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Original Article

Bilateral occipital metastases: Visual deficits and management considerations

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ABSTRACT

Background: Metastases to the bilateral occipital lobes pose a difficult clinical scenario due to risk of debilitating visual loss. We sought to characterize clinical outcomes following different treatment modalities to help guide management in this challenging situation.

Methods: We retrospectively reviewed brain metastases patients treated at a single institution between 2008 and 2017 and assessed visual symptoms before and after treatment, the tumor and peritumoral edema volumes before treatment, and clinical outcomes including mortality.

Results: Eighteen patients with metastases affecting both occipital lobes were identified. Lung cancer represented the most common primary (n = 10). Visual deficits were present in 12 patients at the time of diagnosis of bilateral occipital metastases (67%). Patients received radiotherapy (n = 5) or combined surgical resection and radiotherapy (n = 13). Among symptomatic patients, two received radiation and 10 received combined surgery and radiation. Nine patients had improved visual symptoms after treatment with no new visual deficits reported as a result of treatment. Among asymptomatic patients, three were treated with radiation alone and three with resection and radiation. Three of these patients developed new visual symptoms following treatment, including one patient with Balint's syndrome.

Conclusion: Patients with symptomatic bilateral occipital lobe metastases may experience visual improvement following intervention, especially if symptoms stem from compression or edema. Those without visual symptoms are at risk of developing new visual deficits during treatment, which should be included in the decision-making process and when counseling patients. Visual deficits improved after surgery in the majority of patients, with no cases of immediate visual deterioration.

Keywords: Blindness, Brain metastases, Occipital, Radiation, Vision

INTRODUCTION

Brain metastases are the most common intracranial tumors in adults, with a rising incidence as systemic disease control improves patient survival and screening increases with readily available imaging modalities.[3,5,10] The decision to treat brain metastases balances the benefits of tumor control, symptom alleviation, and survival with the risks of functional impairment and reduced quality of life.[6]

The nuanced impact of the treatment of brain metastases is highlighted in the scenario of metastases involving bilateral occipital lobes, which pose heightened risk to vision loss with or without intervention.[2] As patients with metastatic brain metastasis have a poor prognosis,[1] understanding risk of visual deterioration is vital in considering treatment. We, thus, sought to analyze the rates of visual change following radiation and/or surgery in patients with bilateral occipital metastases to abet decision-making in these challenging cases.

MATERIALS AND METHODS

Data source and study design

We conducted a retrospective cohort study of brain metastases patients treated at a single institution from 2008 to 2017 to identify cases affecting both occipital lobes. We reviewed imaging, patient demographics, histology of the primary tumor, surgical details, visual symptoms, and volume of tumor and edema before and after therapy. The study design was reviewed and approved by the hospital's Institutional Review Board (IRB). Patient consent was waived for retrospective chart review research, within the scope of IRB approval by our institution.

Inclusion and exclusion criteria

We included adult patients (age >18 years) diagnosed with bilateral occipital brain metastases (located between the occipital pole and parieto-occipital sulcus) who received radiation or surgical resection plus radiation treatment. We excluded patients if either occipital metastasis had a diameter under 1 cm at presentation to assess tumors for which surgery would be considered a treatment option.[7] Following radiological review, 18 patients were included for analysis.

Statistical analysis

The volumes of enhancing tumor and associated peritumoral edema were independently segmented (Brainlab, Munich, Germany) for analysis before and following treatment using T1 postcontrast and T2 fluid attenuation inversion recovery (FLAIR) MRI sequences [Figure 1]. Descriptive statistics and unadjusted linear regression analyses were conducted using the R package version 3.3.3.[14]

RESULTS

Patient characteristics

Eighteen patients (13 women and 5 men) with bilateral occipital metastases were identified [Table 1], with a median age of 64 years (range 27–89 years). The most frequent primary cancers were lung (n = 10), melanoma (n = 3), and breast (n = 2). The 10 lung cancers included 3 adenocarcinomas, 2 large cell neuroendocrine tumors, 2 poorly differentiated tumors, 1 small cell lung cancer, and 2 with unknown histopathology. Both breast cancer metastases were triple-positive tumors, with immunopositivity for estrogen receptor, progesterone receptor, and herceptin-2 (HER2).

