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Original Article

Oncology Section

Various Prognostic Factors in Metastatic Brain Tumours: A Cross-sectional Study

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ABSTRACT

Introduction: The most common type of intracranial neoplasms seen in neurosurgical practice is metastatic brain tumours. Adults with cancer have an 8-10% lifetime risk of developing symptomatic metastases. Breast cancer and lung cancer are the commonest to give brain metastases. However, the number of reported cases in India is still a portion of the true prevalence of brain metastases. In order to better understand the clinical presentation of brain metastases, their distribution, and other variables that impact their survival, the present research was planned and conducted.

Aim: To analyse the distribution of metastatic brain tumours, their primary source, characteristics of imaging, the different modalities of treatment and the factors which affect their survival like Karnofsky performance score, time interval between diagnosis of primary and metastasis, treatment method adopted.

Materials and Methods: The cross-sectional study was carried out in the Department of Neurosurgery, SRM Medical College Hospital and Research Centre a tertiary care hospital in Chennai, Tamil Nadu, India during the period from June 2018-May 2021 and included 102 metastatic brain tumour patients with proven biopsy of either of the primary or secondary lesions. Individuals who neither had the main nor the secondary lesion verified by biopsy were excluded. Among these patients, the parameters studied were incidence of various primary tumours, demographic profile, clinical features, imaging characteristics, performance status of the patient, treatment options, patient survival in relation to performance status, pathology, time interval between diagnosis of primary malignancy and the onset of secondary lesions. The results were analysed for the factors which affect survival like nature of systemic disease, source of primary, number of metastatic lesions, treatment methods adopted.

Results: The commonest age group involved was 40-69 years 81 (79.41%). Female to male ratio of 4:1 in the age group of less than 40 years and the overall male to female ratio was 1:1.04. Lungs being the commonest primary source (42%) followed by breast and unknown primary. Ring lesion was the commonest appearance of metastasis 51 (50%), followed by cystic lesions 8 (7.84%) and haemorrhagic secondaries 3 (2.94%). Breast primary had a survival rate of 58.3% with better prognosis. Good karnofsky performance score, longer interval between diagnosis of primary and secondaries brain, combining surgery along with radiotherapy were also found to have good prognosis.

Conclusion: Metastatic brain tumours are the commonest intracranial tumours. The favourable prognostic factors are the breast primary, younger age patients with good karnofsky score. Surgery along with radiation shows promising results than radiation alone even in poor grade patients.

Keywords: Brain cancer, Brain metastasis, Secondaries brain

INTRODUCTION

Metastatic brain tumours are the commonest intracranial neoplasms [1]. The vast majority of brain metastases go undetected. Metastatic cancer passes through the bloodstream and enters the Central Nervous System (CNS) through a breakdown of the blood-brain barrier. Clonal cells then proliferate, causing local invasion, displacement, inflammation, and oedema. Distribution throughout the central nervous system is more common in areas of high blood flow; however, different histological subtypes tend to have different distributions of location within the brain [2]. Breast cancer and lung cancer are the commonest to give brain metastases [3,4]. Considering the frequent occurrence of metastatic brain tumours with small cell lung cancer, prophylactic cranial irradiation is contemplated nowadays [5]. Because of improved imaging techniques, faster identification and treatment, and better life after initial diagnosis due to more successful primary cancer therapy, metastatic brain cancers are on the rise. The occurrence of brain metastasis spans between 10-26% [6]. However, the number of reported cases in India is still a portion of the true prevalence of brain metastases [7]. There isn't a thorough investigation of the behaviour of brain metastases and different prognostic variables in the Indian population. This research was carried out to study the clinical features of brain metastases, their distribution and the factors which affect their survival. In addition to the previously researched variables like source of primary, number of metastasis, status of primary disease, other variables like karnofsky performance score, extent of brain oedema, various treatment modalities and survival were studied for better understanding and treatment of cerebral metastases. The present research was conducted to analyse the distribution of metastatic brain tumours, their primary source, characteristics of imaging, the different modalities of treatment and the factors which affect their outcome and survival.

MATERIALS AND METHODS

The cross-sectional study was carried out in the Department of Neurosurgery, SRM Medical College Hospital and Research Centre a tertiary care hospital in Chennai, Tamil Nadu, India during the period from June 2018-May 2021. After obtaining approval from Institutional Ethical Committee (IEC) with IEC No.14597/ME5/2018.

