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Review Article

Primary Spinal Melanoma: A Review addressing Pathogenesis, Clinical Presentation, Neuroimaging Features, Management and Outcome

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Abstract

Objective: Due to the rarity of Primary Spinal Melanoma (PSM), there is limited evidence regarding the diagnosis, management, treatment and prognosis. The aim of this study was to compile the existing knowledge regarding pathogenesis, clinical presentation, neuroimaging features, management strategy through systematic review of published studies.

Materials and method: We have found 24 eligible publications by searching through PubMed, ScienceDirect, and Google Scholar databases, published between January 2005 to December 2021. We have analysed the data of 27 patients extracted from those articles.

Results: The mean age of the patients was 50.5±14.5 years with minimum 16 and maximum 82 years. The median of age was 49 years, only 2 cases were less than 30 years old and 74% were male. Alcoholism, Paraparesis, heart problems are some of the predisposing factors reported by reviewed studies. Common symptoms are weakness, back pain, asymmetric myelopathy etc. Cervical and thoracic cord are the most common areas where PSM seen. PSM would be either intradural, extradural, or have both intra- and extradural components and the majority of our patients (70%) have intradural-extramedullary lesions. Around 80% of the lesions showed signal hyperintensity on T1W images and hypointensity on T2W images. Laminectomy is the most common surgical approach (>50%) applied for the described cases. Gross Total Resection (GTR) was the most common (59%) approach applied for resection followed by Sub-Total Resection (STR). Death was reported for 22% of the cases described in our selected studies.

Conclusion: Our study has successfully compiled the existing knowledge on targeted areas regarding PSM. These findings may help researchers, pathologists and neurosurgeons to manage this rare tumor for favourable outcome.

Keywords: Chemotherapy; Metastasis; Primary Spinal Melanoma (PSM); Radiotherapy; Surgery

Introduction

Malignant melanoma is extremely aggressive type of skin cancer which developed from the melanocytes. Existing research shows that the propagation of melanoma cells is reliant on genes involved in neural crest formation [1]. Metastatic malignant melanoma in the Central Nervous System (CNS) is a prominent cause of morbidity and death across the world [2]. Brain Metastases (BM) are a frequent complication in advanced-stage melanoma patients. There has been a tremendous progress in the management of melanoma patients within recent years [1]. Melanoma has been on the rise in recent years all over the world, and it is now the fifth largest cause of cancer in the United States of America [3]. Despite the fact that the prevalence of melanoma is rising, fatality rates are beginning to fall, owing to advances in therapy and screening [4]. Melanoma is usually more prevalent among White people compared to Blacks, Asians or Indians. Melanoma is uncommon among children and teenagers, and according to the existing evidences the risk of melanoma increases with the age [4-6]. Melanoma is the third largest cause of death in the United States, behind lung and breast cancer [7]. Although, metastatic melanoma is the third most prevalent reason of CNS metastases, Primary Spinal Melanoma (PSM) is a rare primary malignancy accounting for less than 1% of all CNS melanomas [8,9]. There is limited evidence regarding the diagnosis (clinical and radiographic), management, treatment and prognosis of PSM [10]. As the incidence is on rise, the ability of specialists and spinal surgeons regarding management and treatment of such uncommon diseases is critical [11]. As there are few documented instances of PSM, a little information about the diagnosis, treatment, and prognosis of these tumors are available. We have planned to conduct a thorough assessment of the english literature on PSM in order compile the clinical, radiological, and histological features associated with these tumors, as well as the most often and successfully used treatment approaches.

Materials and Method

Search Strategy

We have restricted the timeframe for article selection between January 2005 to December 2021. For our systematic review, we searched the Google Scholar, PubMed, and Science Direct databases for appropriate peer-reviewed papers. Relevant studies were screened for Primary Spinal Melanoma (PSM). The screening language has been limited to English. “Primary Spinal Melanoma” and “Spinal Melanoma” were the specific keywords used in the search. The PRSMA guidelines were followed during the systematic review [12].

Selection Criteria

For this review, we primarily looked at case reports and case series on primary spinal melanoma. The study included publications that showed demographic information, clinical presentation, neuroimaging characteristics, treatment, and outcome. Articles focusing the main origin of tumor other than the spine, articles with insufficient information, and articles written in languages other than English have been eliminated (Figure 1).

