Research Article

Extra-axial central nervous system lesions- a clinicopathological overview

Patil P.R.[1], Sondankar D.V.[2], Mundhe M.B.[3]

[1]Dr. Purwa Rangrao Patil, Associate Professor Pathology, [2]Dr. Divyaja Vinod Sondankar, Post Graduate Student in Pathology, [3]Mayur B Mundhe, Post Graduate Student in Pathology; All are affiliated with Grant Government Medical College & Sir J J Group of Hospitals, Byculla, Mumbai.

Address for Correspondence: Dr. Purwa Rangrao Patil, 404 Asawari, Near Marine Drive Police Station, Opposite CCI Club, Dinshaw Vaccha Road, Churchgate, Mumbai. E-mail address – patil.purwa@gmail.com

Abstract

Background: Extra-axial Central Nervous System (CNS) lesions simply abut the CNS from meningeal or juxtameningeal site and include lesions arising from extra-parenchymal elements in CNS including meninges, nerve sheath or midline neur-axial structures confining to sellar region, pineal region and ventricles. **Objective:** To study extra-axial CNS lesions in terms of frequency, demography, topography and to assess utility of squash cytology to for their rapid diagnosis. **Material and Methods:** Total 383 cases of all clinically and radiologically suspected and/or histopathologically confirmed cases of extra-axial CNS lesions were studied with above mentioned objectives and resuls were tabulated and analysed. **Result**: Extra-axial lesions contributed 49.10% cases of all CNS lesions. Of these extra-axial lesions 68% were neoplastic (benign & malignant) and most of these (86.9%) neoplasms were benign. Neoplastic lesions were most commonly seen in 4^{th} -5^{th} decade while non-neoplastic in 1^{st}-3^{rd} decade with equal sex distribution. They were commonly located intracranially (73.36%) than at spinal location. Meninges were most common affected site. Intracranially meningioma (37.09%) and epidermoid cyst (46.38%) were most common neoplastic and non-neoplastic lesions respectively. While schwannoma (39.59%) and tuberculosis (45.28%) were most common neoplastic and non-neoplastic lesion at spinal location respectively. Extra-axial metastatic neoplasms contributed 2.08% of extra-axial CNS lesions. Developmental anomalies were seen in 19.5% cases. 7.28% neoplastic lesions were recurrent of which maximum were pituitary adenomas. In 74.41% cases radiological diagnosis matched exactly with histopathological diagnosis while squash cytology provided exact diagnosis in 89.84% cases. **Conclusion**: Extra-axial CNS lesions are common, constituting nearly half of the cases of CNS lesions; most of which are intracranial, slow growing, benign neoplasms and squash cytology plays a great role in intra-operative consultation.

Key words: Extra-axial, Lesions, Cranial, Spinal, CNS, Squash Cytology

Introduction

The gross and microscopic features of CNS lesions are difficult to study in any one specific methodical fashion due to its complex and extra-ordinarily varied regional architecture Neuroanatomist, neurosurgeons and radiologist use several terms to localise these lesions. Extra-axial is one of the localising terms commonly c encountered in neuroimaging reports but encodes information of potential utility to the pathologist. This term is coined by radiologist but is of great help for neurosurgeons and pathologist. As the substance of brain and spinal cord constitute the central neuraxis, the lesions localised to the neuroparenchyma proper are often described as intra-axial where as those that simply abut the CNS from meningeal or juxtameningealsite are said to be extra-axial [1]. These include lesions arising from extraparenchymal elements in CNS and tissues either meant for protecting the neuraxis or present in the nerve sheath or midline neuraxial structures confined to specific spaces in CNS like sellar region, pineal region and ventricles [2-6]. Extra-axial lesions referred for neurosurgical intervention include not only tumours but also clinically symptomatic non-neoplastic lesions like developmental and vascular malformations or

Manuscript received 12^{th} April 2016
Reviewed: 24^{th} April 2016
Author Corrected: 4^{th} May 2016
Accepted for Publication 14^{th} May 2016

inflammatory lesions. Few of the non-neoplastic lesions mimic neoplasms on radioimaging, hence histopathology remains the gold standard for accurate diagnosis.

Extensive search of literature does not reveal any single study covering all these lesions at one glance. Individual studies on lesions in bits and pieces of extra axial zone are described. Hence this present comprehensive study was undertaken to state an institutional overview of all the lesions occurring in extra-axial compartment of brain and spinal cord for three years Grant Government Medical College, Mumbai, a tertiary care centre with special Neurosurgery and Neuropathology Departments. It was aimed at studying the frequency, clinical details, radiological findings and topographic distribution of all lesions lying in extra-axial compartment. We have also attempted to assess diagnostic accuracy of radioimaging and utility of squash cytology to for their intraoperative diagnosis.

Material and Methods

In this cross sectional-observational study total 383 cases were enrolled which were clinically and radiologically suspected and/or histopathologically confirmed cases of extra-axial CNS lesions. The study was approved by institutional ethical committee. The details of the each patient were taken from medical records i.e. age, gender; clinical presentation, radiological evaluation (MRI and/or CT scan), location, brain infiltration and recurrence were noted. During neurosurgical intervention intra-operative consultation was done by squash smear cytology for which tissue was received in normal saline. It was squashed in between two slides and stained with rapid Haematoxylin and Eosin (H&E) stain and intraoperative diagnosis was noted (in 305 cases). The tissue remaining after intraoperative consultation and specimen obtained at conclusion of surgery received in 10% formalin was processed for routine paraffin sections. Special stains like Zeihl-Neelsen (ZN), Periodic acid Schiff (PAS), Gomorimethanamine silver (GMS) and reticulin were done wherever necessary. Immunohistochemistry (IHC) was done in few cases. Both squash cytology and histological sections were viewed by experienced pathologists. Histomorphology was evaluated for tissue diagnosis, histological subtyping and grading in cases of pertinent tumours. The data collected was evaluated for finding out frequency of various lesions, classification, clinico-pathological correlation and finding out diagnostic accuracy of various diagnostic modalities such as neuroimaging, intraoperative squash cytology smears on correlating with gold standard of tissue diagnosis.