Inclusion criteria: The present study included every patient with a metastatic brain tumour who was hospitalised throughout the research period.

Exclusion criteria: Individuals who neither had the primary nor the secondary lesion verified by biopsy were excluded from the study.

The patients were divided into the following categories:

1. Biopsy proven primary malignancy in patients with imaging proof of intracerebral metastasis.
2. Biopsy proved for both primary and intracerebral metastasis.
3. People with intracerebral metastasis proven by biopsy with no known primary source.

Study Procedure

Total 102 people were considered for the research. The following parameters were studied:

1. Number of various primary tumours among the study population;
2. Age and sex distribution;
3. Source of primary;
4. Radiological features of metastatic brain tumours;
5. Clinical characteristics of metastatic brain tumours;
6. Patients' status of their Karnofsky performance [8] which describes the degree of functional impairment and ranges from 0-100 and its effect on survival. Patients were categorised as having a good score if their performance score was 70 or above and a poor score if it was 60 or below;
7. Time interval between diagnosis of primary and secondary disease;
8. Different options for treatment like chemotherapy, whole brain radiotherapy, surgery, and their impacts on prognosis;
9. The extent of oedema was graded from 1-3 as follows:
    - oedema less than tumour size;
    - oedema equals tumour size;
    - oedema more than tumour size [9]. If oedema is not visualised in preoperative imaging, they are subgrouped as no oedema.

The performance status was compared with the parameters like systemic disease status/tumour types/treatment type and number of metastases/age/oedema/time interval between diagnosis of primary and metastases, to assess the effect on survival.

Follow-up period: The usual follow-up time was of 24 weeks, but it might have been as long as two years. For every patient individually, a thorough proforma that included all the pertinent parts of the research was developed and documented.

STATISTICAL ANALYSIS

The full set of data was combined into a master chart and using the Chi-square test and the Statistical Package for the Social Sciences (SPSS) software version 16.0; multivariate analysis was used to examine it. A p-value <0.05 was considered to be statistically significant.

RESULTS

There were 102 metastatic brain tumour cases considered in the present study through proper criteria of inclusion and exclusion. Among these 102 cases, 90 people underwent follow-ups regularly, and 12 people were lost to irregular follow-ups.

Age distribution: Patients were divided into three groups (less than 40 years, 40-69 years, and more than 70 years). There were six patients (5.9%) in the age group above 69 years, 81 patients (79.4%) in the age group of 40-69 years, and 15 (14.7%) people in the age group of 40 years [Table/Fig-1]. Most of the metastatic brain tumours belonged to the 40-69 age group. The youngest was 17-year-old, and the oldest was 80-year-old of age in present study.

Sex distribution: In this study, females slightly outnumbered males with male-female ratio of 1:1.04, including 50 male and 52 female patients, whereas, in the less than 40 years age group, females were much more in number than male with 1:4 ratio [Table/Fig-1].

Clinical features: The duration of symptoms when a patient comes for treatment was 10.4 weeks on average, ranging from one week to as long as one year. The common clinical symptoms were: headaches in 69 (67.6%), motor complaints in 57 (55.9%), seizures were experienced in 35 (34.3%), visual complaints were observed in 7 (6.9%) and cerebellar dysfunctions in 12 (11.8%) [Table/Fig-1]. Only 46% of patients with cerebellar metastasis had shown clinical proof of cerebellar dysfunction, and 8.8% of patients showed speech disturbances, memory disturbances, lower cranial nerve palsy, and disturbed orientation clinical symptoms.

Age distribution (in years)	No. of patients		Percentage
<40	15		14.7%
	M=3	F=12	1:4
40-69	81		79.4%
	M=43	F=38	1.13:1
>70	6		5.9%
	M=4	F=2	2:1
Symptoms	**No. of patients**		**Percentage**
Headache	69		67.6
Cerebellar symptoms	12		11.8
Visual disturbance	7		6.9
Seizure	35		34.3
Motor/sensory disturbance	57		55.9
Behaviour disturbance/vomiting/memory disturbance/lower cranial nerve palsy	9		8.8
Source of primary	**Single**		**Multiple**
Breast	8		7
Lung	23		20
Melanoma	1		0
Unknown	9		14
Lymphoma	0		2
Thyroid	2		3
Soft Tissue Sarcoma (STS)	1		0
Choriocarcinoma	1		0
Renal	1		1
Ovary	1		1
Testis	0		1
Gastrointestinal Tract (GIT)	2		4
Total	49		53

[Table/Fig-1]: Showing age distribution, distribution of symptoms, no. of metastasis from various primary tumours.