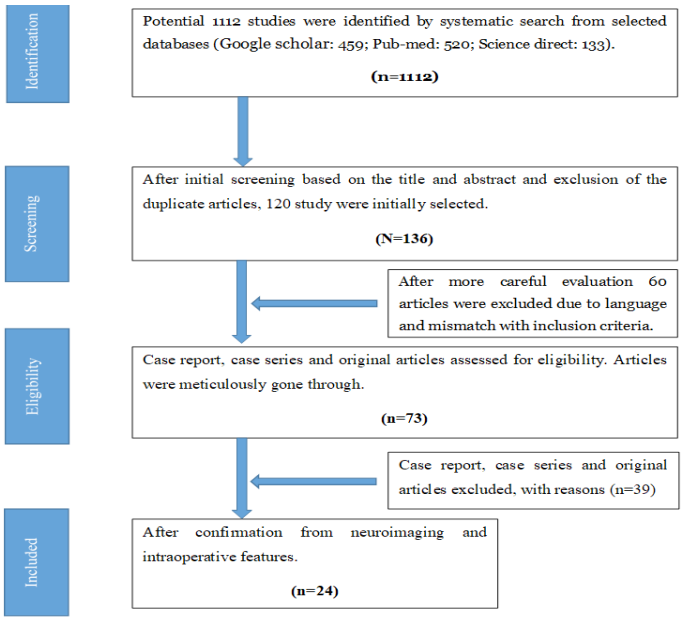

Figure 1: PRISMA flow diagram for study selection.

At the beginning, potential 1112 studies were identified through systematic search from selected databases (Google scholar: 459; Pub-med: 520; Science direct: 133) from inception to December 2020. Based on the title, abstract, and elimination of duplicates, 136 publications were selected after meticulous screening. After a more thorough review, 63 articles were ruled out due to linguistic issues and a mismatch with the inclusion criteria. The remaining 73 studies are thoroughly examined. Overall, 22 research article validated the entity as Primary Spinal Melanoma after validation from neuroimaging and intraoperative characteristics.

Data Analysis

The data collected from selected studies were entered in Microsoft excel 2013 and checked for consistency. Data were analysed by IBM SPSS (version-23) statistical package software.

Results

We have conducted a review of the available literature on PSM from January 2005 to December 2021 for this study. We were able to discover 24 case reports/ case series after using inclusion and exclusion criteria. Only 27 potential cases (maintained inclusion and exclusion criteria of our study) were reported at this time which indicates the rarity of PSM. We also investigated available books and review articles in addition to the small number

of examples we have counted. The majority of studies on PSM has mentioned pigment synthesis by tumor, which is also prevalent in CNS disorders. The mean age of the patients was 50.5±14.5 years with minimum 16 and maximum 82 years. The median of age of the patients was 49 years, which indicates the increase of disease risk with age. Only two patients were younger than 30 years old, indicating that these tumors are uncommon before the age of thirty, males are the most affected (74%). Various investigations have identified alcoholism, paraparesis, and cardiac issues as predisposing variables. Symptoms reported in various researches varied greatly between instances and were often non-specific. However, several symptoms, such as weakness, back discomfort, and asymmetric myelopathy, were particularly prevalent. According to our findings, PSM can affect any part of the spine, although the cervical and thoracic cords are the most commonly affected. Furthermore, PSM can be intradural, extradural, or both intra- and extradural components, with intradural-extramedullary lesions accounting for the bulk of our patients (70%).

All of the described cases were gone through MRI modality and all of the cases showed the characteristics of PSM. Around 80% of the lesions showed signal hyperintensity on T1W images and hypointensity on T2W images. PSM On T2W pictures, iso-intensity or mild to moderate homogeneous enhancement were rarely seen. For the patients presented, laminectomy is the most prevalent surgical procedure (>50%). The most prevalent resection method was Gross Total Resection (GTR) applied among 59.3% patients, followed by Sub-Total Resection (STR) among 30% patients. Despite the fact that around 40% of patients received chemo or radiotherapy, metastasis was reported to be absent in 78% of cases. Overall, 22% of the cases described in selected studies has died after treatment (Table 1 and Figure 2).