Results

Extra-axial CNS lesions contributed about half (49.10%) of all CNS lesions. More than 2/3rd of them were neoplastic. 73.63% lesions were located in cranial cavity while 26.37% were spinal [Table 1]. Extra-axial neoplasms constituted 46.77% (261/558) of overall CNS neoplasms. Neoplastic lesions predominated in intracranial compartment while approximate equal incidence of neoplastic and non-neoplastic lesions seen in spinal region. Intracranial extra-axial CNS lesions were most commonly located in supratentorial compartment (205/282; 72.69%). Spinal tumours were mostly extra-axial (9 extradural + 39 intraduralextramedullary) contributing 64% (48/75) of spinal neoplasms. Intradural–extramedullary location was relatively more common amongst these (52%). Highest incidence of extra –axial lesions was noted in 4th-5th decade (44.65%). The lowest and highest age at presentation was 6 months and 79 years respectively with a mean age of 35.2 years. Neoplastic lesions were seen commonly in 4th decade with mean age of 39 years while non-neoplastic lesions were seen in 3rd decade (26.23%) with mean age of 27.2 years. While approximately 2/3rd of them were observed in the 1st three decades of life. Overall there was approximate equal affection of males and female with noble exception of meningioma which showed distinct female predominance. Presenting complaints were different for cranial and spinal lesions. Headache was the most common complaint (69.50%) of cranial extra-axial lesions followed by visual disturbances (29.79%) while backache (67.32%) and motor disturbances (64.36%) were common presenting features for spinal extra-axial lesions followed by sensory disturbances (49.50%). About 75% cases presented with long standing symptoms (>1month duration). The commonest location for cranial extra-axial lesions was cerebral convexity (27.30%) followed by sellar (23.77%) and cerebellopontine angle region (22.70%). Thoracic region was the commonest affected region in spinal extra-axial lesions (35.65%). Meninges were the commonest affected site for neoplastic and non-neoplastic lesions (overall 171/383; 44.65%)[Table 3] Meningeal neoplasms (42.52%) followed by the nerve sheath tumours (27.20%) were common affected sites in neoplastic lesions. [Table 4] Meninges (49.18%) followed by bone and soft tissue (31.96 %) were more affected site in non-neoplastic lesions. Developmental anomalies contributed highest

percentage in non-neoplastic extra-axial lesions (61.47%) followed by inflammatory and infectious lesions (28.69%). Developmental anomalies were comprised of extra-axial cysts of craniospinal axis (56) and craniospinaldysraphism (19). Extra-axial cysts of craniospinal axis accounted for 14.62 % of all extra-axial lesions in which maximum contribution was of epidermoid cyst. Epidermoid cyst (31.14%) was the commonest non-neoplastic lesion followed by tuberculosis (21.30%) [Table 5] Meningioma (37.09%) followed by schwannoma (21.13%) and pituitary adenoma (19.24%) were most common intracranial extra-axial neoplasms while epidermoid cyst (46.38%) was the most common non-neoplastic lesion. [Table 6] Schwannoma (39.59%) followed by meningioma (16.67%) were most common spinal extra-axial neoplasms while tuberculosis (45.28%) was most common non-neoplastic lesion. [Table 7] 6.79% lesions were recurrent and maximum cases were of pituitary adenoma followed by epidermoid cyst. Maximum extra-axial neoplastic lesions were benign (87.36%, 228/261).While malignant tumours contributed 8.04% of all extra-axial neoplasms.

Table 1: Distribution of CNS lesions.

Total CNS lesions (780)							
Extra-axial CNS lesions (383, 49.10%)				**Intra-axial CNS lesions (397, 50.80%)**			
Cranial (282, 73.63%)		**Spinal (101, 26.37%)**		**Cranial (320)**		**Spinal (77)**	
Neo (213, 55.61%)	Non-neo (69, 18.02%)	Neo (48, 12.53%)	Non-neo (53, 13.84%)	Neo (270)	Non-neo (50)	Neo (27)	Non-neo (50)

Total intracranial lesions = 602; Total intracranial neoplasms = 483
Total spinal lesions = 178; Total spinal neoplasms = 75

Table 2: Presenting signs & symptoms of extra-axial lesions.

Symptoms	**Cranial**	**Cranial% (n=282)**	**Spinal**	**Spinal% (n=101)**	**Total**	**Total%**
Headache	196	69.50	13	12.87	209	54.56
Vomiting	32	11.35	--	--	32	08.35
Convulsion	34	12.06	--	--	34	08.88
Visual disturbances	84	29.79	--	--	84	21.93
Hearing defect	48	17.02	--	--	48	12.53
Giddiness /Imbalance	74	26.24	03	2.97	77	20.10
Motor disturbances	39	13.82	65	64.36	104	27.15
Sensory disturbances	29	10.28	50	49.50	79	20.62
Backache	--	--	68	67.32	68	17.75
Bowel-bladder disturbances	02	0.71	08	7.90	10	0.26
Local swelling	13	4.60	19	18.81	32	08.35

Table 3: Site (Tissue) of origin.