Number of metastases: Nearly 49 of the 102 individuals had a single metastasis, whereas 53 had more than one metastasis. With breast primary, seven cases had multiple and eight cases had single metastasis, similarly in primary lung malignancy, 20 cases had multiple and 23 cases had single metastasis. For unknown primary, 14 patients had multiple, and nine patients had single metastasis. The incidence of single vs multiple metastases in various primary groups were almost similar. The unknown primary tends to have a slightly higher incidence of multiple metastases (60.87%) compared to single metastases (39.13%) [Table/Fig-1].

Source of primary: Lungs are a common primary source (42.15%), followed by unknown primary and breast malignancy in all age groups with the exception of age groups under 40, where breast cancer was more prevalent. Among the 15 patients with breast primary, nine cases (60%) belonged to the age group of <40 years. In the case of unknown primary, 19 patients, 82.6% were from the 40-69 age group, and two patients were in the below 40 age group and 8.69% were in the more than 60 age group [Table/Fig-2]. The different types of lung primary carcinoma include non squamous cell carcinoma (4), squamous cell carcinoma (5), adenocarcinoma (7), bronchioalveolar carcinoma (10), and small cell carcinoma (17). All breast carcinoma cases were infiltrating ductal carcinoma. The details of various histopathology details of the primary tumours are enlisted in [Table/Fig-3].

Imaging appearance: Radiologic features of all the study patients were thoroughly noted. Ring lesion was the commonest

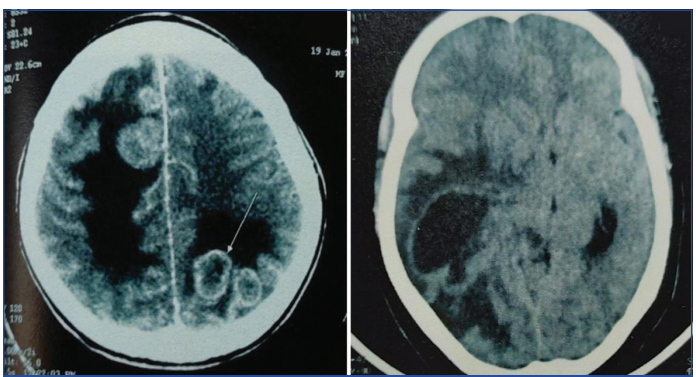
Source of metastasis	Age group (years)			Total
	<40	40-69	<70	
Breast	9	6	0	15
Lung	0	40	3	43
Melanoma	0	1	0	1
Unknown	2	19	2	23
Renal	0	2	0	2
Lymphoma	1	0	1	2
Thyroid	0	5	0	5
Choriocarcinoma	1	0	0	1
Soft tissue sarcoma	1	0	0	1
Ovary	0	2	0	2
Gastrointestinal tract	0	6	0	6
Testis	1	0	0	1

[Table/Fig-2]: Distribution of various primaries according to age group.

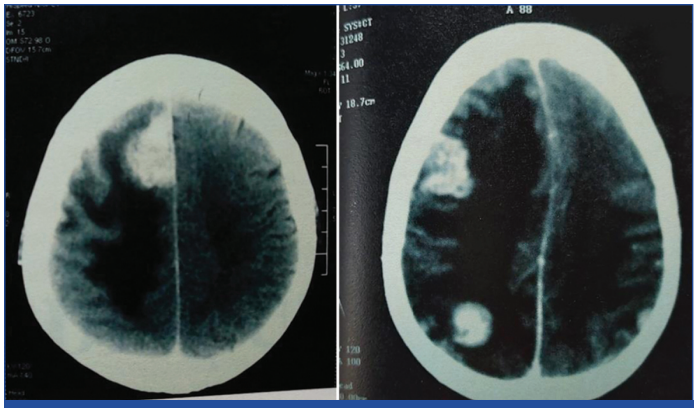
S. No.	Primary tumour	Histopathology
1.	Lung cancer	Small cell carcinoma (17) Bronchioalveolar carcinoma (10) Adenocarcinoma (7) Squamous cell carcinoma (5) Non squamous cell carcinoma (4)
2	Breast carcinoma	Infiltrating ductal carcinoma (15)
3	Thyroid carcinoma	Papillary carcinoma (4) Anaplastic carcinoma (1)
4	Lymphoma	B cell lymphoma (2)
5	Renal malignancy	Renal cell carcinoma (2)
6	Gastrointestinal tumours	Colorectal (3) Gastric (1) Pancreas (2)
7	Ovary	Ovarian carcinoma (2)
8	Testis	Germ cell tumour (1)

