Research article

Postoperative complications in patients with intracranial meningiomas who underwent surgery

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ABSTRACT

Introduction and Aim: A benign tumor of the central nervous system known as a meningioma of the brain can be effectively treated surgically to assure complete patient recovery. The objective of this study was to investigate intracranial postoperative complications in meningiomas, identify factors that are prognostically significant, assess the results of surgical therapy, and provide rational solutions for difficulties associated with brain meningiomas.

Materials and Methods: The 202 observations of patients with supratentorial meningiomas who had surgery provided the basis for the current study. In the 20 patients who survived, we looked at a number of surgical problems. Clinical evaluation and instrumental diagnostic methods were used to confirm their nature.

Results: Most patients with basal located meningiomas experience surgical issues. Meningiomas were discovered to be basal in 12 (60.0%) of the survivors who encountered postoperative complications. Patients with postoperative complications from meningiomas frequently encountered many cumulative issues, with a death rate of 5 (2.5%) and one or occasionally two complications in survivors.

Conclusion: The growth of tumors, surgical trauma, and the body's general reaction to the removal of neoplasms all affect the body's activity at all levels (subcellular, cellular, organ, and systemic) in patients with supratentorial meningiomas, leading to postoperative complications.

Keywords: Meningioma; postoperative complications; swelling; surgical trauma; intracranial pressure.

INTRODUCTION

Meningiomas of the brain are a type of benign tumor of the central nervous system, and they can be successfully treated surgically to ensure full recovery for patients (1, 2). Numerous studies have shown that the clinical manifestations and signs of brain tumors are variable and result from a number of causes, such as the tumor process itself as well as the processes of the brain tissue that surround the tumor and anomalies in the patterns of the hemo- and cerebrospinal fluid as well as the water-electrolyte balance (3).

The use of multicomponent anesthesia, microsurgical techniques, optimal surgical approaches to the tumor, modern life support techniques in the postoperative period, and continuous improvement of diagnostic methods have significantly decreased postoperative mortality and increased the radicality of surgical operations (4, 5). However, even with advanced diagnostic and surgical methods, meningioma treatment outcomes aren't always satisfactory. Contrary to expectations, well-executed meningioma removal procedures frequently end in fatal complications involving the nervous system and internal organs (6, 7).

Numerous studies on meningiomas of the brain have focused on the diagnosis and various surgical treatment facets of these neoplasms to date. However, a crucial area of neuro-oncology that deals with the formation and growth of a complex of numerous complications following surgery that are brought on by the tumor process, surgical trauma, and pathophysiological reactions to the removal of the neoplasm is still largely unexplored. The pathogenetic processes underlying these illnesses are not well understood (8, 9).

The objective of this study was to investigate intracranial postoperative problems in meningiomas, identify aspects that are prognostically important, evaluate the effects of surgical therapy, and propose rational therapeutic strategies for complications related to meningiomas of the brain.

MATERIALS AND METHODS

The current study is based on an analysis of 202 observations of patients with supratentorial meningioma who underwent surgery at the neurosurgical clinic of the National Hospital of the Ministry of Health of the Kyrgyz Republic (Bishkek, Kyrgyzstan). In 20 surviving patients, we investigated various surgical issues. Their problems' nature was

validated clinically and by instrumental diagnostic techniques. There were 146 (72.3%) women and 56 (27.7%) males among the patients. The average age was 50.5±1.7 years (range:18 to 75 years). All patients had roentgenological evaluations of the brain both before and after surgery. 154 patients (76.2%) had tumors that were big in size, according to computed tomography (CT) and magnetic resonance imaging (MRI) data (Table 1).

Table 1: General characteristics of the investigations

General characteristics	**N (%)**
Number of patients undergone surgery	202
Number of surgeries performed	212
Males	56 (27.7%)
Females	146 (72.3%)
Mean age	50.5±1.7 (18–75 years)
Giant tumors	154 (76.2%)
Basal location	12 (60%)
Mortality	5 (2.5%)

202 patients received 212 surgeries aimed to remove the tumor over the study period. Meningiomas were surgically removed using a variety of surgical techniques. Under general anesthesia, endotracheal anesthesia and intubation were used for all procedures.

The obtained data are presented as the n (%). Statistical data analysis and mathematical processing were carried out using Excel.XLSTAT v2020.1 (Microsoft, Addinsoft, France). The Mann–Whitney U-test was used to assess the statistical significance of the differences. The data obtained was kept confidential, and the study was authorized by the I.K. Akhunbaev Kyrgyz State Medical Academy Bioethics Committee (Protocol No. 12 dated December 18, 2018).