Site	**Neoplastic**	**% (n=261)**	**Non-neoplastic**	**% (n=122)**
Meninges	111	42.52	60	49.18
Nerve sheath	71	27.20	01	0.82
Pituitary gland	41	15.72	01	0.82
Rathke's pouch	21	8.05	--	--
Pineal gland	05	1.92	--	--
Bone & soft tissue	11	4.21	39	31.96
Congenital malformation	--	--	15	12.30
Ventricle	01	0.38	06	4.92
Total	261	100	122	100

Table 4: Incidence of various extra-axial neoplastic lesions.

Meningioma	87	Neurofibroma	06	Haemangioblastoma	01
Schwannoma	64	Melanocytoma	01	Metastatic lesion	08
Pituitary adenoma	41	NHL	01	Cordoma	01
Craniopharyngioma	21	Osteoma	01	Mature teratoma	02
Pineal parenchymal tumours	05	Mesenchymalchondrosarcoma	01	Chondromyxoid fibroma	02
Hemangioma	06	Granulocytic sarcoma	01	Lipoma	04
Haemangiopericytoma	02	PNET	04		
Haemangioendothelioma	01	Melanocytosis	01		

Table 5: Incidence of various Extra-axial Non-neoplastic lesions.

	Lesions	**No. of cases**	**% (n=122)**
Developmental anomalies and congenital malformations 75 cases; 61.47%	Epidermoid cyst	38	31.14
	Dermoid cyst	01	0.82
	Arachnoid cyst	09	7.38
	Colloid cyst	06	4.92
	Tarlov cyst	01	0.82
	Enterogenous cyst	01	0.82
	Tethered cord	04	3.28
	Encephalocele	01	0.82
	Meningocele	02	1.64
	Meningomyelocele	05	4.10
	Lipomeningocele	04	3.28
	Lipomeningomyelocele	03	2.46
Vascular lesions 02 cases; 1.64%	A-V malformation	01	0.82
	Subdural haemorrhage	01	0.82
Inflammatory & Infectious lesions 35 cases; 28.69%	Tuberculosis	26	21.30
	Pyogenic abscess	04	3.28
	Necrotising granulomatous inflammation	01	0.82
	Acute on chronic inflammation	01	0.82
	Hydatid cyst	02	1.64
	Actinomycosis	01	0.82
Non-neoplastic masses (pseudotumour) 10cases; 8.20%	Langerhans cell histiocytosis[LCH]	02	1.64
	Mucocele	03	2.46
	Fibrous dysplasia	05	4.10
Total		122	100

Table 6: Intracranial Extra-axial lesions.

Neoplastic lesions(n=213)	No.	%	Non-neoplastic lesions(n=69)	No.	%
Meningioma	79	37.09	Epidermoid cyst	32	46.38
Schwannoma	45	21.13	Arachnoid cyst	07	10.14
Pituitary adenoma	41	19.24	Colloid cyst	06	8.69
Craniopharyngioma	21	9.85	Pyogenic abscess	04	5.79
Pineal parenchymal tumours	05	2.35	TB inflammation	02	2.90
			Pituitary Hypophysitis	01	1.45
Hemangioma	04	1.88	Mucocele	03	4.35
Haemangiopericytoma	02	0.94	Fibrous dysplasia	05	7.25
Haemangioendothelioma	01	0.47	LCH	02	2.90
Haemangioblastoma	01	0.47	Hydatid cyst	01	1.45
Chondromyxoid fibroma	01	0.47	Dermoid cyst	01	1.45
Cordoma	01	0.47	Encephalocele	01	1.45
Osteoma	01	0.47	Meningocele	01	1.45
Mesenchymalchondrosarcoma	01	0.47	A-V malformation	01	1.45
Granulocytic sarcoma	01	0.47	Sub-dural hematoma	01	1.45
PNET	01	0.47	Actinomycosis	01	1.45
Melanocytosis	01	0.47			
Mature teratoma	01	0.47			
Lipoma	01	0.47			
Metastatic lesion	05	2.35			

Table 7: Spinal extra-axial lesions

Neoplastic lesions	No.	%(n=48)	Non-neoplastic lesions	No.	%(n=53)
Meningioma	08	16.67	Tuberculosis	24	45.28
Schwannoma	19	39.59	Epidermoid cyst	06	11.32
Neurofibroma	06	12.50	Meningomyelocele	05	9.43
Lipoma	03	6.25	Meningocele	01	1.88
PNET	03	6.25	Lipomeningocele	04	7.55
Hemangioma	02	4.17	Lipomeningomyelocele	03	5.66
Mature teratoma	01	2.08	Arachnoid cyst	02	3.77
Melanocytoma	01	2.08	Enterogenous cyst	01	1.89
NHL	01	2.08	Tarlov cyst	01	1.89
Metastatic	03	6.25	Hydatid cyst	01	1.89
Chondromyxoid fibroma	01	2.08	Non-specific Inflammatory lesion	01	1.89
			Tethered cord	04	7.55
Total	**48**	**100**		**53**	**100**

