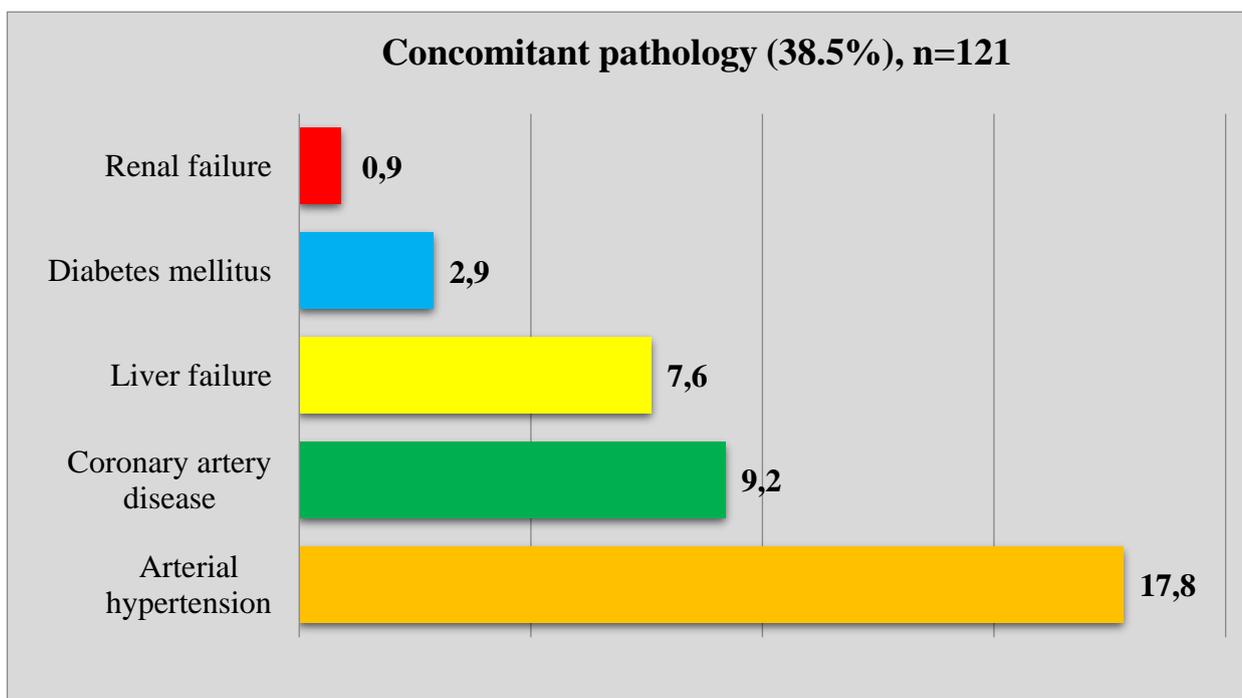

Fig. 2. Nosology of somatic pathology in patients, n=121

Of the 314 patients admitted to hospital, 117 (37.3%) were treated for neoplasms, including 97 (31%) with brain tumors and 20 (6.4%) with spinal cord tumors.

Almost half, 58 (49.6%), were in moderate condition upon admission, slightly more than a third, 43 (36.7%), were in severe condition, and only 13 (11.1%) were in

satisfactory condition. Two (1.7%) and one (0.85%) patients were admitted in an extremely severe and agonal state, respectively.

A study of 117 patients using the Glasgow Coma Scale revealed that 68 patients, or 58.1%, retained clear consciousness. Sixteen (13.7%) patients were in moderate obtundation and nine (7.6%) were in profound obtundation. The distribution of patients in severe condition was as follows: stupor - 9 (7.6%), coma I - 7 (5.9%), coma II - 5 (4.2%). The remaining 2 patients (1.7%) had a terminal coma - coma grade III.

A clinical and neurological examination of patients in the first group revealed the following changes: epileptic seizures were recorded in 11 (9.4%) patients; primary generalized epileptic seizures were observed in 24 patients (20.5%), and convulsive readiness was recorded in 16 (13.7%).