RESULTS

The two main categories of postoperative complications by localization are visceral and intracranial. Hemorrhages, localized softening, and brain edema are the three primary categories of intracranial complications. Patients who experienced postoperative complications were primarily young and middle-aged women. For comparison, we point out that 146 (72.3%) of the 202 patients who underwent surgery for supratentorial meningiomas were female. Recent studies suggest that meningiomas frequently occur in female patients because these tumors are hormone dependent.

Patients with meningiomas that have basal location have surgical problems most frequently. In 12 (60.0%) of the survivors who experienced postoperative complications, meningiomas were found to be basal. The significant functional role of the basal-subcortical and adjacent brain stem divisions for the vital activity of the patient's brainstem is what accounts for a significant number of postoperative complications in patients with basal localization of meningiomas.

Meningioma patients who experienced postoperative problems often had several cumulative difficulties, with a fatality rate of 5 (2.5%) and one or rarely two complications in survivors. The process of complications' development typically started with brain disorders in cases with poor postoperative outcomes (localized softening, hemorrhages, dislocations), and then internal organ complications (hemorrhages, inflammatory changes, thromboembolism) were added.

Only if there is complete, trustworthy knowledge about each of these illnesses is timely diagnosis and pathogenetically justified treatment of postoperative problems with their independent development or in conjunction with each other possible.

Brain swelling, which almost all patients experienced after the excision of meningiomas, was one of the most frequent postoperative complications. It should be mentioned that only postoperative brain swelling and edema that had pathological importance in the postoperative phase were considered.

Swelling of the brain with extensive dislocation abnormalities were found in 19.3% of patients as the primary cause of postoperative death, more frequently with convexital and parasagittal localization of meningiomas.

Rough forms of their presentation, a common combination of several types of dislocations in one patient, particularly cerebellar and temporo-tentorial wedges and infringements, and distortion of the brain stem were all characteristics of dislocation diseases.

Contrary to the deceased, brain and dislocation abnormalities emerged in the survived patients in a lesser form, with no obvious vital aberrations, and a propensity to stabilize with therapy. A distinctive clinical picture, intracranial pressure (ICP) monitoring, and other research techniques (electrophysiological, CT, and MRI) were used to make the diagnosis of postoperative brain swelling.

Electroencephalographic results indicate of the tumor's impact on the diencephalic-stem regions of the brain were identified prior to surgery in patients with a poor postoperative result. The individuals for whom this crucial predictive criterion was identified needed more thorough preoperative planning. In the first few hours following surgery, over half of the patients showed symptoms of intracranial hypertension, with the largest increase in ICP (up to 670 mm), according to the monitoring of ICP in the epidural space after removal of the tumor.

Visually tracking the dynamics of postoperative brain swelling development and isolating its local, generalized, or total forms were made possible by CT and MRI. The CT image of increasing brain swelling in the first 2-5 days following surgery against the background of decongestant therapy served as a poor

prognostic sign in observations with an unfavorable postoperative outcome of CT and MRI that revealed the predominance of generalized forms of brain swelling. Cerebral vascular problems were the most common category of surgical complications in meningioma patients, with localized softening and hemorrhages seen in 13 (65.0%) deceased patients. Focal ischemia was found in four cases (20.0%), hemorrhages in 3 (15.0%) patients, and their combinations in five cases (25.0%) (Fig. 1).

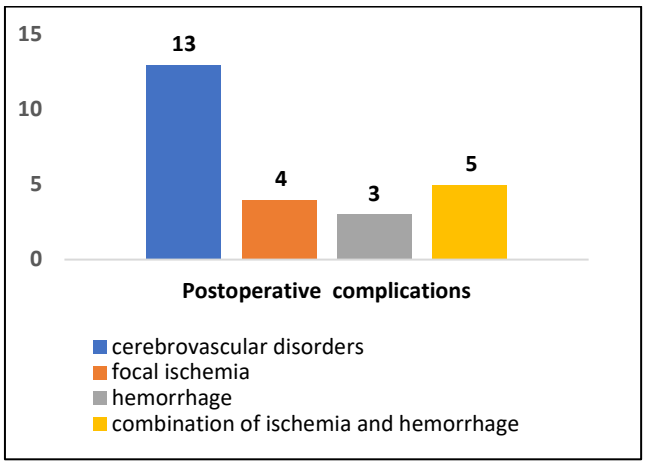

Fig. 1: Distribution due to complications

Following the resection of meningiomas with basal location, localized softening in the brain most frequently occurred (in 68.4% of dead patients). The softening foci were typically found close to the resected tumor, more frequently in the basal-diencephalic regions, and frequently progressed to the stem regions of the brain.