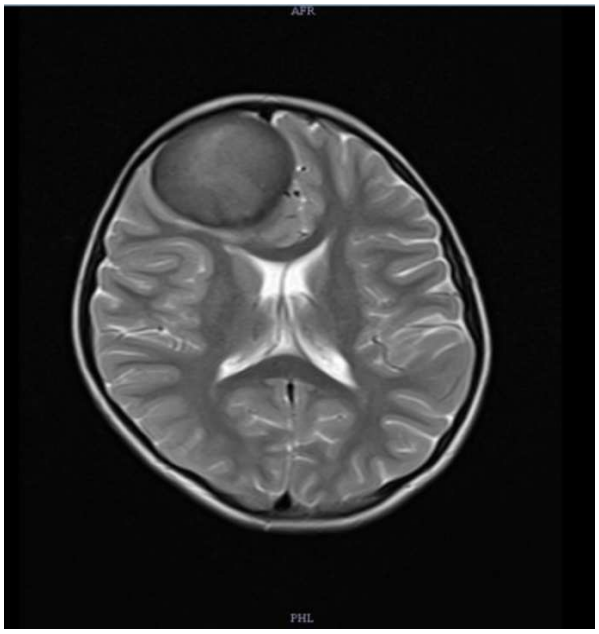

Figure-1: MRI brain showing dura based enhancing extra-axial lesion – Meningioma.

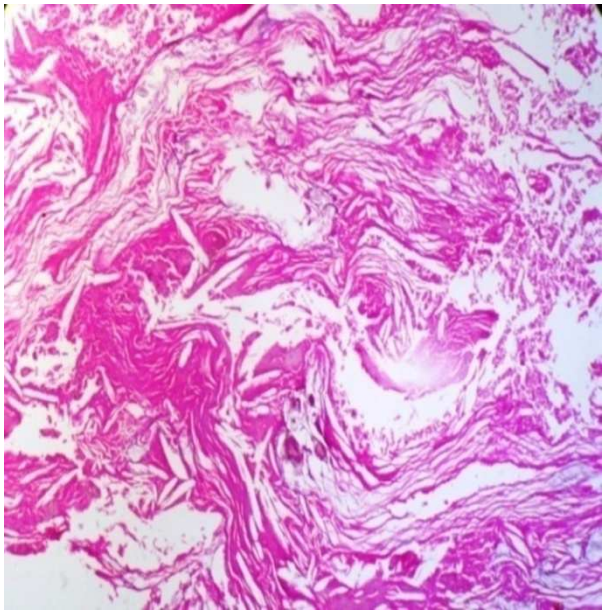

Figure-2: Epidermoid cyst- Abundant lamellated keratinous material with focal squamous epithelium (H&E, X100).

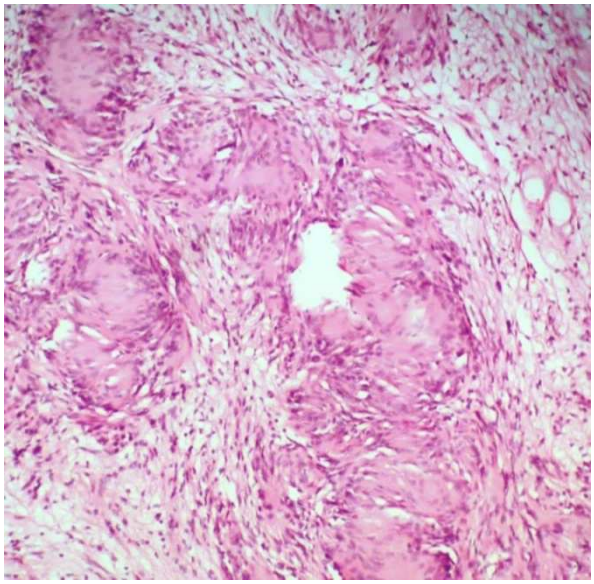

Figure-3: Schwannoma showing verocay bodies (H&E, X100).

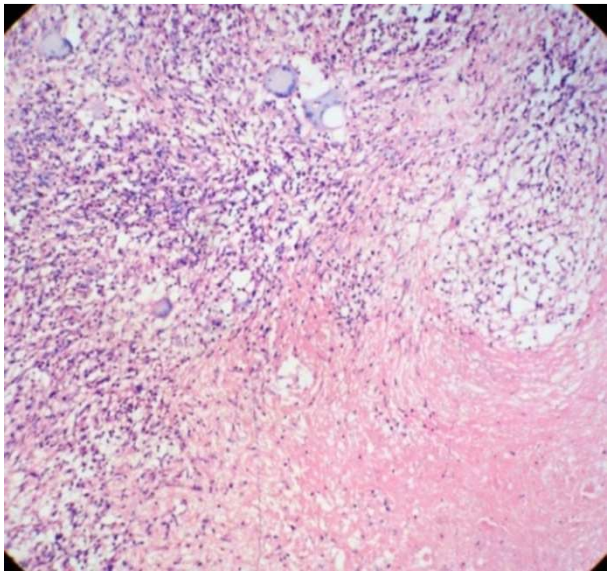

Figure-4: Tuberculosis- showing caseous necrosis, epithelioid cell granulomas and Langhans giant cells (H&E, X100).

Exact correlation between clinico-radiological diagnosis and final histopathological diagnosis was seen in 74.41 % (285/383) cases. 305 out of 383 cases were evaluated for intra-operative squash cytology as per requested. Of which 89.84% cases correlated with the final histopathological diagnosis. 81 out of 98 cases where radiology could not hit the exact diagnosis were received for squash cytology and 54 of them were correctly diagnosed on intraoperative squash cytology.