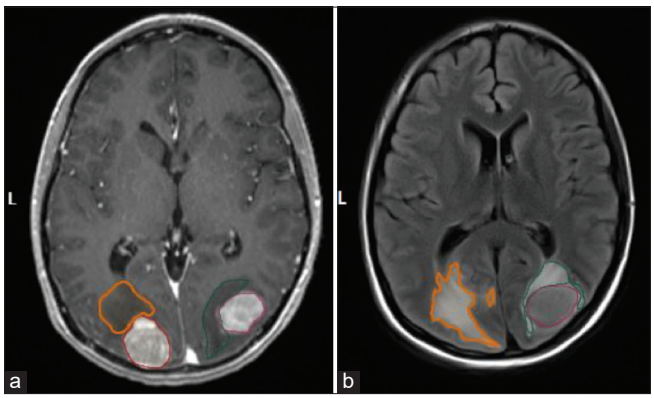

Figure 1: Representative image of patient with bilateral occipital metastases highlighting tumor size and edema. (a) A representative T1 postgadolinium contrast signal of a patient is highlighted. Segmentation of the solid tumor was used for quantitative volumetric analysis. (b) A representative T2 FLAIR sequence signal of a patient is highlighted. Segmentation of surrounding edema was used for quantitative volumetric analysis. The outlined portions are as follows: red is right tumor volume, orange is R tumor edema, purple is left tumor volume, and green is left tumor edema.

Table 1: Patient characteristics.

	Median	IQR
Age	64	55–69
Gender	*n*	Percent
Female	13	72
Primary histology	*n*	Percent
Lung	10	56
Melanoma	3	17
Breast	2	11
Other: synovial, endometrial, and appendical	3	17
Prior chemotherapy	*n*	Percent
	9	50
Symptoms	*n*	Percent
Any visual deficit	12	67
Contralateral field cut*	10	83
Diplopia*	2	17
Loss of acuity*	2	17
Treatment	*n*	Percent
Radiation alone	5	28
Both: surgery + radiation	13	72

*Percent calculated from total of 12

Table 2: Description of case series.