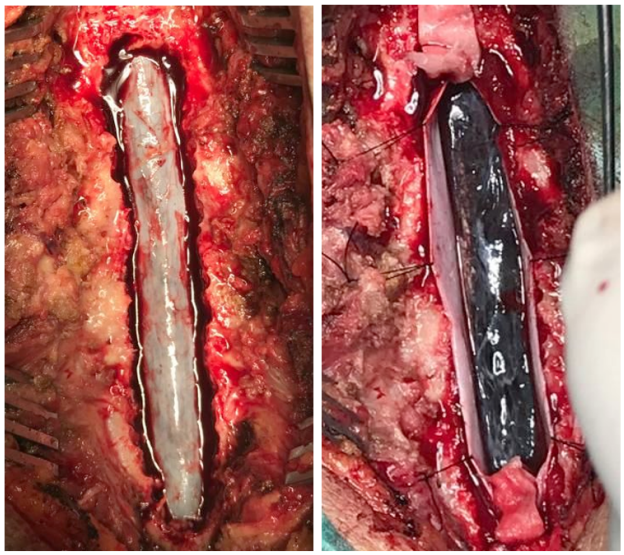

Figure 2: A 62-year-old male, diagnosed as intradural extramedullary spinal melanoma extending from D9-D11 level. Intraoperative photograph demonstrates the macroscopic appearance of the tumor after laminectomy of D9-D11**(A)**. After durotomy and dural tack-up suture, a black, firm and hypervascular mass observed beneath the dura, having firm attachment with the spinal cord **(B)**.