[Table/Fig-3]: Histopathologic details of various primary tumours observed in this study.

appearance of metastasis 51 (50%), followed by cystic lesions 8 (7.8%) and haemorrhagic secondaries 3 (2.94%) [Table/Fig-4-6]. In patients with cystic metastasis, the primaries identified were lung, unknown primary, breast and renal. Haemorrhagic lesions resulted from primaries in the lung (non small cell cancer), melanoma and choriocarcinoma. Heterogenous contrast enhancement was commonly observed with homogenous enhancement noted only in 14.70% (15 numbers) [Table/Fig-7]. Grade-3 oedema was demonstrated in 14 cases, and in the other 14 cases, no oedema was detected. The extent of oedema was graded from 1-3 as already described [9]. In metastatic disease with breast primary 68.67% had grade-1 oedema and with unknown and lung primary, majority of the cases had mild oedema (34.78% and 46.51%, respectively). In the two cases of lymphoma studied, grade-1 oedema was observed [Table/Fig-8].



[Table/Fig-4]: Multiple ring enhancing metastasis in CT brain.
[Table/Fig-5]: CT brain showing cystic secondaries brain. (Images from left to right)



[Table/Fig-6]: CT brain showing intense contrast enhancement of secondaries brain lesion.
[Table/Fig-7]: CT brain showing haemorrhagic secondaries. (Images from left to right)

Source of primary	Cyst	Haemorrhage	Ring lesion	Contrast enhancement homogenous	Contrast enhancement Intense
Breast	1	0	9	3	4
Lung	3	1	24	7	9
Melanoma	0	1	0	0	1
Unknown	3	0	10	1	5
Lymphoma	0	0	0	1	1
Thyroid	0	0	2	1	0
Choriocarcinoma	0	1	0	1	1
STS	0	0	1	0	0
Renal	1	0	0	0	0
Testis	0	0	1	0	0
Ovary	0	0	2	0	0
GIT	0	0	2	1	1
Total	**8**	**3**	**51**	**15**	**22**

Oedema				
Source of primary	No	Mild	Moderate	Severe
Breast	2	8	5	0
Lung	5	20	11	7
Melanoma	0	1	0	0
Unknown	4	8	6	5
Lymphoma	2	0	0	0
Thyroid	0	2	2	1
Sts	0	1	0	0
Renal	0	0	1	1
GiT	1	1	4	0
Choriocarcinoma	0	1	0	0
Testis	0	0	1	0
Ovary	0	1	1	0
Total	**14**	**43**	**31**	**14**

Distribution in various lobes					
Source of primary	Frontal	Parietal	Occipital	Temporal	Cerebellum
Breast	7	7	2	2	5
Lung	31	21	8	6	9
Melanoma	1	0	0	0	0
Unknown	12	12	7	3	8
Lymphoma	2	1	0	1	0
Thyroid	4	2	1	1	0
STS	0	0	1	0	0
Renal	0	1	0	0	1
GIT	5	2	1	4	2
Choriocarcinoma	3	0	0	0	1

Ovary	1	1	1	0	0
Total	**66**	**47**	**21**	**17**	**26**

[Table/Fig-8]: Radiologic features according to various tumour types.

Site of metastases: The location of metastases were cerebellum in 26 cases (25.49%), temporal lobe in 17 cases (16.67%), occipital lobe in 21 cases 20.59%, parietal lobe in 47 cases (46.08%), and frontal lobe in 66 cases (64.71%), fewer common locations were internal capsule, basal ganglia, thalamus and brainstem. In 37 cases, the bilateral and right hemispheres were involved, and in 30 cases left hemispheres.

