Section: Pathology

Original Research Article

INCIDENCE AND HISTOMORPHOLOGY OF PAPILLARY NEOPLASMS OF NERVOUS SYSTEM IN A TERTIARY CARE HOSPITAL

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Abstract

Background: This study investigates the frequency, histopathological characteristics, and potential primary sites of papillary neoplasms of the nervous system. The objective is to determine the incidence of these tumors, analyze their histological behavior and grading, and identify primary sites in nervous system metastatic tumors. **Materials and Methods:** A retrospective and prospective study was conducted at Stanley Medical College and Hospital in Chennai from January 2018 to December 2022. Histological analysis of 62 cases with a papillary pattern was performed, correlating the findings with WHO grading. Clinical data including age, sex, symptoms, radiological findings, and surgical history were collected. Statistical analysis was conducted using OpenEpi software. **Result:** The relative frequency of nervous system tumors with a papillary pattern was 2.66%. Metastatic tumors with a papillary pattern accounted for the majority at 62.90%. The peak age group affected was 51 to 60 years, and males were more commonly affected in both primary and secondary papillary tumors. Primary lung carcinoma was the leading cause of nervous system metastasis. Choroid plexus tumors were common in the younger age group, while papillary meningiomas were prevalent in young adult males. The spinal cord was the most frequent site for primary papillary tumors, particularly myxopapillary ependymoma. In metastatic papillary tumors, the cerebrum was the most common site. **Conclusion:** This study provides insights into the frequency, histopathological characteristics, and primary sites of papillary neoplasms of the nervous system. Understanding these aspects contributes to a better understanding of tumor incidence, behavior, and origin, aiding in clinical management decisions.

INTRODUCTION

Nervous system neoplasms, although constituting a small percentage of all cancers, have a significant impact on both adults and children. Understanding their incidence, prevalence, and survival rates is crucial to assess the disease burden among different populations. However, variations in these rates necessitate investigations into the etiology, treatment, and prognosis of these tumors. Institutional studies on nervous system tumors often suffer from biases due to selective case inclusion and exclusion. In developed countries, comprehensive cancer registries help provide accurate data, whereas in developing countries like India, the lack of registration hampers the estimation of the true disease burden. Therefore, multi-institutional data from tertiary care hospitals become essential for assessing the disease load. This study aims to address the need for descriptive data on primary brain and nervous system tumors in India, specifically focusing on papillary neoplasms. These tumors pose diagnostic challenges, and histological diagnostic difficulties. By analyzing data from our tertiary care hospital, this study aims to elucidate the epidemiology and histopathological characteristics of papillary neoplasms of the nervous system.

MATERIALS AND METHODS

This retrospective-cum-prospective descriptive study was conducted at the Department of pathology, Stanley Medical College and Hospital in Chennai from January 2018 to December 2022. The data source included papillary neoplasms reported in the Department of pathology during this period from the

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Department of Neurosurgery. A total of 62 neurosurgical specimens with papillary tumors were collected. Inclusion criteria encompassed all nervous system neoplasms exhibiting a papillary pattern, irrespective of their origin. Recurrent papillary tumors, non-neoplastic conditions, and cases with inadequate material for histopathological analysis were excluded. Detailed clinical data, including age, sex, symptoms, radiological findings, and surgical history, were obtained from Surgical Pathology records. Histopathological evaluation was performed using Hematoxylin and Eosin-stained sections, and the WHO grading criteria were applied. Follow-up data regarding adjuvant therapy, recurrence, and disease-free survival were collected. Statistical analysis was performed using the Statistical Package for the open epi software version.

RESULTS

In the 5-year study period from January 2018 to December 2022, the pathology department of Stanley Medical College received a total of 2,932 specimens for histological examination. Among these, there were 2,333 neoplasms, with 62 cases (2.66%) exhibiting a papillary pattern. Non-neoplastic cases accounted for 593 in total. The ratio of neoplastic to non-neoplastic cases was 4.3:1. Metastatic papillary tumors were the most common type of nervous system tumor with a papillary pattern, comprising 39 out of the 62 cases (62.90%). Primary nervous system tumors with a papillary pattern accounted for 23 cases (37.10%) in this study. [Table 1]