Author	Year	Age	Sex	Predisposing factor	Location	Compartment	Presentation	MRI	Surgical corridor	Nature of tumor	Resection	Metastasis	Chemo/ radio	Post OP period	outcome
Kouni,et al. [8]	2005	41	F	None	C2-C4	ID-EM, ED	Cord swelling; Intracranial hypertension	T1WI hypertence, T2WI hypotence,	NM	Malignant pigmented tumor	GTR	No	No	Papilledema persisted a week	No symptoms at three months F/U.
Kanatas, et al. [13]	2007	76	F	None	C6/7	ID-EM	Neck pain, paraesthesia, myelopathy	Llarge, enhancing tumor	C5 to T1 laminectomy	Malignant melanoma	STR	No	No	Good recovery, improvement in arm paraesthesia.	Stable at six month F/U.
Mukul, et al. [14]	2010	40	M	None	C1-C2	ID-EM	Progressive pain, weakness	T1WI hypertence, T2WI hypotence,	C1-C3 laminectomy	Bell-shaped mass	NM	No	No	Neurologically intact.	No melanotic lesions at one year F/U.
Bhargava, et al. [15]	2011	55	M	None	CVJ	ID-EM, ED	Quadriparesis, haemorrhage in ED component	T1WI iso-hyper, T2WI hypo, T1C+ homogenous	Foramen magnum approach	Moderate vascularity, C2 nerve root entrapment	NTR	No	No	Improved motor function.	Complete recovery except left UL monoparesis at 1 year F/U.
Katalanic, et al. [16]	2011	47	M	Spastic paraparesis	T7-T9	NM	Low back pain, fatigue and loss of body weight	Osteolytis	Laminectomy T7-T9 level	Stage-IV melanoma	GTR	Thoracic, abdominal and skeletal	Dacarbazine, cisplatin, carmustine	Neutropenia, sepsis and multiple organ failure	Died
Cicuendez, et al. [17]	2012	82	F	Paraparesis	L2	ID-EM	Lumbago femorica	T1WI iso-hyper, T2WI hypo, T1C+ homogenous	L1-3 laminectomy	Conus medullaris and cauda equina	STR	No	RT	Worsening of motor power	Died two months after the surgery
Ganiusman, et al. [18]	2012	49	F	Heart problems	NM	NM	LBP, leg pain	T1WI iso to hyperintense, L3 neural foramen	NM	Mass with internal necrosis	NM	Lung, S1 pedicle	RT/ temozolomide, IFN	No residual tumor at one month follow-up	Neurologically intact at three years F/U.
Yu, et al. [19]	2012	48	M	None	C2-C6	ID-EM	Shoulder and neck pain, Lower extremities	Hyperintense T1, and hypointense T2	Laminectomy at the C2 - C6	Primary cervical melanoma	STR	Brain	No	Referred but no radio or chemotherapy received	Died after 2 months of surgery.
Chang, et al. [20]	2013	16	M	Paraparesis	L5, S1	ED	Trauma, Hip pain	T1WI hyper, T2WI hypo, hemorrhage in S1-2 & S2-3	S1 hemilaminectomy	Bluish & organized clotted mass	GTR	lung	imatinib	Improved	Progression free for several months.
Jeong, et al. [20]	2013	42	M	Headache and eyeball pain	T2, ventral side	ID-EM	Leg weakness, seizure attack	Enhancement of gadolinium in the T1	T2 laminoplasty, mass was removed	Malignant melanoma of intermediate grade	STR	No	No	A seizure attack occurred.	A revision surgery performed and was discharged.
Sinha, et al. [21]	2013	55	M	Urinary and anal incontinences	Opposite the L4	NM	Paraplegia, Back pain, weakness	Widening the intervertebral foramen	L4	Extradural intraspinal lesion	GTR	No	No	NM	NM
Kawanabe, et al. [21]	2014	54	F	None	T12	ID-EM	Weekness, fell down	T1WI hyper, T2WI hypo, lesion enhance	T11-L1	Malignant melanoma	GTR	No	No	No postoperative defect.	Normal at five years F/U.
Chance, et al. [22]	2015	46	M	Paresthesia	D12, L5	ID-EM	Urinary retention	T1WI iso, T2WI hypo, T1C+homogenous L5: T1WI hyper, T2WI hypo	D11-12 laminectomy L4-5 laminectomy	Highly vascular attached with dura and D12 nerve root	GTR	No	No	Recurrence at D12 pedicle, patient underwent D12 costotransversectomy.	Survived
Liu, et al. [23]	2015	39	M	None	T9-10	EM	Lower limb weakness, ataxic gait	Hyperintense T1W, hypointense on T2W	T-9	Malignant melanoma	STR	No	No	No other melanoma foci were found.	Improved neurological function.
Liu, et al. [23]	2015	47	M	Hypoesthesia	C4-5	EM	Schwannoma	Hyperintense T1W, hypointense on T2W	C-5	Black melanoma	GTR	No	No	No other melanoma foci were found.	Improved neurological function after 76 months F/U.
Liu, et al. [23]	2015	76	M	None	L2-3	EM	Lower extremity weakness	Hyperintense T1W, hypointense on T2W	NM	Extramedullary melanoma	GTR	No	No	No other complication.	Alive with improved neurological function.
Beculic, et al. [24]	2015	54	M	Alcohol abuse	C5	ID-EM	Cervical pain, paresis of the upper and lower limbs	Intradural, extramedullar mass lesion	C5/C6 laminectomy	Malignant melanoma	GTR	No	No	Infected with Klebsiella pneumoniae; Tracheotomy.	Died one month later.
Hering, et al. [25]	2016	57	F	None	D12	ID-EM	Lower limb paresthesia	T2WI hetero hypo, T1C+homo	NM	Highly vascularized tumor	STR	No	3D-CRT	Recurrence free survival at 104 weeks F/U.	Unchanged neurological status.
Yoshizaki, et al. [26]	2017	49	M	None	T12 to L1	ID-EM	Numbness, back pain	T1W: slightly high-signal intensity, T2W isosignal intensity	T12 laminectomy	Malignant melanoma	GTR	Skin	Dacarbazine chemo, and radio	Symptoms improved with the chemoradiation	No evidence of recurrence at five years F/U.
Iga, et al. [27]	2018	39	M	None	C1-2, C3-4, C4,C5	ID-EM	Impaired sensation from C5-D8	T1WI hyper, T2WI iso-hypo, T1C+homogenous	C2 to C5 Open-door laminoplasty	Malignant melanoma	GTR	No	Chemotherapy (with anti-PD-1 Antibody)	Situation improved	No evidence of recurrence after two years F/U.
Sharma, et al. [28]	2019	67	F	None	L1-3	ID-EM	Lower back pain, weakness	T1 hyperintense, T2 hypointense, altered signal intensity lesion at L1 and L2	L1 to L3 laminectomy	Malignant melanoma	STR	No	No	After 9 months of surgery, same clinical features retained.	Partially improved condition at 9 months F/U.