Factors affecting survival:

Systemic disease: In patients with poor KPS score, irrespective of the activity of primary disease, less than one-fifth of the patients were alive during the follow-up (20% without active systemic disease versus 15.79% with active systemic disease). On the contrary, in patients with good KPS score, 66.67% of patients with active systemic disease were alive compared to 50% of patients without active systemic disease. But this was not statistically significant (p-value=0.838) [Table/Fig-2].

Source of metastasis: In patients who had metastasis from breast primary, the survival rate was 58.33%, irrespective of their performance status. The survival rate of patients who had metastasis from lungs and unknown primary were 24.32% and 23.81%, respectively. The survival period observed were 52.6 weeks, 28 weeks and 21 weeks for breast, unknown primary and lung primaries respectively. The prognosis was bad in patients with poor KPS scores irrespective of solitary or multiple metastasis.

Performance status: The Karnofsky performance score determines the state of performance in the present study. In the present research, 32 patients had KPS scores of 70 or higher, compared to 70 who had Karnofsky scores of 60 or below.

Treatment: Patients received either Whole-Brain Radiation Therapy (WBRT) alone, craniotomy alone, stereotactic biopsy alone, or craniotomy combined with WBRT as treatment. Stereotactic Radiosurgery (SRS) was not utilised as a therapeutic option, as it was not accessible. Total seven patients underwent craniotomy and excision alone, as patient attendees refused radiotherapy or the patient's general condition was very poor. In 26 study patients, a craniotomy was performed, the lesion was removed, and WBRT was then applied. In 48 instances, WBRT was used alone; in seven cases, a stereotactic biopsy was used first and then WBRT. Chemotherapy was suggested for patients in metastatic brain tumours with small cell lung, breast, ovarian, lymphoma, and GIT primary. If craniotomy is paired with WBRT instead of only craniotomy, the survival of patients even with poor performance scores was raised. However, this association did not had statistical significance. Similar to this, WBRT coupled with craniotomy improved patient survival when compared to WBRT alone [Table/Fig-9]. Of the 48 patients treated by WBRT alone in this study, 35 patients succumbed (72.91%) during the study period, in contrast 15 out of 26 patients treated by combined surgery and WBRT had a fatal outcome (57.69%), giving the survival advantage of about 15% and this difference was significant statistically.

Survival and age: In the 40-69 years age range, performance status was a significant predictor of survival. Performance status did not predict overall survival at three months, six months, or one year for those aged less than 40 years and for older age groups. Under 40 years had a higher rate of survival (50%) than those over 70 years (33%) irrespective of KPS.

Survival and number of metastases: The result was not considerably impacted by either multiple or single metastases. Those with numerous metastases had performance scores that predicted overall survival, while patients with single metastases did not. As depicted in the table, patients with good KPS score had a better survival in patients with multiple metastases (10 out of 14), whereas in patients with single metastasis, even with good KPS score, the survival rate was poor (5 out of 13), though it was not statistically significant in solitary metastasis group (p-value=0.76) [Table/Fig-2].

Systemic disease-Active	KPS-Good		p-value	KPS-Bad		p-value
	Alive	Death		Alive	Death	
No	10	10	0.646	9	36	0.838
Yes	4	2		3	16	
Specific tumour types vs KPS vs survival						
Breast	5	1	vs	2	4	0.079
Lung	4	5	vs	5	23	0.106
Unknown	3	2	vs	2	14	**0.030**
Treatment type vs KPS vs survival						
Craniotomy alone	0	0	0.198	1	6	
Craniotomy+WBRT	4	3		7	12	**0.048**
WBRT alone	9	7		4	28	
Stereotactic BX+WBRT	1	2	vs	0	4	0.212
No. of METASTASES vs KPS vs survival						
Single	5	8	0.76	9	22	**<0.01**
Multiple	10	4		4	30	
Age (years) vs KPS vs survival						
<40	5	3	vs	1	3	0.221
40-69	9	8	vs	9	46	**0.02**
>70	0	1	vs	2	3	0.439
Oedema vs KPS vs survival						
No	3	1	**0.002**	3	5	0.06
Severe	0	1		3	9	
Interval between METS and primary vs KPS vs survival						
Simultaneous	6	7	**0.002**	7	39	0.32
>6 months	7	2		2	8	

[Table/Fig-9]: Comparing performance status with systemic disease status/tumour types/treatment type/no. of METS/age/oedema and time interval between primary and metastasis.
The statistical significance assessed by Chi-square test

Time interval between metastases and primary: In this research, patients who received main and secondary diagnoses simultaneously fared worse than patient groups in whose primary and secondary diagnoses were separated by more than six months., particularly when the KPS is good and it is statistically significant (p-value=0.002) [Table/Fig-2].

