

Original Article

Surgical treatment of cerebellar metastases

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Abstract

Background: Cerebral metastases are a common neurosurgical finding. Surgery confers several advantages to other therapies, including immediate symptomatic improvement, diagnosis, and relief from corticosteroid dependence. Here we evaluate patients with cerebellar metastases who underwent surgery and compare their findings to those in the literature, and address the benefit of avoiding ventriculo-peritoneal shunting in patients undergoing surgery.

Methods: We performed a retrospective analysis involving 50 patients with cerebellar metastases who underwent surgical resection. Ventriculo-peritoneal shunts were placed in patients necessitating permanent CSF drainage. We evaluated presentation, diagnosis, complications, and outcome.

Results: Our review included 21 males and 29 females, 29 to 82 years of age. Primary tumors included lung (48%), breast (14%), GI (14%), endometrial/ovarian (6%), melanoma (6%), sarcoma (4%), lymphoma (4%), laryngeal (2%), and other (2%). Clinical symptoms at presentation commonly were those secondary to elevated intracranial pressure and were the initial complaint in 34% of patients. Preoperatively, 29 patients were noted to have hydrocephalus. Importantly, 76% of these patients were able to avoid placement of a ventriculo-peritoneal shunt following surgery. Only two complications were noted in our series of 50 patients, including a symptomatic pseudomeningocele and a wound infection. No symptomatic postoperative hematoma developed in any surgical case.

Conclusion: A review of the literature has shown a high complication rate in patients undergoing surgical resection of cerebellar metastases. We have shown that surgical resection of cerebellar metastases is a safe procedure and is effective in the treatment of hydrocephalus in the majority of patients harboring cerebellar lesions.

Key Words: Cerebellar metastases, external ventricular drain, hydrocephalus, ventriculo-peritoneal shunt

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INTRODUCTION

Cerebral metastases are the most common oncological issue encountered in the neurosurgical community. The

incidence of cerebral metastasis ranges from 20% to 40% of patients with solid cancers.^[2,5] Reports estimate that in the United States, 60,000 to 170,000 new cases of metastatic brain lesions occur each year, up to 20% of

these lesions being solitary.^[4,10,19] Untreated, the median survival of patients with metastatic brain lesions is 1 month and 2 months with the use of corticosteroids.^[9,14,15] Results of the efficacy of treatment options is still debated, with the literature showing benefits of all three major treatment modalities—surgical resection, whole brain radiation (WBR), and stereotactic radiosurgery (SRS).^[3,7,10,11,15,17,18,23] The advantage of surgery is immediate symptomatic improvement, diagnosis, as well as relief from corticosteroid dependence.^[1,3,6-8,11-13,18,20-22]

Metastases to the cerebellum are poorly tolerated, and carry a poorer prognosis compared to supratentorial metastases. Posterior fossa lesions can lead to hydrocephalus, herniation, brainstem compression, and death. Diagnosis is critical to survival, and signs/symptoms of cerebellar lesions should prompt diagnostic studies. Even though up to 30% of patients with intracranial metastases harbor cerebellar lesions, only a limited number of papers are available evaluating treatment of such lesions. From the limited literature available, factors leading to improved survival included surgical resection, radiotherapy, Karnofsky scores (>70), younger age, fewer intracranial metastases, and absence of postoperative complications.^[1,6-8,12,13,16,20-22]

In order to evaluate the effectiveness and safety of surgery in patients with cerebellar metastases, we retrospectively evaluated patients with cerebellar metastases who underwent surgery and compare our findings to those in the literature. We also address the surgical efficacy of avoiding ventriculo-peritoneal shunting (VPS) in patients with hydrocephalus secondary to cerebellar metastases, an issue that has not been addressed in the literature.

MATERIALS AND METHODS

After IRB approval, we performed a retrospective study involving 50 consecutive patients with cerebellar metastases who underwent surgery at Rush University Medical Center (RUMC) from 1999 to 2009. Patients were selected from several hundred patients with known intracranial metastases treated at the institution. Patients selected for surgery had large lesions with mass effect and/or hydrocephalus. Resection was carried out via either a retrosigmoid craniotomy or midline suboccipital craniotomy, with the exception of one trans-tentorial occipital approach. Additionally, external ventricular drains (EVD) were placed perioperatively in patients necessitating temporary cerebrospinal fluid (CSF) drainage—some of whom required permanent shunting. Postoperatively, all patients received a non-contrast head CT within hours of surgery. Our analysis included a review of presentation, diagnosis, complications, and outcome.