Hironaka, et al. [29]	2019	39	M	None	L1-S5	ID-EM	Headache, nausea, paraplegia	T1WI iso, T2WI hyper, T1C+homo	NM	Malignant melanoma	STR	No	No	VP shunt done for hydrocephalus	Died after 14 months F/U.
Erika, et al. [30]	2020	62	M	None	T10-11	ID-EM	Schwannoma	T1W hyperintense/ T2W isointense/ enhancement	T10-T11 laminectomy	Malignant melanoma	GTR	No	Five fractions of radiotherapy	Situation improved	Alive after 15 months F/U.
Erika, et al. [30]	2020	29	M	None	S1-2	ID-IM and ED	Schwannoma or ependymoma	T1W hyperintense, T2W hyperintense	Posterior approach	Malignant melanoma	GTR	No	Radiotherapy	No postoperative neurological deficits.	Alive after 24 months F/U.
Zahra, et al. [31]	2021	61	M	None	T10-11	ID-EM	Weakness, numbness, paresthesia.	T1W hyperintense/ T2W isointense	T9-T11 laminectomy	Malignant melanoma	GTR	Yes	RT	Improved motor power	Complete neurological recovery, no recureence at 12 months F/U.
Hanna, et al. [32]	2021	37	M	None	C1-5	ID-EM	Quadriplegia and breathing difficulty	T1WI hypertence, T2WI hypotence	C1-5 laminectomy	Malignant melanoma	GTR	No	No	Situation improved	Good condition at 1 year F/U.
Le- dong, et al. [33]	2021	56	M	None	L3-L4, S1	ID-EM	Pain in the lower limbs	T1W hyperintense/ T2W isointense	L4-S1 discectomy	Intramedullary malignant melanoma	GTR	No	No	Molecular targeted therapy refused by patient	Died after 6 months

M: male, F: female, ED: extradural, CVJ: cranio vertebral junction, C: cervical, D: dorsal, L: lumbar, S: sacral, ED: extradural, ID-EM: intradural extramedullary, IM: intramedullary, CN: cranial nerve, LBP: low back pain, GTR: gross total resection, NTR: near total resection, STR: subtotal resection, POD: post-operative day, UL: upper limb, LL: lower limb, F/U: follow up, RT: radiotherapy, 3D-CRT: 3-dimensional conformal radiotherapy.

Table 1: Reported cases of Primary spinal melanoma between January 2005 to December 2021.

Discussion

Epidemiology

Our research has effectively demonstrated the rarity of PSM and examined various key parameters such as causation, prognosis, therapy, and outcome. PSM instances account for fewer than 1% of all melanoma cases, according to existing data, and generally emerge from the leptomeninges, regardless of its specific cellular origin [32]. The vascular bundles allow leptomeningeal melanoblasts to penetrate the spinal cord. When the neural crest is created, epidermal melanoblasts reach the leptomeninges. Intradural intramedullary tumors are less prevalent in PSMs, accounting for fewer than 40% of all PSMs [32,34-36]. According to our analysis, the mean age of the patients was 51 years and median of age was 49 years, which indicates the increase of disease risk with age. These tumours are uncommon before the age of thirty as only 2 cases were less than 30 years old among the analyzed cases. Our research also indicates, PSM most typically occurs in the fifth decade of life and in the middle and lower thoracic portions of the spinal cord, which is corroborated by some earlier research [37,38]. Furthermore, PSM can be intradural, extradural, or a combination of the two, and the majority of our patients have intradural-extramedullary lesions. The cervical, conus medullaris, thoracolumbar, and cervicothoracic areas are also affected by PSM [39-41]. According to our findings, PSM can affect any part of the spine, although the cervical and thoracic cords are the most commonly affected. Symptoms reported in various investigations varied greatly between instances and were often non-specific. Back or neck discomfort with a gradual, asymmetrical myelopathy is a common presenting complaint [38,42,43].