Headache was a persistent symptom and was observed in 74 (63.2%) patients. During the patient's inpatient stay, headache was often accompanied by vomiting and nausea (44 (37.6%) and 55 (47.0%) cases, respectively), and vomiting was repeated in 37 (31.6%) patients. One of the most common symptoms of brain tumors is nystagmus, which was observed in 37 (31.6%) of the 117 patients examined. Based on the analysis of data from the 117 observations, nuchal rigidity was observed in 57 (48.7%) patients. Motor impairments in the form of hemiparesis were recorded in 26 (22.2%) of the 117 patients in the study group. In our studies, patients with brain and spinal cord tumors were distributed according to the severity of their condition as follows.

In our studies, all 82 patients in the second group underwent surgical treatment. The indications for surgical treatment were: cauda equina syndrome with progressive pelvic dysfunction and radiculo-ischemic manifestations; radicular pain syndrome or lumbar pain of at least 4 weeks duration; intervertebral disc herniation of any location, but only at one level, confirmed by MRI with axial sections; Lack of response to conservative treatment.

There were only 122 cases of neurological symptoms in the second group; several symptoms could coexist in the same patient. The most common complaint presented by patients in the second group was lumbar spine pain (43 cases), the second most common

complaint was gait disturbance and sensory impairment (26 cases each), and the third most common complaint was a forced body position due to pain (21 cases). Neurological symptoms: low back pain - 27 (32.9%); low back pain radiating to one leg - 9 (9.7%); low back pain radiating to both legs - 7 (8.5%); isolated pain in the leg(s) - 7 (8.5%); gait disturbance - 26 (31.7%); forced body position due to pain - 21 (25.6%); sensory impairment - 25 (30.5%) cases.

The third group included 57 patients (18.1%) requiring rehabilitation care, including 46 (14.6%) with spinal cord injury and 11 (3.5%) with traumatic brain injury.

In our observations, two patients (18.2%) with movement disorders such as hemiparesis following traumatic brain injury received comprehensive rehabilitation treatment.

Twenty patients (4.3%) with sensory impairment following degenerative diseases with lumbar disc herniations also received comprehensive rehabilitation treatment. The patient examination revealed various types of impairments and neurological symptoms that persisted for a long time. It should be noted that forced body positions due to pain quickly regressed in 21 (25.6%) patients after rehabilitation treatment.

The fourth group included functional and other neurosurgical diseases (58 cases, 18.5%), including trigeminal neuralgia (16, 5.1%), vascular diseases of the head and spinal cord (14, 4.4%), and congenital anomalies (Arnold-Khiari malformation, 25 cases, brain cysts, 2 cases, and spinal scoliosis, 1 case, representing 28 cases, 8.9% of a total of 314 observations).

In our study of 16 patients, an analysis of the provoking factors based on the results of the study showed that almost all patients had the following: provoking factors such as chewing and talking (more than 93%), touch (8%), and cold, brushing teeth, washing, shaving, and opening the mouth (less than 5%).

We also examined symptoms of hypertonicity of the masticatory muscles, autonomic dysfunction, and hypoesthesia in the innervation zones of individual branches or the entire side of the face. We also confirmed that trigeminal neuralgia is characterized by short attacks (2-15 minutes) that can recur frequently (up to 30 times per day). A study of sensory disturbances in the innervation zone of the trigeminal nerve branches yielded the following results.

In our study of 58 patients with functional and other neurosurgical diseases, 25 (43.1%) had Arnold-Kiari anomaly-1 (AK-1). The most common and earliest symptom was headache, observed in 18-73% of patients. The most typical headache is "cough headache." A characteristic symptom, as the name suggests, is increased pain in the cervical-occipital region during coughing and sneezing, observed in 12-48% of patients. A similar increase in headache during the Waltz maneuver is observed in 75% of patients.

Sensory disturbances are reported as the first manifestation of the disease in up to 60% of all patients, most often affecting the arms. Overall, sensory disturbances were found in 19–76% of cases. Patients with concomitant syringomyelia typically exhibit symptoms of anterior horn involvement.