The most common age group for primary papillary neoplasms in this study was 0-10 years, comprising 7 out of 23 cases. This age group represented approximately 11.29% of all papillary tumors and 30.44% of primary papillary tumors. The next most common age group was 11-20 years, with 6 cases accounting for about 9.68% of papillary tumors and 26.09% of primary papillary tumors. The least common age group was the 4th to 7th decade, with 3 cases representing approximately 4.84% of all cases and 13.04% of primary papillary tumors. The age-wise distribution of primary papillary tumors is shown in the table. [Table 2]

Metastatic tumors with a papillary pattern are most commonly observed in the 3rd to 6th decade, with the peak age group being 51 to 60 years. This age group accounts for approximately 13 cases, representing 20.97% of all papillary tumors in the nervous system and 33.33% of secondary deposits with a papillary pattern. The least common age groups for metastatic tumors are the 1st two decades, which show a relative percentage of 0%. The age-wise distribution of metastatic tumors with a papillary pattern is illustrated in the table. [Table 3]

Males exhibit a higher prevalence in both primary and secondary nervous system tumors, with an overall relative percentage of 27.42% in primary tumors and 38.71% in secondary tumors. The male-to-female ratio for papillary tumors was found to be 2:1. The sex-wise distribution of primary and secondary papillary tumors in the nervous system is presented in [Table 4] for primary tumors, and [Table 5] for secondary tumors.

In this study, the spinal cord was identified as the most common site for primary papillary tumors, comprising approximately 9 cases (14.52% overall) and representing around 39.12% of primary papillary tumors. Other common sites included the lateral ventricle and cerebrum, each accounting for 4 cases (6.45%). The sellar region was the least common site (3.22%), with an incidence of 8.70% among primary tumors. The site-wise distribution of primary papillary tumors is presented in [Table 6].

In this study, the cerebrum emerged as the most common site for metastatic deposits with a papillary pattern, comprising 29 cases and accounting for approximately 46.77% of all cases and 74.36% of secondary tumors. The ventricles were the least common site, with a relative percentage of 0%. The distribution of metastatic deposits with a papillary pattern according to site is illustrated in [Table 7].

In cerebrum, the frontal lobe was the most common site for secondary deposits with papillary pattern which constituting 13 cases (44.83%). Temporo parietal region was the next common site (24.14%). Lobe wise distributions of metastatic deposits with papillary pattern are shown in this table. [Table 8]

Histomorphologically, metastatic papillary adenocarcinomatous deposits were the most common type, comprising approximately 39 cases (62.90%). Among primary papillary tumors, myxopapillary ependymoma accounted for 7 cases (8.06%). The histomorphological distribution of tumors with a papillary pattern is presented in [Table 9].

In this study, the primary site for metastatic deposits with a papillary pattern was identified for 29 cases. The lung was the primary site in 20 cases (51.28%), followed by the thyroid with 4 cases (10.26%). For 10 cases (25.64%), the primary site was either unknown at the time of metastasis or the details were not available. The primary site distribution of metastatic deposits with a papillary pattern is presented in [Table 10].

In this study, among the 39 cases of metastatic deposits, males (24 cases) were more commonly affected than females (15 cases). In the 20 cases of lung carcinoma, 15 cases (38.47%) were males and 5 cases (12.82%) were females. This sex distribution is depicted in [Table 11].

The primary papillary tumors were classified into different WHO grades, with 11 cases (47.83%) classified as Grade I and 13.04% as Grade III. The grading of primary papillary tumors is presented in [Table 12]

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Table 1: Origin wise distribution of nervous system neoplasms with papillary pattern

Origin	Number of cases	Percentage
Primary	23	37.10%
Secondary	39	62.90%
Total cases	62	100%

Table 2: Age wise distribution of primary papillary tumours of nervous system

Age in years(primary)	Number of cases	Percentage (overall)	Percentage (among primary papillary tumours)
0 to 10	7	11.29%	30.44%
11 to 20	6	9.68%	26.09%
21 to 30	4	6.45%	17.39%
31 to 40	3	4.84%	13.04%
41 to 50	0	0	0
51 to 60	3	4.84%	13.04%
61 to 70	0	0	0
Total cases	23	37.10%	100%