Case	Age	Sex	Primary cancer	Prior chemo	Prior radiation to occipital lobe (s)	Diagnosis to development of BOMs (years)	Intracranial metastases (*n*)	Pretreatment visual symptoms	Treatment for BOMs	Posttreatment new visual symptoms	Involves primary visual cortex (L)	Involves primary visual cortex (R)	Tumor extends to surface (R)	Tumor extends to surface (L)	GTR achieved
1	63	Female	Lung, NOS	No	No	3.8	8	No symptoms	Radiation, WBRT	No symptoms					
2	73	Female	Endometrial adenocarcinoma	Yes	SRS (L)	1.2	33	No symptoms	Radiation, 20 Gy SRS (L)	Blurry vision					
3	54	Female	Lung, NOS	No	SRS (L)	0.2	5	No symptoms	Radiation, 16 Gy SRS (L)	Visual field cut					
4	67	Female	Breast, ER/PR/HER2 triple positive	Yes	WBRT	3.8	3	Blurry vision	Radiation, 17 and 20 Gy SRS (L, R)	Improved					
5	75	Female	Lung, large cell neuroendocrine	Yes	WBRT	3.7	10	Visual field cut, blurry vision	Radiation, 18 and 20 Gy SRS (L, R)	Improved					
6	64	Male	Lung, small cell	No	No	0.1	10	Diplopia, visual field cut	Both: R occipital craniotomy and WBRT	Improved	No	Yes	No	No	Yes
7	63	Female	Lung, adenocarcinoma	No	WBRT	1.5	2	Blurry vision	Both: bilateral occipital craniotomy and WBRT	Improved	No	No	Yes	No	Yes
8	70	Male	Lung, poorly differentiated	No	No	0.5	12	Visual field cut	Both: L occipital craniotomy and WBRT	No change	Yes	Yes	No	No	Yes
9	60	Female	Lung, adenocarcinoma	No	WBRT	1.9	21	Visual field cut, hemispatial neglect	Both: L occipital craniotomy and WBRT	Improved	No	No	Yes	Yes	Yes
10	27	Female	Synovial sarcoma	Yes	No	1.7	4	Visual field cut	Both: bilateral occipital craniotomy and WBRT	Improved	Yes	No	Yes	Yes	Yes
11	35	Female	Breast, ER/PR/HER2 triple positive	Yes	No	1.9	3	No symptoms	Both: R parieto-occipital craniotomy and bilateral 24 Gy SRS	Contralateral field cut, optic ataxia and simultagnosia (partial Bálint's syndrome)	No	No	Yes	Yes	Yes
12	67	Male	Lung, large cell neuroendocrine	No	No	0.8	90	Diplopia	Both: R occipital craniotomy and WBRT	No change	No	Yes	Yes	No	No
13	52	Female	Appendical adenocarcinoma	Yes	No	8.3	3	Visual field cut	Both: R parieto-occipital craniotomy and WBRT	Improved	Yes	No	No	Yes	Yes
14	76	Female	Lung, NSCLC	Yes	No	0.6	2	No symptoms	Both: L occipital and R parietal craniotomy; bilateral 18 Gy SRS preoperative, WBRT postoperative	No symptoms	Yes	No	Yes	Yes	Yes
15	89	Male	Melanoma, NOS	No	No	1.9	10	Visual field cut	Both: L occipital craniotomy and bilateral 20 Gy SRS	No change	Yes	No	No	No	Yes
16	44	Female	Melanoma, NOS	Yes	No	4.3	8	Visual field cut	Both: R occipital craniotomy and WBRT	Improved	No	No	Yes	No	Yes

(Contd..)

Table 2: *(Continued).*

Case	Age	Sex	Primary cancer	Prior chemo	Prior radiation to occipital lobe (s)	Diagnosis to development of BOMs (years)	Intracranial metastases (*n*)	Pretreatment visual symptoms	Treatment for BOMs	Posttreatment new visual symptoms	Involves primary visual cortex (L)	Involves primary visual cortex (R)	Tumor extends to surface (R)	Tumor extends to surface (L)	GTR achieved
17	66	Female	Lung, adenocarcinoma	Yes	No	Unknown	4	No symptoms	Both: L occipital craniotomy, WBRT and SRS	No symptoms	Yes	No	No	No	Yes
18	59	Male	Melanoma, NOS	No	No	5.1	3	Visual field cut	Both: L occipital craniotomy and 18 Gy SRS (R) + WBRT	Improved	No	Yes	No	No	Yes

Clinical presentation

Visual symptoms were present in 12 patients (67%) at time of presentation with bilateral occipital metastasis. These patients exhibited visual field deficit (67%), diplopia (17%), and visual acuity deficit (17%) on neurologic examination [Table 2].

Visual symptoms before and after treatment

In patients with pretreatment visual deficits, no visual deficits worsened following treatment with either radiation or surgical resection plus radiation. Three patients remained with a stable deficit, whereas 9 of 12 patients improved. Of the three that did not improve, one patient had a biopsy rather than a gross total resection and presented with diplopia which was presumed secondary to a cavernous sinus metastasis [Table 2]. Of those that improved, approximately half showed signs of visual improvement by day 7 posttreatment, and all the patients who did improve showed signs of improvement by day 30 [Table 3a].