Survival and oedema: Patients had a greater chance of surviving when there was less oedema seen on imaging than when there was substantial oedema. Those with excellent performance scores were seen to have a difference in survival (3 out of 5 were alive), as opposed to patients with poor performance scores (only 4 out of 20 were alive). Age under 40, high Karnofsky performance status, and breast cancer as the primary disease was linked to good survival. Low survival was linked to age above 69, poor performance level, and lung primary.

DISCUSSION

Brain metastases are the commonest intracranial lesions. They are 10 times more common than its primary counterpart [10]. Almost 24-45% of all patients diagnosed with malignant tumours develop metastatic brain tumours [1,11]. They are predominantly diagnosed in the age group ranging from 50-70 years. About 15% of cancer patients have neurologic symptoms prior to the diagnosis of their systemic malignancy [12,13]. The CNS is the sole site of dissemination in 9% of cases. Metastasis from unknown primary constitutes about 10%. This was similar to the metropolitan Detroit cancer surveillance system [14].

Pathophysiology of metastatic disease: Tumour cells from the primary malignant tumour must enter the bloodstream, remain alive, while doing so, they migrate and navigate the microvasculature of the receptive organs, extravasating into the parenchyma, and then establish themselves, once again in the secondary organ to manifest as metastatic disease. By releasing proteolytic enzymes such as cathepsins and metalloproteinases, the tumour cells are able to pass the subendothelial barrier and infiltrate the basement membrane. Additionally, to change the kind of integrin receptor on the surface of the stromal cells which surrounds them, tumour cells change the expression of laminin, collagen, or fibronectin. This leads to the desegregation of stromal cells and produces an environment that is favourable for their growth and invasion. Detaching from the tumour mass, the invasive cells spread out and cross the endothelial/epithelial barrier. By protecting themselves with a layer of blood, platelets and fibrin, tumour cells are able to survive intravascular circulation and escape immune detection. The metastatic emboli also produce adherens, which help them to attach to the arterial wall and then enter the host tissue. This results in distant micro-metastasis. The spinal epidural plexus directly extends into the Cerebral-dural sinuses [15]. The preferential involvement of the posterior fossa in individuals with pelvic and abdominal malignancies is explained by spread through this retrograde pathway [13].

Source of primary: Lung, breast, gastrointestinal, skin cancers are the most typical primary tumours metastasing [1]. Present study also had the highest number of brain metastasis from the lung. Eighty percent of lung cancer cases with more than two years of survival will develop brain metastases [16,17]. In most instances, primary lung cancer diagnosis is typically made four months prior to the diagnosis of brain metastases. Even though they are uncommon, small cell carcinomas are responsible for 50% of lung cancer brain metastases [18]. The commonest primary source for metastatic brain tumours in women is breast tumour [1]. Present study also found metastases from the breast as the commonest primary tumour in women less than 40 years of age. The interval between diagnosis of primary breast malignancy and the development of brain metastasis can be as long as three years. Nearly 22.5% of brain matastases patients in present study had no identifiable primary tumour. Thus, unknown primary was the second commonest cause for the secondaries brain.

Single/Multiple: While metastatic illness in the brain arising from lung cancer, melanoma and cancers of unknown source are more often multiple, it is more frequently observed solitary metastatic lesion, when the primary source is colon, renal cells, thyroid, and breast [3]. In present study, except for unknown primary, all other tumours had an almost equal chance for solitary or multiple metastases.

Intracranial site of metastases: Both the right and left-side of the brain were equally involved. The frontal and parietal lobes were involved more often as compared to the occipital and temporal lobes [19]. The frequency of infratentorial metastases was 50% for primary malignant tumours located in the abdomen (GI tract) and pelvis (uterus or prostate) [19,20]. A similar pattern was observed in present study too. The frontal and parietal location of the metastatic lesions was observed in close to half of the study population and cerebellar location was observed in quarter of the study patients.