RESULTS

Of the 50 patients undergoing resection of cerebellar

metastases, 21 were males and 29 females ranging from 29 to 82 years of age (average 54 years) [Table 1]. The mean time from diagnosis of the primary cancer to the diagnosis of cerebellar metastases was 17 months (range 0–88 months). Of the 50 patients included in this review, neurological symptoms were the initial complaints in 34% of the patients leading to an investigation of a primary malignancy. All patients were diagnosed based on neurological symptoms necessitating evaluation with either a head CT or MRI. Primary site of tumor metastases included lung (48%), breast (14%), GI (14%), endometrial/ovarian (6%), melanoma (6%), sarcoma (4%), lymphoma (4%), laryngeal (2%), and other (2%). Sixty-four percent of patients were found to have single cerebellar metastases, 4% had two cerebellar metastases, 8% had single cerebellar and single supratentorial metastases, and 24% had a single cerebellar and multiple supratentorial metastases. 30 of the 50 patients had a cerebellar lesion more than 3 cm in diameter.

Clinical symptoms were often multiple at presentation, and commonly were those caused by increased intracranial pressure [Table 2]. Presenting manifestations of intracranial metastases included headaches (64%), gait disturbances (42%), nausea/vomiting (30%), dizziness (18%), visual changes (10%), altered mental status (6%), and seizure (2%).

Perioperatively, EVDs were temporarily placed in 10 patients needing temporary CSF diversion for either hydrocephalus or fear of possible hydrocephalus following surgery. Preoperatively, 29 patients were noted to have hydrocephalus on imaging. Of these 29 patients, 7 required a VPS, including 3 of the 10 who received a perioperative EVD. One patient developed delayed hydrocephalus 2 weeks after surgery and another patient

Table 1: Characteristics of patients

	Number (%)
Age at diagnosis of cerebellar metastases (years)	
Average	54
Range	29-81
Time of diagnosis from primary cancer (months)	
Average	17
Range	0-88
Male sex	21 (42)
Primary disease	
Lung	24 (44)
Breast	7 (14)
GI	7 (14)
Endometrial/ovarian	3 (6)
Melanoma	3 (6)
Lymphoma	2 (4)
Sarcoma	1 (2)
Laryngeal	1 (2)
Other	1 (2)

Table 2: Clinicopathological features

	Number (%)
Symptoms	
HA	32 (64)
Gait	21 (42)
Nausea/vomiting	15 (30)
Dizziness	9 (18)
Visual	5 (10)
Altered mental status	3 (6)
Seizure	1 (2)
Number of cerebellar metastases	
1	48 (96)
2	2 (4)
3 or more	0 (0)
Number of supratentorial metastases	
0	34 (68)
1	4 (8)
2 or more	12 (24)
Tumor size (cm)	
<3	13 (26)
3 or more	30 (60)
unknown	7 (14)

developed hydrocephalus secondary to leptomeningeal carcinomatosis diagnosed on MRI. The average hospital stay was 4.64 days after surgery, with a mean ICU stay of 1.5 days.

Of the 50 patients in our series, complications were observed in 2 patients, a symptomatic pseudomeningocele and a wound infection, both of which required an additional operation. No symptomatic postoperative hematoma developed in any surgical case.

DISCUSSION

Posterior fossa metastases by nature of their location can prove life threatening if untreated. Patients may deteriorate within days, from intracranial hypertension and/or brain stem compression. This may also be the scenario in patients undergoing radiation for cerebellar lesions, with increased swelling and acute hydrocephalus. Yet, many patients with primary malignancies have no knowledge about their disease burden until presenting with neurological complaints. In our study, we found that 34% of our patients had no prior diagnosis of cancer and learned of their malignancy only after neurological complaints led to appropriate imaging. Surgery should be strongly considered in patients harboring large lesions with significant edema and neurological symptoms.

A review of the literature yields little information on treatment and clinical scenarios of cerebellar metastases [Table 3]. The first large series published was conducted by Fadul *et al.*, in 1987, encompassing 59 patients. Sixteen of the patients underwent surgical decompression

Table 3: Studies comparisons

Study	Age	Complications	VPS*	Hospital stay (days)	Time to diagnosis (months)
Wronski ^[21]	61	19 % Requiring reoperation	23%	NA	27
Yoshida ^[22]	57	NA	NA	NA	13.5
Ampil ^[11]	33<65 12>65	NA	4%	NA	7
Pompili ^[12]	58	18% Hematomas requiring re-operation 2% Occipital infarct 4% Surgical deaths	0%	NA	NA
Rajendra ^[13]	53	NA	NA	15	NA
Fadul ^[6]	56	25% Meningitis	10%	NA	15.5

in addition to radiation and steroids—the remaining received radiation and steroids alone.^[6] Patients who underwent surgery all had solitary cerebellar metastases. Surgical results proved disappointing with two patients dying postoperatively and two developing meningitis. Additionally, reported survival time was similar in the surgical and non-surgical groups, questioning the benefit of surgery in patients with cerebellar metastases.