Disscusion

Present study is an institutional clinical, radiological and pathological overview of 383 cases of extra-axial CNS lesions. After extensive search in literature for previous similar studies on extra-axial CNS lesions with special emphasis on epidemiological and pathological aspects, we did not come across any single comprehensive study for comparison. Hence we think that this is the pilot study. However, few individual lesional studies are described in the literature. So, we tried to put forth results of our study and comparison with individual disease studies wherever possible.

Extra-axial CNS lesions contributed about half cases (49.10%) of the overall CNS lesions. The majority of these extra-axial lesions were neoplastic (68.15%) and located in cranial region (73.63%). Of the extra-axial neoplasms, 81.61% (213 out of 261) cases were located intracranially. This intracranial predilection of extra-axial neoplasms matches with studies done on overall CNS neoplasms by TamkeenMasoodiet al [6] and Intisar Patty et al [7].They found intracranial location in 86.8% and 91.3% cases respectively. According to Richard E, Latchaw et al [1] intracranial extra-axial tumours are common, comprising of 33-40% of all intracranial tumours. In present study neoplastic intracranial extra-axial lesions contributed 44.1% of all intracranial neoplasms.

Extra-axial lesions were mostly seen in 4^{th}-5^{th} decade (44.65%). Notably non-neoplastic lesions occurred at younger age (>$2/3^{rd}$ cases in first 3 decades of life) than neoplastic (52.47% in 4^{th}-5^{th} decade). The age incidence for extra-axial neoplasms did not differ much from that of overall CNS neoplasms as seen in Tamkeenmasoodiet al [6] who found maximum overall CNS neoplasms in 30-50 years age (47.1%). There was no obvious difference in sex distribution in overall cases.

Like other CNS lesions they presented with varied symptoms depending on their topographical location. But overall headache (69.5%) and visual disturbances (29.79%) were common presenting complaints for cranial lesions while backache (67.32%) and motor disturbances (64.36%) for spinal lesions. In addition, supratentorial lesions showed higher frequency of seizures and focal neurological deficit while infratentorial presented with hearing defects and imbalance. There were few clues such as fever suggesting infective etiology; hormonal disturbances (amenorrhoea, galctorrhoea) suggesting sellar origin, midline swelling over back suggesting spinal dysraphism. In study on overall CNS neoplasms by Tamkeenet al [6] headache (69.6%) and visual disturbances (29.3%) were seen in intracranial neoplasms and limb weakness (85.7%) and backache (57.1%) in spinal neoplasms. Similar findings were noted by Intisar Patty et al [7] for overall CNS neoplasms. Thus on comparing symptomatology of extra-axial lesions with overall CNS lesions, we unfortunately did not find much difference and there were no specific clinical pointers to suggest their extra-axial location. Majority cases presented with long standing symptoms representing their benign nature. (>75% patients had symptoms of > 1 month duration).
73.63% were located at intracranial location. Of these intracranial extra-axial lesions 72.69% (205/282) intracranial extra-axial lesions were located supratentorially. Overall most common location for cranial extra-axial lesions was cerebral convexity (27.30%) followed by sellar region (23.77%) and cerebellopontine angle region (22.7%). On comparing with intra-axial lesions in our institute, we found slight predominance of intra-axial lesions over extra-axial lesions in the supratentorial compartment, while extra-axial lesions predominated in the infratentorial compartment. Infratentorial tumours in adults were mostly extra-axial (71.43 %) which is in total agreement with the findings by Anne G. Osborn et al [8] who described most Infratentorial tumours in adults are extra-axial. Primary infratentorial extra-axial tumours are rare in children [2]. In present study infratentorial extra-axial tumours contributed to least (5cases) in children. Spinal tumours showed relatively higher incidence at intradural extra-medullary location which was matching with studies by Engelhard et al [9] and Hufana et al [10] Thoracic region was the most commonly affected.

Neoplastic lesions: Meninges (44.65%) were the most common site of origin. Meningioma constituted 15.60% of all CNS neoplasms which was lower than study done by Zalataet al [11] who reported 25.6%. Intracranially, meningioma was most common extra-axial neoplasm in supratentorial compartment while schwannoma was most common in Infratentorial compartment. This finding matches with study done by Kalyani D et al [12] who also found schwannoma as the most common infratentorial neoplasm. In spinal region schwannoma (39.59%) followed by meningioma (16.67%) were

common neoplasms. In present study nerve sheath tumours constituted 27.20% of all extra-axial neoplasms and 12.72% of all CNS neoplasms. This frequency was slightly higher than observation done by Zalata KR et al [11] in which nerve sheath neoplasms constituted 6.6% of all CNS lesions. Schwannoma constituted 25.33 % of all spinal neoplasms. This figure matches with the studies of Celli et al [13], Jeonet al[14] and Seppala et al[15] who found incidence of spinal schwannoma ranging from 21-25% of spinal neoplasms. All tumours involving the pineal gland are rare and account for less than 1% of all intracranial neoplasms [16,17]. In present study they contributed 1.04% of all intracranial neoplasms. In present study 8 cases of extra-axial metastatic tumours contributed to 2.09% of all extra-axial lesions of which 62.5% were intracranial. These findings correlated with Intiasar S.H. Patty et al [7] who found 70% cases intracranially.