Synchronous/Metachronous disease: Patients who develop brain metastases concurrently with systemic cancer (synchronous metastasis) often go through worse conditions than those who develop metachronous metastatic illness [12]. This was confirmed by the present study too. If the metastatic lesions occur later than six months of the initial primary malignant diagnosis, the prognosis was found to be better.

Clinical features: Subacute symptoms are seen in around 60% of individuals with brain metastases [21]. An acute presentation might be due to bleeding or seizure. Seizures (21%) and headache (42%) are the two most prevalent presenting symptoms [7,20]. Motor dysfunction (30%) and cognitive impairment (35%) are the other frequent symptoms. In present study patients also presented predominantly with headache. Motor deficits were more frequently observed compared to the literature in more than half of the patients.

The performance score has a direct impact on the length of survival. Although the Karnofsky performance status strongly predicted survival after 3-6 months and one year, it does not predict overall survival. This was due to the fact that patients with the same Karnofsky score had different follow-up times.

Brain metastases imaging: Contrast enhancement on Magnetic Resonance Imaging (MRI) is the investigation of choice [19,20]. It has been shown in several studies that contrast-enhanced MRI picks up 2-3 times as many lesions than contrast-enhanced Computed Tomography (CT), particularly lesions with a diameter of <5 mm. With MRI, around 20% of patients with single metastatic lesions on CT will be having multiple lesions.

PET scan: Intracerebral metastases may show up on 18-Fluorodeoxyglucose (FDG) Positron Emission Tomography (PET) as regions of increased metabolic uptake. Despite being exceedingly non specific, they are sensitive. Currently, in the early assessment of suspected brain metastases, FDG-PET is not thought to be superior to CT or MRI [19].

Treatment of brain metastasis: The treatment options that are present today are chemotherapy, surgical resection, SRS, and "Whole-Brain Radiation Therapy" (WBRT).

WBRT: For the majority of cases with brain metastases, WBRT is the treatment of choice. Kocher M et al., provided the first description of WBRT for brain metastases 50 years ago. WBRT is given in fractions to a total dose of 37.5 Gy [22]. WBRT provides symptomatic relief and stabilises or improves neurocognitive function and overall performance; However, only half of the patients will have good disease control with this treatment approach alone, and the prognosis is dismal [23].

WBRT plus chemotherapy: A treatment strategy that combines daily low (75 mg/m^2) dose of TMZ (Temozolomide) and WBRT has helped in improving the response rate with acceptable toxicity in people with brain metastases from many different solid tumours [24].

Surgery: Only around half of patients with the metastatic illness have a single operable tumour, and less than half of individuals with metastatic disease have operable tumours [14]. The remaining patients have deeply placed deposits, which makes surgery even more difficult [24]. Patients with a single metastasis, satisfactory primary disease management should be considered for surgery. The surgery increases median survival and considerably lowers recurrences. The median survival of patients who had surgery in addition to WBRT was considerably longer than that of those who just got WBRT [25] and also addition of WBRT or radiosurgery improves the local control of the disease. With reference to neurocognitive outcome, radiosurgery scores over WBRT [26]. The similar pattern was observed in present study also. Recent single centre retrospective studies concluded that when the larger lesion is removed surgically in patients with excellent prognostic characteristics even with two to three brain metastases, the survival advantage is comparable to solitary metastases [27]. The operative mortality for brain metastatic lesion resection is approximately 3% [14].

Radiosurgery: The SRS employs several convergent beams to provide a single, high radiation dosage to a particular target volume [14]. The linear accelerator, gamma knife, and cyclotron are the three most popular radiation delivery mechanisms [28]. With higher radiation doses, greater tumour volumes, and previous treatment with radiation, the risk of radiation necrosis rises [29]. Even for patients who underwent complete excision of metastatic brain lesions, SRS plays a major role in achieving local control [30]. The extent of local control is predicted by the mean dose used per volume [31].

Limitation(s)

Only CT Brain was used to evaluate the patients, as MRI couldn't be done due to financial constraints. SRS was not available in the centre and couldn't be assessed.

CONCLUSION(S)

Metastatic brain tumours are on the rise owing to advancement in neuroimaging technologies and longer survival of primary cancer patients owing to advancement in treatment modalities. Patients with better performance score, surgically accessible location of metastatic deposits, considerable interval between diagnosis of primary and metastatic disease should be strongly considered for surgery. Addition of radiotherapy improves the median survival.

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