Pathogenesis

According to our analysis, alcoholism, paraparesis, heart problems are some of the predisposing factors reported by various studies. The symptoms presented by various studies were highly varies among cases and typically non-specific. However, some symptoms were very much common such as weakness, back pain, asymmetric myelopathy etc. Primary spinal melanoma is a very rare disorder, and the cause is unknown. Mutations in GNAQ and GNA11 are thought to play a role in melanocytic lesions [44]. Melanocytic tumors of the leptomeninges are the most common source of primary melanocytic tumors. A majority of the articles reported the production of pigment by PSM which is also common for other are CNS lesions. This group of neoplasms share morphologic characteristics such as a predominance of spindled and epithelioid cells, prominent pigmentation, and lack of epithelial involvement, as well as frequent mutations in GNAQ or GNA11. GNAQ or GNA11 mutations impact codon 183 in exon 4 or codon 209 in exon 5 of both genes in a mutually exclusive fashion. Enzymatic function is crippled by mutations at these locations, resulting in a constitutively active GTP-bound state. GNAQ and GNA11 operate as dominant-acting oncogenes in this condition, activating a number of important signaling pathways, including the MAP-kinase pathway [45,46]. The presence of GNAQ and GNA11 mutations in melanocytomas, dermal melanocytic tumors, and uveal melanomas shows a developmental relationship between these malignancies' cells of origin [46-48].

Clinical Presentation

PSM have a vague clinical appearance that is comparable to other malignancies such as meningioma, neurofibroma, and degenerative disc disease [13,49,50]. The clinical manifestation is vague and varies depending on the lesion's degree. Progressive motor weakness is the most prevalent symptom, although patients have also reported dysesthesias, weakness, aberrant reflexes, loss of bowel or bladder control, and discomfort [23,32,33]. Primary spinal melanomas have an uncertain clinical course. The majority of melanomas exhibit malignant characteristics and eventually induce direct or distant metastases. This malignant propensity is similar to primary CNS or spinal melanomas, however documented instances exhibited varying durations of disease-free time following the first procedure and subsequent radiation or chemotherapy. Because no other cerebral or spinal source of headaches and ocular pressure rise was detected in this patient, leptomeningeal spreading was suspected at the time of the first operation [23,33].

Disease Progression

Because a spinal cord lesion was seldom detected when the initial symptoms appeared, the identification of a primary spinal cord melanoma might be delayed, and leptomeningeal spread could occur before a conclusive diagnosis. Although negative CSF study findings did not indicate leptomeningeal spread, the clinical sensitivity of the CSF study and MRI with gadolinium enhancement was similar, and radiologic diagnosis of leptomeningeal seeding was possible [51]. Although the melanoma was largely excised during the initial procedure, no adjuvant radiation or chemotherapy was administered, and leptomeningeal seeding may have proceeded. In an intracranial melanoma or other malignant tumor, hydrocephalus can develop, but it is less common in a primary spinal cord melanoma. There has been no mention of the presence of hydrocephalus at the time of first diagnosis in any of the documented instances of spinal cord melanomas. However, congenital disorders such as neurocutaneous melanomatosis have been observed to be often associated with leptomeningeal seeding or spread [52].

Diagnosis

All of the described cases were gone through MRI modality and all of the cases showed the characteristics of PSM. Preoperative imaging investigations frequently reveal primary spinal cord melanoma as an IDEM tumor, usually nerve sheath tumors or meningiomas. When compared to other IDEM cancers, spinal cord melanomas have no distinct radiologic features. After exposing the dura mater, most surgeons recognize spinal cord melanomas by their distinct black or dark gray hue. Due to the paramagnetic characteristics of melanin or hemorrhagic materials in the tumor, initial diagnosis needs neuroimaging, with spinal MRI being the best imaging modality [32,40,53]. After the surgery and pathologic diagnosis of the resected tumor, the patient may have a full body surface examination or a PET scan to check for a primary melanoma site. It is difficult to distinguish this tumor from other IDEM tumors before surgery. It develops from melanotic cells in the leptomeninges and resembles other nerve sheath tumors or meningiomas in appearance. Preoperative diagnosis based on imaging investigations is critical for determining the surgical scope and treatment options. To discover diagnostic evidence of a PSM, imaging data should be gathered [54].