Non-neoplastic lesions: Non-neoplastic lesions were 31.85% of all extra-axial lesions. Of these 61.47% cases were congenital and/or developmental anomalies while inflammatory and infectious lesions contributed to 28.69% of cases. They were found more commonly in first three decades with approximately equal male:femaledistribution. About 56.56% cases were located intracranially. Congenital / Developmental anomalies were comprised of maldevelopmental lesions (74.66%) and cranio-spinal dysraphism (25.34%). Maldevelopmental lesions included mostly the cysts of craniospinal axis which contributed 14.62% of all extra-axial lesions. Epidermoid cyst was the most common non-neoplastic intracranial extra-axial lesion while tuberculosis (45.28%) was the most common non-neoplastic lesion in spinal region. Epidermoid cysts account for 0.2 to 1.8% of all intracranial lesions and <1% of all spinal lesions [18]. In present study intracranial epidermoid cyst contributed 5.31% of overall intracranial lesions while spinal epidermoid cyst contributed 3.37% of all spinal lesions. Cranial sites outweigh spinal by 14:1 [19]. About 84.21% were seen intracranially in our study. Similar findings were seen in a study done by Sundaramet al [20]. Other cystic lesions in our study were arachnoid cyst and colloid cyst.

Incidence of spinal cyst 1.15 % of all CNS lesions in present study correlated with study of Traulet al [21] who documented incidence of 1%. In our study most of the cases of spinal cysts were in first two decades. Documented studies of Traulet al [21] and Guidetti et al [22] also observed their occurrence in first two decades. Overall spinal cysts are rare and have been reported as case reports only. Our study also included rare cases of neuroenteric cyst and tarlov cyst. Neuroenteric cyst accounted for 0.99% of all spinal lesions. Similar observations were seen by Fortuna et al [23] who documented its incidence as 0.7 to 1.3% of spinal lesions.19 cases of craniospinaldysraphism contributed to 4.96% of all extra-axial lesions. Most of them were located in spinal region. Almost all cases were in first decade and presented with swelling over back.Most commonly in Lumbo-sacral region (76.47%), all in extradural compartment. These findings correlated with Odebodeet al [24] who found them mostly in first decade with lumbo-sacral involvement in 62% cases. There were only two cases of cranial dysraphism.

Tuberculosis contributed 21.31% (26 out of 122) of all non-neoplastic extra-axial lesions. Spinal region was most common affected site with maximum cases presented as pott's spine affecting the bone and soft tissue.While meninges were affected in 7% cases. Though tuberculous meningitis is commonly encountered in our country, present study includes only 2 cases of cranial meningeal tuberculosis because the biopsies are rarely done for the same. Present study included 4 cases of pyogenic abscesses, 2 rare cases of isolated hydatid cyst and 1 case of actinomycosis . 10 cases of non-neoplastic masses of skull were comprised of 5 of fibrous dysplasia, 3 cases of mucoceleand 2 cases LCH- eosinophilic granuloma.

Overall recurrent extra-axial lesions were 6.79%. Of these 19 were neoplastic and 7 were non-neoplastic. 30.77% were pituitary adenomas followed by epidermoid cyst (19.23%).

In present study maximum extra-axial neoplasms were benign (87.36%) while intermediate and malignant cases contributed 4.60% and 8.04% cases. This is in contrast with study on overall CNS neoplasms by Intisar et al [7] who found 61.4% CNS neoplasms as malignant.

Radiological and pathological correlation and utility of squash cytology in the cases of discrepancies: In present study we considered the cases as radiologically and pathologically correlated only if the radiological diagnosis matched exactly with final histopathological diagnosis thus excluding the cases in which radiology gave multiple diagnosis, totally wrong diagnosis, non-specific diagnosis and the cases where radiology could not identify the higher grades of lesions.

In present study in 285 cases (74.41%) radiological diagnosis matched exactly with the final histopathological diagnosis. There was excellent correlation for grade I meningioma, intracranial schwannoma, pituitary adenoma, craniopharyngioma, epidermoid cyst, tuberculosis and other non-neoplastic lesion.

The maximum discrepancies were seen in benign neoplasms where they were mistaken by radiology as other benign neoplasms. Of 38 such cases maximum confusion was for schwannomas which were misdiagnosed as meningioma or neurofibroma. Also 13 non-neoplastic lesions were confused as other non-neoplastic lesions. Of the former 38 cases, 29 were received for intra-operative squash cytology and 22 were correctly diagnosed while of the later 13 cases, 10 were received for squash cytology and 8 were diagnosed correctly on cytology. Although cytology and histopathology played role in giving exact diagnosis the surgical management was not affected. But in two cases histopathology gave exact etiological diagnosis in unsuspected cases of hydatid cyst and tuberculosis thus guiding the post-surgical medical management.

Radiologically over diagnosis was done in 9 cases of which 4 cases of non-neoplastic lesions were diagnosed as benign neoplasms e.g. meningeal tuberculosis as enplaque meningioma, pituitary hypophysitis as pituitary adenoma. But still management was not affected. But in other 5 cases benign neoplasms were considered malignant e.g. mature teratoma as atypical teratoidrhabdoid tumours, meningothelial meningioma as meningeal metastasis, pineocytoma as germinoma or pineoblastoma. 4 of these were received for intra-operative squash cytology of which 3 were diagnosed correctly and thus definitely guided neurosurgeons intra-operatively.

Radiologically under diagnosis was made in 22 cases, specially seen regarding the diagnosis of intermediate and high grade neoplasms and the metastatic tumours; where radio-imaging failed to identify their malignant nature and thus cytology and histopathology had central role in making treatment decisions and predicting their behaviour. 19 of these were considered on radiology as benign neoplasms while 3 cases were considered non-neoplastic e.g.