In the surviving patients with postoperative ischemia problems, meningiomas were primarily localized in the convexital and parasagittal regions. Compared to their convexital and parasagittal localizations, softening foci located in the basal regions of the brain caused a larger risk to the patients' lives.

DISCUSSION

After basal meningioma removal, most patients suffered from postoperative cerebral hemorrhages. In addition, 2/3 of the patients had just one brain hemorrhage, while 1/3 had many. In 67.3% of patients, hemorrhages were localized in the ventricles and subcortical-stem areas of the brain; in 33.2% of cases, they were in the white matter and subcortical spaces of the hemispheres, uncommonly close to the location of the surgically removed tumor (10).

Complex changes were observed in the brain, coupled with combined ischemia and hemorrhagic effects. Gross dislocation anomalies, as well as one or more sites of softening and hemorrhage, were invariably seen. These most severe side effects almost often manifest when basal meningiomas are resected (11). Cerebral vascular problems (focal softening and hemorrhages) usually coexisted with internal organ disorders, the most prevalent of which were pneumonia, adrenal hemorrhages, and gastrointestinal bleeding (12).

Clinically evident in the first hours following surgery in 2/3 of patients, focal softening is characterized by a very serious general state with cerebral, stem, and vital abnormalities. After the tumor was removed, in 1/3 of the patients, symptoms of focal ischemia began to manifest in the first three days. This was followed by a brief period of relative health, a sharp rise in cerebral and stem problems, and to a lesser extent, localized symptoms. Due to the frequent location of softening zones in the subcortical-stem regions and the rapid worsening of the overall state carried on by the underlying disease and frequently coexisting complications, hemispheric focused symptoms were not typical of patients with ischemic disorders.

The clinical manifestation of intracranial hemorrhages in half of the patients occurred right away following surgery and was defined by a combination of severe cerebral, stem, and vital abnormalities. In these observations, brainstem and subcortical hemorrhages predominated. The hemorrhages more frequently occurred in the subcellular spaces and white matter of the cerebral hemispheres in the other half of the patients, appearing 1-4 days after the tumor was removed and showing a "light gap". The quick onset of cerebral and localized symptoms, followed by dislocation problems, provided the clinical picture (13).

The clinical picture and other research techniques (brain CT and MRI, and electrophysiological analysis) were used to make the diagnosis of ischemic and hemorrhagic illnesses of the central nervous system. In the initial hours following surgery as well as the first three days following tumor excision, combined ischemia and hemorrhagic consequences emerged and were characterized by severe violations of essential functions (14). Regardless of the extent of surgical blood loss, studies of the volume of circulating blood, central venous pressure, and other hemodynamic parameters conducted in the postoperative period showed that signs of hypovolemia caused by violations of the central regulation of blood circulation were always found in patients. Considering this, vascular problems and other events developed (15).

The most useful diagnostic technique for cerebral hemorrhages was CT/MRI, which, independent of the location and magnitude of the hemorrhages, always accurately revealed the nature of the process (16). It might be challenging to anticipate how the postoperative phase will unfold. It is impossible to accurately predict the extent of changes and abnormalities caused by the tumor process in different organs and tissues. However, by using the revealed patterns in the development of types of postoperative complications and taking into account the factors

predisposing to these complications, it is possible to predict with a degree of certainty and, as a result, control the course of the postoperative period (17).

CONCLUSION

Postoperative complications in supratentorial meningiomas impact 65.0% of patients and are conditionally defined as intracranial (brain edema, localized softening, and hemorrhages). The most frequent type of surgical complication, brain swelling is reported in almost all patients with poor surgery results. Edema and brain swelling are demonstrated to be the main contributing factors in fatal outcomes in 19.3% of cases. Postoperative complications in patients with supratentorial meningiomas are caused due to alterations in the body's activity at all levels (subcellular, cellular, organ, and systemic) caused by the growth of tumors, surgical trauma, and the general response of the body to the removal of neoplasms. Changes in the brain's integrative functioning as well as the dysfunction of various organs and body systems are the root causes of a range of postoperative complications.

CONFLICT OF INTEREST

Authors declare no conflict of interest.

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