The third most common manifestation of MAC-1 is spinal pyramidal syndrome, characterized by tetra-, para-, or hemiparesis. Progressive weakness in the upper extremities is the initial manifestation of the disease in 44% of patients, and in the lower extremities in 39%. Bilateral lesions are characterized by asymmetry of paretic disturbances. Overall, motor impairments are detected in 20-80% of patients.

Pyramidal symptoms in our patients were combined with cerebellar and brainstem symptoms. In 13-52% of patients, the disease manifests with cerebellar symptoms, including static and gait disturbances, dysmetria, dyssynergia, and intention tremor.

Cranial nerve dysfunction was observed in 16-64% of patients. In 10-25% of these patients, the disease begins with unilateral or bilateral damage to the caudal nerves (dysphonia, dysphagia, tongue muscle atrophy, etc.).

Nocturnal breathing disorders are observed in 50-70% of patients, manifesting as hypopnea, central or obstructive apnea, and even acute respiratory failure.

To establish a diagnosis and select a treatment method, all patients underwent a comprehensive examination, including clinical, neurological, and instrumental examinations.

A quality-of-life assessment of 314 patients was performed using the EuroQol-5D Quality of Life Questionnaire and a visual analog scale (VAS) to determine pain intensity.

A study of 314 patients showed that the most significant impact on quality of life was on the pain/discomfort and anxiety/depression dimensions, which is contributed to by the patients' emotional state. Discomfort and anxiety, in turn, significantly impact patients' quality of life. An analysis of the quality of life (QOL) study results for 314 patients revealed that the data obtained in all four groups varied.

The deterioration in QOL indicators in the first group did not significantly differ from normal values. In the second group, QOL indicators deteriorated moderately.

In the second group, this indicator deteriorated significantly and recovered slowly. This is related to the disease progression and degenerative changes associated with spinal osteochondrosis and concomitant somatic pathology.

Across all study groups, the most significant deterioration in the EuroQol-5D questionnaire parameters was pain/discomfort and anxiety/depression. QOL assessments in all groups were conducted before and after surgical treatment (Table 1).

Table 1

Comparative indicators of the Euro Qul-5D questionnaire before treatment (n=314)

Groups	Number of patients	M (Mobility)	S (Self-service)	DA (Daily Activities)	P/D (Pain/Discomfort)	A/D (Anxiety/Depression)	EQ-health status score
1	117	1	1	0,39658	0,123	0,08611	0,66271
2	82	1	1	0,3404	0,123	0,08465	0,6645
3	57	1	1	0,34767	0,123	0,08727	0,65795

4	58	1	1	0,34767	0,123	0,08727	0,65795
Total:	314	1	1	0,36138	0,123	0,08601	0,661705
Note: the differences between the indicators are statistically significant (P < 0.001)							

The quality of life indicators for patients in the third group were stable, as they required rehabilitation.

Pain/discomfort and anxiety/depression descriptors were significantly abnormal in the second and third groups and recovered slowly. The quality of life indicators for patients in the first group returned to normal immediately after surgery.

Pain indicators for patients in the third group were stable, as they required rehabilitation. The indicators for the fourth group were labile, as pain is a major factor in trigeminal neuralgia, significantly affecting patients' quality of life.

The indicators for the fourth group were labile, as pain is a major factor in trigeminal neuralgia, significantly affecting patients' quality of life (see Table 2).

Table 2

Comparative indicators of the Euro Qul-5D questionnaire after treatment (n=314)

Groups	Number of patients	M (Mobility)	S (Self-service)	DA (Daily Activities)	P/D (Pain/Discomfort)	A/D (Anxiety/Depression)	EQ-health status score
1	117	1	1	0,38922	0,4979	0,95208	-0,57638
2	82	1	1	0,3259	0,5244	1,025	-0,6124
3	57	1	1	0,3501	0,3727	0,9483	-0,4421
4	58	1	1	0,3501	0,3727	0,9483	-0,4421
Total:	314	1	1	0,354912	0,464848	0,975237	-0,54345
Note: the differences between the indicators are statistically significant (P < 0.001)							

Pain syndrome as a strong irritant primarily affects the emotional state of patients, being a provoking factor; for clarity, we present data from a visual analogue scale (see Table 3).