Table 3: Age wise distribution of metastatic papillary tumours of nervous system

Age in years	Number of cases	Percentage (Overall)	Percentage (2* papillary tumours)
0 to 10	0	0	0
11 to 20	0	0	0
21 to 30	3	4.83%	7.69%
31 to 40	6	9.68%	15.38%
41 to 50	11	17.74%	28.22%
51 to 60	13	20.97%	33.33%
61 to 70	6	9.68%	15.38%
Total cases	39	62.90%	100%

Table 4: Sex wise distribution of primary papillary tumours nervous system

	Number of cases	% (Overall)	% (Among 1* papillary tumours)
Male	17	27.42%	73.91%
Female	6	9.68%	26.09%
Toatal cases	23	37.10%	100%

Table 5: Sex wise distribution of metastatic papillary tumours of nervous system

Sex(Primary)	Number of cases	% (Overall)	% (Among 2* papillary tumours)
Male	24	38.71%	61.54%
Female	15	24.19%	38.46%
Total cases	39	62.90%	100%

Table 6: Site wise distribution of primary papillary tumours of nervous system

Site(primary)	Number of cases	% (Overall)	% (Among 1* papillary tumours)
Cerebrum	4	6.45%	17.39%
Posterior fossa	2	3.23%	8.70%
Lateral ventricle	4	6.45%	17.39%
Third ventricle	2	3.22%	8.70%
Spinal cord	9	14.52%	39.12%
Sellar	2	3.23%	8.705
Total cases	23	37.10%	100%

Table 7: Site of distribution of metastatic deposits in nervous system with papillary pattern

Site(secondary)	Number of cases	% (overall)	% (among 2* papillary tumours
Cerebrum	29	46.77%	74.36%
Posterior fossa	7	11.3%	17.95%
Lateral ventricle	0	0	0
Third ventricle	0	0	0
Spinal cord	3	4.83%	7.69%
Sellar	0	0	0
Total cases	39	62.90%	100%

Table 8: Cerebral lobe wise distribution of metastatic tumour with papillary pattern

Lobes of cerebrum (secondary)	Number of cases	Percentage
Frontal	13	44.83%
Temporal	2	6.90%
Parietal	2	6.90%
Temporoparietal	7	24.14%

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Parieto occipital	5	17.24%
Total cases	29	100%

Table 9: Histomorphological distribution of nervous system tumours with papillary pattern

Histomorphology	Number of cases	Percentage
Metastatic papillary adeno carcinomatous deposits	39	62.90%
Myxopapillary ependymoma	7	11.29%
Papillary meningioma	5	8.06%
Choroid plexus papilloma	2	3.23%
Choroid plexus papilloma with atypia	2	3.23%
Chroid plexus carcinoma	2	3.23%
Papillary craniopharyngioma	2	3.23%
Others	3	4.83%
Total cases	62	100%

Table 10: Primary tumour wise distribution of metastatic deposits with papillary pattern

Primary tumour	Number of cases	Percentage
Lung carcinoma	20	51.28%
Thyroid	4	10.26%
Git(colon)	2	5.13%
Fgt	2	5.13%
Breast	1	2.56%
Unknownprimary/ details unavailable	10	25.64%
Total cases	39	100%

Table 11: Sex wise distribution of primary tumours produced deposits in nervous system

PRIMARY TUMOUR	Male (NO)	%	Female (NO)	%
LUNG CARCINOMA	15	38.47%	5	12.82%
THYROID	1	2.56%	3	7.69%
GIT	2	5.13%	0	0
FGT	0	0	2	5.13%
BREAST	0	0	1	2.56%
Unknown/primary details unavailable	6	15.38%	4	10.26%

Table 12: Who grade wise distribution of primary nervous system tumours with papillary pattern

Who grade	Number of cases	Percentage
Who grade i	11	47.83%
Who grade ii	3	13.04%
Who grade iii	7	30.43%
Who grade iv	2	8.70%
Total cases	23	100%

DISCUSSION

Nervous system tumours are increasing in incidence in both developed and developing countries in the present era. Both adults and paediatric population show increasing occurrence of nervous system tumours. In the present study, histomorphological evaluation was done in 56 cases of papillary neoplasms. Stanley Medical College being a tertiary referral centre, the relative percentage of nervous system tumours among neuropathology samples was 79.48%. 20.22% were non neoplastic lesions. Among the nervous system tumours 62 cases were papillary neoplasms which constituted about 2.66%. In this study Male: Female ratio of nervous system tumours was 2:1.