In patients without pretreatment visual symptoms, half remained at baseline and half worsened throughout treatment. Of three patients who received radiation alone, one patient remained at baseline, one developed blurry vision which resolved within 1 week of treatment, and one developed a visual field cut within 1 day of treatment and subsequently died or was lost to follow up. Of three patients who received surgery plus radiation, two remained at baseline, whereas one patient developed a contralateral field cut, optic ataxia, and simultanagnosia (Balint's syndrome) following 24 Gy of fractionated SRS. The patient then underwent surgical resection approximately 18 months later, and his visual deficits showed only miniscule improvement at 90 day follow-up [Table 3b].

Volumetric analysis

Nine of 18 patients had imaging pre- and postintervention available for volumetric analysis. Surgical resection showed greater reductions in postcontrast T1 volumes than radiation alone. Changes in FLAIR signal were variable across treatment modalities [Table 4].

Mortality

Patients who underwent surgical selection plus radiation tended to have a higher likelihood of survival than those who underwent radiation alone at various follow-up times [Figure 2]. In this cohort, median overall survival was 38 (range: 6–371) versus 387 (range: 43–1918) days for patients undergoing radiation alone versus surgical resection plus radiation, respectively ($P = 0.15$).

Table 3: Visual symptoms following treatment.

a. Patients with pretreatment visual symptoms						
Patients with pretreatment visual symptoms (n=12)						
Treatment	**Worsened**	**No change (%)**	**Better at day 1**	**Better at day 7 (%)**	**Better at day 30 (%)**	**Better at day 90 (%)**
Radiation	0	0	0/2	2/2 (100)	1/1 (100)*	1/1 (100)
Surgery + radiation	0	3/10 (30)	0/10	5/10 (50)	7/10 (70)	6/9 (67)*
Total	0	3/12 (25)	0/12	7/12 (58)	8/11 (73)*	7/10 (70)*
b. Patients without pretreatment visual symptoms						
Patients without pretreatment visual symptoms (*n*=6)						
Treatment	**Stable (%)**	**Worse at day 1 (%)**	**Worse at day 7 (%)**	**Worse at day 30 (%)**	**Worse at 90 (%)**	
Radiation	1/3 (33)	2/3 (67)	0/2*	0/2	0/2	
Surgery + radiation	2/3 (67)	1/3 (33)	1/3 (33)	1/3 (33)	1/3 (33)	
Total	3/6 (50)	3/6 (50)	1/5 (20)*	1/5 (20)	1/5 (20	

*Decrease in denominator indicates patient death or lack of follow-up

Table 4: Percent change in volume of tumor and surrounding edema for patients with available follow-up imaging.

Case number	Treatment for BOMs	L T1	L FLAIR	R T1	R FLAIR
4	Radiation, 17 and 20 Gy SRS (L, R)	−54.3	−71.5	−81.1	−85.8
5	Radiation, 18 and 20 Gy SRS (L, R)	−30.1	22.2	76.9	382.0
Average radiation		−42.2	−24.6	−2.1	148.1
6	Both: R occipital craniotomy and WBRT	13.9	6.7	−93.8	−31.0
7	Both: bilateral occipital craniotomy and WBRT	−78.0	−46.8	−94.4	−55.0
8	Both: L occipital craniotomy and WBRT	−93.8	300.9	−2.3	−49.9
9	Both: L occipital craniotomy and WBRT	−73.4	6.4	13.5	27.6
10	Both: bilateral occipital craniotomy and WBRT	−100.0	−95.3	−100.0	−62.3
12	Both: R occipital craniotomy and WBRT	−38.9	423.9	−97.3	−100.0
18	Both: L occipital craniotomy and 18 Gy SRS (R) + WBRT	−100.0	−97.2	−8.7	55.6
Average surgery + radiation		−67.2	71.2	−54.7	−30.7
Average total		−61.6	49.9	−43.0	9.0