Table 3

Comparative VAS scores before treatment (n=314)

Groups	Number of patients	1-no pain (0)	2-weak pain (1-3)	3-moderate pain (4–6)	4-strong pain (7-9)	5-unbearable pain (10)
1	117	0	20	7	0	0
2	82	0	22	33	1	1
3	57	0	30	42	8	1
4	58	0	30	42	8	1
Total:	314	0	72	82	9	2
Note: the differences between the indicators are statistically significant (P < 0.001)						

After surgical treatment, pain regressed to complete resolution in all three groups. Mild pain persisted in only two patients in the first group, one patient in the second group, and four patients in the third group, demonstrating the effectiveness of differentiated treatment methods. Postoperative pain parameters in patients are presented in the following table (Table 4).

Table 4

Comparative VAS scores after treatment (n=314)

Groups	Number of patients	1-no pain (0)	2-weak pain (1-3)	3-moderate pain (4–6)	4-strong pain (7-9)	5- unbearable pain (10)
1	117	115	2	0	0	0
2	82	81	1	0	0	0
3	57	53	4	0	0	0
4	58	58	0	0	0	0
Total:	314	307	7	0	0	0
Note: the differences between the indicators are statistically significant (P < 0.001)						

The visual scale and its five parameters allow for a more detailed examination of pain syndrome. Absence of pain (0 points), mild pain (1-3 points), moderate pain (4-6 points), very severe pain (7-9 points), and unbearable pain (10 points) represent the maximum possible range of pain sensation.

We place significant emphasis on magnetic resonance imaging (MRI) data from 1.5 to 3.0 Tesla, MSCT, and digital X-ray examination methods when establishing a diagnosis and determining further treatment strategies.

Our studies utilized electroneuromyography (ENMG), which determines the level of damage to the cauda equina roots, allowing us to choose surgical or conservative treatment strategies for lumbar pain associated with spinal osteochondrosis with a 75% accuracy rate.

In our studies, we used questionnaires to assess patients' quality of life: the Euro Qol-5D Quality of Life Questionnaire and a visual analogue scale (VAS) to determine pain intensity. After diagnosis, all patients underwent surgery or conservative treatment, with the strategy determined based on the increasing severity of pain and signs of root damage.

Thus, limited mobility and the inability of patients to perform daily activities significantly impair social functioning and adaptation to the surrounding environment. The lengthy rehabilitation process and pain syndrome exhaust the nervous system in most patients, causing emotional distress and depressive symptoms that persist long after recovery.

CONCLUSIONS

1. A physical examination revealed that among 314 patients, 121 (38.5%) had somatic pathology, manifested as arterial hypertension in 98 (31.2%) patients and ischemic heart disease in 23 (7.3%) patients. Diabetes mellitus was noted in 35 (11.1%) cases, liver disease in 8 (2.5%) patients, and renal failure in 3 (0.9%) patients. The main contraindications for high-tech neurosurgical interventions are general anesthesia and lack of equipment.

2. Of the total number of 314 patients, 117 (37.3%) were observed with neoplasms, including 97 (31%) with brain tumors and 20 (6.4%) with spinal cord tumors admitted to hospital for treatment. Almost half, 58 (49.6%), were in a moderate condition upon admission, slightly more than a third, 43 (36.7%), were in a severe condition, and only 13 (11.1%) were in a satisfactory condition; 2 (1.7%) and 1 (0.85%) patients, respectively, were admitted in an extremely severe and agonal state, which greatly affects the quality of life of patients.

3. The neurosurgical service in Navoi Region is well

organized, employing high-tech neurosurgical treatment methods in approximately 80% of cases. The equipment available accounts for 60% of the total number of cases of brain tumors per 100,000 people, representing 4% of the total cancer incidence in the Republic of Uzbekistan.

4. The use of high-tech methods and a differentiated approach to treating neurosurgical patients with different conditions has proven effective, particularly for brain and spinal cord tumors, with an average improvement of 2.5%.

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