As per WHO statistics nervous system tumours account for about 1.9% of overall tumour incidence in males and 1.8% in females.[1] In paediatric age group, nervous system tumours are one of the most common solid tumours. As per Gurney et al,[2] CNS tumours are the second most commonly distributed (20.7%) tumours after leukemia (23.2%). In India as per ICMR statistics,[3] annual percentage change in brain cancer for males in Chennai was 3.0%, for females in Chennai was 4.6%. ICMR and WHO statistics are population-based studies. This study is a tertiary care hospital based descriptive study.

This study showed that secondary metastatic carcinomatous deposits with papillary architecture constituted the most common nervous system tumours with an incidence of 62.90%. This is in concurrence with WHO statistics(60), KE Smedby et al, Barnholtz-Sloan et al.[4,5] Among 62 cases of papillary neoplasms, primary papillary tumours of nervous system constituted about 23 cases with a relative percentage of about 37%.In this study choroid plexus tumour constituted about 6 cases with a relative percentage of about 10%. The peak age was between 1-15 years. Among 6 cases of choroid plexustumour, 3 cases occurred in children ≤ 1 year of age with a relative percentage of 5%. This is in concurrent with WHO analysis.[6] As per WHO among all brain tumours,[6] choroid plexus tumours account for 0.3 – 0.6%; 2 – 4% of those occur in children less than 15 years of age. 10 % of those occur in 1st year of life. This is slightly higher than the present study. Among 6 cases of choroid plexus

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tumours, 2 cases were choroid plexus papillomas (WHO Grade I), 2 cases were choroid plexus papilloma with atypia (WHO Grade II) and 2 cases were choroid plexus carcinoma (WHO Grade III) with relative percentage of about 3%.

As per Janish et al, Rickert et al and Wolff et al,[7-9] 80% of Choroid plexus carcinoma arise in children in whom they constitute 20 – 40% of chroid plexus tumours. In the present study choroid plexus carcinoma constituted about 33%. This is in concurrence with the study of Janish et al In this study among 6 cases, 4 cases presented as a lateral ventricle mass with a relative percentage of 67% among choroid plexus tumours. This is in concurrence with WHO analysis. 2 cases presented as a third ventricle SOL (33%).[10-15] The overall male: female ratio was 1:1. This ratio was 1:1 for lateral ventricle tumours and 3rd ventricle tumours. This is similar to the WHO study. Myxopapillary ependymoma constituted the most common intra medullary neoplasm in this study. Among 7cases, 6 were intra medullary, predominantly involving lumbar region. This is in concurrent with Kurt et al and Schiffer et al.[9,10] Age range was 17 – 60 years with a male predominance. The male: female ratio was 6:1. This is in concurrent with Cervoni et al,[11] study in which average age of presentation was 36 years with an age range of 6 to 82 years and Male: female ratio was about 2.2:1. In this study the most common site was lumbar region. As per WHO almost they exclusively occur in conus medullaris and filum terminale.Ludwin et al,[12] described the clinico pathologic features of 17 cases and found that in comparison to other variants of meningiomas, PM was more frequent in children; 8/17(47%). Mitoses were seen in 7/17(41%), local recurrences in 10/ 17(59%), brain invasion in 8/17(47%), and extra cranial metastasis in 4/17(23.5%). This was not in concurrence with the present study.