- 3 PNET (grade IV) cases were radiologically misinterpreted as nerve sheath tumours or meningioma. Only in one case diagnosis of small round cell tumour could be offered in intra-operative cytology.
- Most WHO grade II meningeal neoplasms were diagnosed on radio-imaging as simply a meningioma, but histological subtyping and microscopic brain invasion proved them to be of higher grades. In few of these cases cytology proved useful.
- Of 8 metastatic neoplasms only 3 were suspected on radiology, rest were misdiagnosed as meningiomas or non-neoplastic lesions (tuberculous abscess and dermoid cyst). 5 were received for intraoperative squash cytology and all of them were diagnosed correctly, thus played a great role in intra-operative management.

6 cases of malignant neoplasms were diagnosed as malignant neoplasms but of different tissue origin e.g. osseous sarcoma for anaplastic meningioma, germinoma for pineoblastoma. Intraoperative squash cytology proved to be fruitful in 3 cases. Lesions at unusual sites were confused for the common lesions at that site e.g. sellar meningioma for pituitary adenoma, intraventricular meningioma for ependymoma. None case of hemangioma was suspected on radiology.

In about 33 out of 98 mismatched cases radiology gave two or more differential diagnosis. There were 4 cases where radiology gave non-specific diagnosis e.g. suggestive of neoplastic etiology without pointing towards any specific entity.

Correlation of intra-operative squash cytology with histopathology: Diagnostic accuracy of Intraoperative squash cytology in present study was 89.84 %. According to various studies on overall CNS lesions diagnostic accuracy ranges from 85-97% [25-29]. 81 out of 98 cases where radiology could not hit the exact diagnosis were received for squash cytology.

54 of these 81 cases were correctly diagnosed on intraoperative squash cytology. In present study excellent correlation was seen in meningioma, schwannoma, pituitary adenoma and even metastases. This finding matches with findings of Rosseleret al [30] and Goel et al [29]. But discrepancies were noted with few high grade meningioma, pineoblstoma, vascular tumours, PNET and few benign cystic lesions. The grade II and III histological subtypes of meningioma (chordoid, anaplastic, papillary) could not be subtyped on squash cytology. There was limitation of cytology for identifying grade II neoplasms showing brain invasion.

So it is clear from above discussion that both radiology and cytology had their limitations. But in overall smear preparations were used successfully to provide an extremely rapid, economic and acceptable intra-operative diagnosis. With the help of intraoperative cytology one can overcome limitations of radiology to some extent thus helping the neurosurgeons intraoperatively and ultimately benefiting the patient which should be the ultimate goal of every pathologist.

Summary and Conclusion

Extra-axial CNS lesions are common, comprise nearly half of the cases of CNS lesions; most of which are intracranial, slow growing, benign neoplasms commonly affecting meninges with low recurrence and squash cytology is of great help in their intra-operative diagnosis.

List of Abbreviations Used.

1. H & E - Haematoxylin and eosin.
2. CNS- Central nervous system.
3. CT- Computerised tomography.
4. MRI- Magnetic resonance imaging.
5. WHO- World Health Organisation.
6. CP angle- cerebellopontine angle.
7. Neo-Neoplastic.
8. Non-neo-Nonneoplastic.
9. LCH- Langerhans cell histiocytosis.
10. PNET- Primitive neuroectodermal tumour.
11. PAS - Periodic acid Schiff.

Funding: Nil, **Conflict of interest:** None initiated.
Permission from IRB: Yes

References

1. Richard E, Latchaw, Ansaar T Rai, Barton F Branstetter IV, Jeffery P Hogg. Chapter 41, Extra-axial Tumors of the Head: Diagnostic Imaging, Physiologic Testing, and Embolization, In: Richard E Latchaw, John Kucharczyk, Michael E Moseley, eds. Imaging of the Nervous System Diagnostic and Therapeutic applications. Vol 2. USA. Elsevier Mosby. 2005. p.771-836.

2. Zimny A, Sasiadek M. Contribution of perfusion-weighted magnetic resonance imaging in the differentiation of meningiomas and other extra-axial tumors: case reports and literature review. Journal of Neuro-Oncology. 2011;103(3):777-783.

3. Mustafa Kemal Demir, ÖzlemYapıcıer, ElifOnat et al. Rare and challenging extra-axial brain lesions: CT and MRI findings with clinico-radiological differential diagnosis and pathological correlation. DiagnInterv Radiol. 2014 Sep-Oct; 20(5): 448–452.doi: 10.5152/ dir.2014.14031.

4. Soonmee Cha, Edmond A. Knopp, Glyn Johnson, Stephan G. Wetzel, Dr med Andrew W. Litt, David Zagzag. Intracranial Mass Lesions:Dynamic Contrast-enhanced Susceptibility-weighted Echo-planar Perfusion MR Imaging. Radiology. 2002;223:11–29.doi /pdf/10.1148/radiol.2231010594.

5. Extraaxial Brain Tumors. National Institute of Neurological Disorders and Stroke (NINDS) [Updated on: 3 Feb 2014] Available from: http://www.ninds.nih.gov/about_ninds/groups/brain_tumor_prg/Extraaxial.htm.