Ampil *et al.* described their experience at LSU in 45 patients from 1981 to 1993.^[11] Eleven of the patients underwent surgery followed by radiation, the remainder underwent radiation alone. When comparing surgery and radiation to radiation alone, they found a much longer survival time in the surgery group (median survival time of 15 months versus 3 months). This sharply contradicted the outcomes noted by Fadul *et al.* However, the authors noted that patients treated with radiation alone had a poorer prognosis and failed to note complications encountered in their experiences.

The largest study is that of Yoshida, which included 109 patients.^[22] Patients either received radiation alone, surgery alone, or both. The group found that surgery combined with radiation conferred improved prognosis and that surgery alone proved more beneficial than radiation alone. However, complications encountered following surgery, including morbidity/mortality, and the number of patients receiving VPSs was not addressed.

In the article presented by Pompili *et al.*, the authors made note of the complications encountered in 44 patients undergoing resection of cerebellar metastases.^[12] Of the nine significant complications encountered, eight

included cerebellar hematomas which required evacuation and one occipital infarct believed to be a result of retraction. One common factor among these nine patients was a tumor dimension greater than 3 cm. From a surgical perspective, the authors utilized both a trans-tentorial occipital approach and a suboccipital approach, and found that hematomas were a complication of both approaches.

Wronski *et al.* looked at 74 patients with intracranial metastases from colorectal cancer, 26 of which included surgically treated cerebellar lesions.^[21] 23% of these patients required a VPS, and more importantly, 19% experienced postoperative complications requiring reoperation. Whether complications occurred in tumors of greater dimensions is not mentioned nor are the specific details of the complications encountered. Rajendra *et al.* included 13 patients in their series.^[13] Unique to their paper, the authors include the average hospitalization stay (15 days), but make no remarks on complications.

In review of the literature, several papers note complications involved in resection of posterior fossa metastases, and only two describe specific complications requiring surgical intervention [Table 3]. From a technical standpoint, only Ampil *et al.* and Pompili *et al.* make reference to surgical technique. In comparison to other publications, we found a dramatic decrease in operative complications and a shorter hospital stay. In our series, there was no mortality and only 4% morbidity. Also, no symptomatic postoperative hematoma developed in any surgical case. Two patients who underwent re-operation for wound complications were discharged without any permanent neurological changes. Length of stay at 5 days was favorable, shorter than the 15 days in the series found by Rajendra *et al.*

We feel there are several explanations to address our low complication rates compared to those found in the literature. Preoperatively, we utilize stealth imaging in order to better delineate tumor from “normal” brain parenchyma as well as from important vascular structures, which translates into intraoperative stealth guidance and safer surgery. Our group also emphasizes the importance of intraoperative hemostasis and we prophylactically transfuse platelets and blood factors to reverse patients who are taking anti-coagulants and/or are found to have elevated international normalized ration (INR) of greater than 1.5. If patients are taken to the operating room on a semi-elective basis while taking aspirin, they are told to hold aspirin 1 week prior to surgery. Additionally, postoperative patients are monitored with arterial lines in a neurological intensive care unit and placed on anti-hypertensive oral or intravenous medications in order to achieve meticulous blood pressure goals following surgery in order to prevent postoperative hematoma formation.

In our study, 76% of patients with preoperative hydrocephalus were able to forgo permanent CSF shunting following surgical resection. We could find no study in the literature describing the benefits of surgery or radiation in avoiding a VPS. Our data suggests that surgery reverses hydrocephalus in the majority of patients with hydrocephalus, eliminating the need for further surgery and possible complications that may arise from placement of a VPS (i.e., malfunction, infection, hemorrhage). Whether radiotherapy can have such an impact may be a topic for future studies.

From a technical standpoint, suboccipital craniotomy is a safe and efficient way to treat cerebellar metastases in the hand of an experienced surgeon. Surgery has been shown to increase the mean duration of survival in patients with cerebellar metastasis when compared to radiation alone, and shortens the need for corticosteroid therapy, provides immediate symptomatic relief, and many times avoids the requirement of a VPS. We advocate such procedures in patients medically stable for surgery, or otherwise those with acute obstructive hydrocephalus and deterioration.

Several limitations exist in our paper. The study was a retrospective study assessing surgical outcomes. Additionally, many of the patients in this analysis were sent to our institution from referring oncologists from outside institutions, and returned back to their oncologists for further care following surgery. As a consequence, after reviewing the patient charts and clinic notes within our hospital database, much of the data on prior and/or future radiation treatment as well as patient survival was not obtainable for review. We would like to stress, however, the importance we aim to emphasize is to show that by surgical resection, we can avoid the need for VPS in these patients and the problems associated with this procedure both operatively and post-operatively.

CONCLUSION

Surgical resection of cerebellar metastases is a safe procedure and is effective in the treatment of hydrocephalus in the majority of patients harboring cerebellar lesions. Many patients are able to avoid the need for a VPS following surgical resection, which limits the immediate and sequential complications affiliated with VPSs. From our knowledge, this is the first paper analyzing the importance of surgery in preventing the need for a VPS.

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