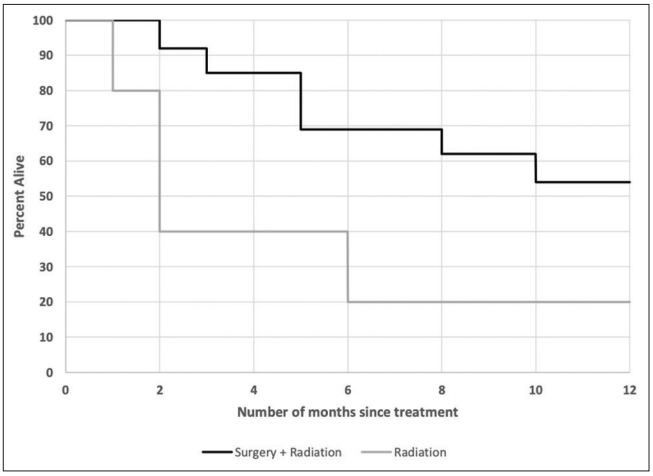

Figure 2: Kaplan–Meier curve showing percent of patients alive through 12-month follow-up stratified by treatment cohort.

DISCUSSION

There is an absence of published experience in the management of patients with tumors involving bilateral occipital lobes. A major risk of treating these patients is iatrogenic visual deficits, including cortical blindness, weighed against deficits conferred by the disease itself. In the setting of patients presenting with bilateral occipital metastases and unilateral visual field deficit, the decision to undergo bilateral treatment depends on extent of intracranial and extracranial tumor burden. In those with more severe tumor burden, unilateral treatment is favored to avoid unnecessary morbidity without a mortality benefit. When the bilateral occipital metastases are present in the setting of stable primary disease, treatment – especially surgical resection – may be safely conferred.

In our study, no patients who presented with visual deficits exhibited worsening of symptoms following treatment with any modality. Patients who presented with visual field deficit or blurry vision treated with surgical resection tended to gradually improve over days to weeks, likely due to relief of mass effect and reduction of edema.[15] Diplopia is unlikely related to tumor in the occipital lobe and does not appear to improve following treatment aimed at the occipital lobes. Patients who did not show improvement in visual deficits

within the 1st month of treatment were unlikely to show improvement at 90-day follow-up.

In patients without pretreatment visual deficits, the risk of iatrogenic visual deficits is an important consideration. In our cohort, one patient's vision worsened months after radiation therapy which did not improve following surgical resection, and two patients' vision worsened acutely following radiation alone. In terms of visual complications that may arise during treatment, one patient developed Bálint syndrome months following SRS. This may have been related to radiation, but could also have been tumor progression. Interestingly, the patient's visual status did not improve following surgical resection.

Functional preservation is essential in patients with metastatic brain tumors to maximize quality of life. For patients who undergo surgical resection, meticulous care to preserve functional brain parenchyma, including selection of natural anatomic corridors to the surface of the tumor when subcortical, offers promising results in improving visual deficits in patients with bilateral occipital metastases. As subtotal resection is associated with decreased survival compared to a gross total resection, a gross total resection should be achieved when safely possible.[4]

Patients in our cohort who underwent surgical resection followed by radiation had markedly improved prognosis compared to radiation alone, which likely reflects selection bias in those patients deemed suitable for surgery. Our results appear consistent with literature in brain metastasis indicating improved survival benefit with surgical resection plus radiation compared to radiation alone.[9,13] In addition to treatment type, other considerations that have been shown to be significant risk factors for mortality are systemic tumor burden, intracranial tumor volume, and number of intracranial metastases.[8,11,12]

CONCLUSION

The management of bilateral occipital metastases involves consideration of symptomatology, disease burden, and goals of care. Patients often present with visual symptoms, which may improve following treatment, especially surgical resection. However, newly developed visual symptoms, including cortical blindness, are a potential consequence of treating these lesions. Surgical resection is a safe method for treatment in select patients with bilateral occipital metastases, especially if there is preoperative visual compromise, with careful consideration of anatomical corridors and brain parenchyma-sparing surgical technique.

Declaration of patient consent

Institutional Review Board permission obtained for the study.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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