Neuroimaging Features

Our analysis observed 78% of the lesions with signal hyperintensity on T1W images and hypointensity on T2W images. Rarely showed isointensity on T2W images or mild to moderate homogenous enhancement. Laminectomy is the most common surgical approach (>50%) applied for the described cases. Due to the paramagnetic characteristics of melanin or hemorrhagic materials in the tumor, initial diagnosis needs neuroimaging, with spinal MRI being the best imaging modality. PSM are typically slightly hyperintense on T1 and iso- to hypointense on T2, with uniform modest enhancement following intravenous gadolinium augmentation [55]. Further diagnosis, according to Hayward's criteria, necessitates the absence of malignant melanoma outside of the CNS (primary or metastatic) and histological confirmation of the lesion. A full-body PET-CT scan and extensive dermatologic, ophthalmologic, gastrointestinal, and gynecological assessments, followed by histopathologic confirmation, are used to rule out extra-CNS abnormalities. This has limitations, however, because achromic cutaneous melanomas occur, and metastatic skin melanomas can emerge after a primitive melanoma has completely disappeared [37,38,43]. A full-body PET-CT scan and extensive dermatologic, ophthalmologic, gastrointestinal, and gynecological assessments, followed by histopathologic confirmation, are used to rule out extra-CNS abnormalities. This has limitations, however, because achromic cutaneous melanomas occur, and metastatic skin melanomas can emerge after a primitive melanoma has completely disappeared. Melanoma is defined by large, pleomorphic epithelioid or spindled cells with irregular nuclei, necrosis, a high mitotic index, and positive staining for HMB-45 and S100 protein on histological examination [35,38].

Management

It's crucial to distinguish PSM from the metastatic melanoma since the former has a better prognosis. Primary CNS melanomas develop more slowly than cutaneous melanomas and appear to be less aggressive [56]. Metastatic cutaneous melanomas normally have a one-year survival rate, but initial spinal cord melanomas have a six-year and seven-month survival rate. There have been reports of recurrences, both in the initial tumor bed and by leptomeningeal spread [43,57-59]. The therapy and prognosis of primary spinal cord melanoma are poorly understood. For primary spinal melanomas, resection has been recommended as the therapy of choice. Despite substantial evidence of minimizing the risk of metastasis, some experts advocate for postoperative chemotherapy or radiation [55].

Treatment, Prognosis and Outcome

Gross Total Resection (GTR) was the most common approach applied for resection followed by Sub-Total Resection. Metastasis was absent in around 78% cases though 40% patients taken chemo or radiotherapy. After surgical resection, radiation is the conventional treatment for CNS melanoma. Although metastatic melanoma in the CNS is resistant to adjuvant therapy and advances quickly, initial spinal cord lesions have a better prognosis than metastatic melanomas. Furthermore, a research has documented additional long-term survival durations

of treated primary spinal cord melanoma patients [43,57,60,61]. Although the survival duration is yet unknown, there have been suggestions that entire excision and postoperative radiation may help to lengthen it. Not only in melanomas, but also in other spinal cord cancers, leptomeningeal seeding and hydrocephalus are poor prognostic markers, indicating disease progression and difficulties archiving entire melanoma excision [62]. Whether or not entire resection of melanoma is performed, radiation treatment should be used to prevent melanoma recurrence or progression. In order to conduct future research, more cases of hydrocephalus in spinal cord tumors, particularly malignant tumors, will be required. Metastatic CNS melanoma is more common than primary CNS melanoma, and it has a poorer prognosis. After complete excision and further radiation or chemotherapy, patients with primary CNS melanoma have had a better prognosis [63]. Overall, 20% of the cases mentioned in the selected studies died and majority of the treated patients gone back to their normal life after treatment procedure.

Conclusion

In conclusion, we can san say this study has successfully compiled the existing knowledge on PSM and discussed the targeted areas briefly. In future, these knowledges would help researchers, pathologists and neurosurgeons to manage these rare cases of tumor for favourable outcome. We have observed a lack of molecular study on PSM which is very much important for improvement of management and treatment. More research also required for the improvement of surgical procedure which will help to increase the survivability rate after the treatment process of PSM.

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Manuscript preparation, technical revision and manuscript editing	Dr. Nazmin Ahmed
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