6. TamkeenMasoodi, Ram Kumar Gupta, J. P. Singh, ArvindKhajuria. Pattern Of Central Nervous System Neoplasms: A Study Of 106 Cases. JK-Practitioner. 2012;17(4): 42-46.

7. Intisar S H Patty. Central Nervous System Tumors A Clinicopathological Study. J Dohuk Univ. 2008; 11(1) :173-180.

8. Anne G. Osborn. Extra-Axial Neoplasms, Cysts and Tumor-Like Lesions, In: Professor Nicholas C. Gourtsoyiannis, Pablo R. Ros, eds. Radiologic-Pathologic Correlations from Head to Toe. Berlin Heidelberg. Springer. 2005. p. 27-33.

9. Engelhard HH, Villano JL, Porter KR, Stewart AK, Baura M, Barker FG et al. Clinical presentation, histology and treatment in 430 patients with primary tumours of the spinal cord, spinal meninges or caudaequina. J Neurosurg Spine. 2010 Jul;13(1):67-77.doi: 10.3171/2010.3.

10. Hufana V, Tan JS, Tan KK. Microsurgical treatment for spinal tumours. Singapore Med J. 2005;46(2):74-77.

11. Zalata KR, El-Tantawy DA, Abdel-Aziz A, Ibraheim AW, Halaka AH, Gawish HH, Safwat M, Mansour N, Mansour M, Shebl A et al. Frequency of central nervous system tumors in delta region, Egypt. Indian J Pathol Microbiol. 2011;54(2):299-306.

12. DukkipatiKalyani, S. Rajyalakshmi, O. Sravan Kumar et al. Clinicopathological study of posterior fossa intracranial lesions. J Med Allied Sci. 2014;4(2):62-68.

13. Celli P, Trillo G, Ferrante L: Spinal extradural schwannoma. J Neurosurg Spine. 2005;2:447-456.

14. Jeon JH, Hwang HS, Jeong JH, Park SH, Moon JG, Kim GH. Spinal schwannoma : analysis of 40 cases. J Korean Neurosurg Soc. 2008;43:135-138.

15. Seppala MT, Haltia MJ, Sankila RJ, Jaaskelainen JE, Heiskanen O. Long term outcome after removal of spinal schwannoma: a clinicopathological study of 187 cases. J Neurosurg. 1995 Oct;83:621-626.

16. Konovalov AN, Pitskhelauri DI. Principles of treatment of the pineal region tumors. Surg Neurol. 2003;59:250-268.

17. Regis J, Bouillot P, Rouby V, FigarellaB,Dufour H, Peragut JC. Pineal region tumors and the role of stereotactic biopsy: review of the mortality, morbidity, and diagnostic rates in 370 cases. Neurosurgery. 1996;39:907-912.

18. Katzman GL. Epidermoid cyst, In: Diagnostic imaging: brain. Salt Lake City, Utah. Amirsys. 2004. p.7-16.

19. Roux A, Mercier C, Larbrisseau A et al. Intramedullary epidermoid cysts of the spinal cord. J Neurosurg. 1992;76(3):528-533.

20. Sundaram C, Paul T R, Raju B V, Ramakrishna Murthy T, Sinha A K, Prasad V S, Purohit A K. Cysts of the central nervous system : a clinicopathologic study of 145 cases. Neurol India. 2001;49:237.

21. Traul DE, Shaffrey ME, Schiff D. Spinal cord neoplasms- intradural neoplasms. Lancet oncol. 2007 Jan;8(1):35-45.

22. Guidetti B, Gagliardi FM. Epidermoid and dermoid cysts. Clinical evaluation and late surgical results. J Neurosurg 1977;47:12-18.

23. Fortuna A, Mercuri S. Intradural spinal cysts. ActaNeurochir (Wien). 1983(3-4);68:289-314.

24. Odebode, Udoffa U, Nzeh D. Cervical myelomeningocele and hydrocephalus without neurological deficit: A case report. American-Eurasial Journal of Scientific Research. 2007;2(1):60-62.

25. Shah AB, Muzumdar GA, Chitale AR, Bhagwati SN. Squash preparation and frozen section in intraoperative diagnosis of central nervous system tumors. Acta Cytol.1998;42(5):1149–54.

26. Chacko G, Chandi SM, Chandi MJ. Smear diagnosis of central nervous system lesions: a critical appraisal. Neurol India 1998;46:115–8.

27. Firlik KS, Martinez AJ, Lunsford LD. Use of cytological preparations for the intraoperative diagnosis of stereotactically obtained brain biopsies: a 19-year experience and survey of neuropathologists. J Neurosurg 1999;91:454–8.

28. Bleggi-Torres LF, de Noronha L, Schneider Gugelmin E et al. Accuracy of the smear technique in the cytological diagnosis of 650 lesions of the central nervous system. Diagn Cytopathol 2001;24:293–95.

29. Goel D, Sundaram C, Paul TR et al. Intraoperative cytology (squash smear) in neurosurgical practice – pitfalls in diagnosis experience based on 3057 samples from a single institution. Cytopathology 2007;18:300–8.

30. Roessler K, Dietrich W, Kitz K. High diagnostic accuracy of cytologic smears of central nervous system tumors. A 15-year experience based on 4,172 patients. Acta Cytol 2002;46(4):667-74.

……....

How to cite this article?

Patil P.R., Sondankar D.V., Mundhe M.B. Extra-axial central nervous system lesions- a clinicopathological overview. *Int J Med Res Rev* 2016;4(5):820-830.doi: 10.17511/ijmrr.2016.i05.27.

……