Radhakrishnan et al,[13] reported 6 cases of PM all of which occurred in adults and most of them showed histological evidence of bone and brain invasion. This is in concurrence with the present study. In the present study 5 cases were reported as papillary meningioma with a relative percentage of about 8%. All cases occurred in male patients with an age range of 18 to 53 years. This is in concurrence with the study of Radhakrishnan et al.[13] Among 5 cases, 2 cases were papillary meningioma with rhabdoid differentiation. For 2 cases paraffin blocks were not available. Among 62 papillary tumours, 2 cases were papillary craniopharyngioma. As per Adamson et al and Crotty et al,[14,15] papillary craniopharyngioma occurs exclusively in adults with a median age range of 40 – 55 years. In the present study age range was 20 – 40 years. Compare to Crotty et al,[15] the age group was younger in this study. Male: female ratio was 1:1. Sellar location was common in both studies. Metastatic papillary tumour included 39 cases with a relative percentage of 63 %. This is in concurrence with Barnholtz et al and K E Smedby et al.[11,12] Among 39 cases, 24 cases were males with a relative percentage of 39%. 15 cases were female patients with a percentage of 24%. This is in concurrence with Barnholtz et al and Ksmedby et al.[4,5] Most common histological pattern was papillary adeno carcinomatous deposits. Among 39 cases, 28 cases were known primary. 23 cases with lung as primary constituted 37% of papillary neoplasms; 59% of secondary adenocarcinomatous deposit; 1 case was thyroid carcinoma, 2 cases were from GIT, 2 cases from ovarian malignancy. This is in concurrence with K E Smedby et al, Jill et al and WHO.[4,5] Most common affected age group was between 41-60 years with a male predominance of about 24 cases with percentage of 39%; among metastasis percentage of males was 62%. This is in concurrence with WHO, & Jill et al.[4-6] Females constituted 15 cases with an overall percentage of 24%, among metastasis 38%. In this study, anatomical site wise analysis revealed that cerebrum was the most commonly affected region in the nervous system. Among 39 cases, 29 (47%) occurred in cerebrum, 7(11%) cases were in posterior fossa, 3(5%) cases were in spinal cord. This study is similar to WHO analysis(6).Among the cerebral lobes, frontal lobe was the most commonly affected lobe by metastasis. 13 cases occurred in frontal lobe followed by 7 cases in temperoparietal, and 5 cases parieto occipital. This was in concurrence with WHO analysis and Jill et al.[5.6]

Among 6 cases of choroid plexus tumour, 2 were WHO grade I choroid plexus papilloma, 2 cases were WHO grade II choroid plexus papilloma with atypia, 2 cases were WHO grade III choroid plexus carcinoma. CPP showed papillary pattern with central delicate fibro vascular core. These cores are lined by uniform single layer of cuboidal to columnar cells. Cells have oval to round, basally situated uniform nuclei. They have very low mitotic activity. Atypical choroid plexus papilloma showed increase mitotic activity. This is similar to WHO analysis (61) CPC showed patternless diffuse sheets with ill defined papillary pattern. They showed >5 mitosis pAll 7 myxopapillary ependymomas were WHO grade I tumour. They showed arrangement of cells in a papillary pattern around blood vessels. The cells were cuboidal to columnar with myxoid material in the background. This is similar to WHO analysis.[6] Among 5 cases of papillay meningioma blocks were available for 3 cases only. These were WHO grade III tumours. They showed ill defined papillary pattern and diffuse pattern with adjacent brain parenchymal infiltration. In this 2 cases showed rhabdoid differentiation. Rhabdoid cells are plump oval cells with eccentrically placed nuclei with open chromatin and prominent nucleoli. Cytoplasm is waxy eosinophilic in nature. 2 cases of papillary craniopharyngioma were reported. These are WHO grade I tumours. They showed well differentiated squamous epithelium in papillary pattern. Among 39 cases, 36 cases showed well defined papillary pattern of cells with central fibrovascular core. The cells lining the papillae were columnar cells showing stratification with increased N: C ratio and coarse

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hyperchromatic nuclei. Foci of necrosis were also seen.

2 cases of lung primary showed vague papillae and bronchiole alveolar pattern of cells. The cells are arranged in papillary pattern with oedematous fibro vascular core. The lining cells are low columnar with peg like appearance. 2 cases of primary thyroid carcinoma showed papillary and follicular arrangement of cells. The cells are round to oval with clear nuclei with nuclear crowding and overlapping.

CONCLUSION

In conclusion, this study highlights the increasing incidence of papillary neoplasms in the nervous system, both in adults and pediatric populations. Metastatic deposits with a papillary pattern were found to be the most common type of nervous system tumors, particularly in older individuals. Lung carcinoma emerged as a significant contributor to brain metastasis, resembling trends observed in Western populations. Further research employing immunohistochemistry panels is recommended to identify the primary site for secondary papillary tumors. The implementation of these markers in clinical practice aids in understanding tumor antigen expression, diagnosing challenging cases, and guiding appropriate management. To address the lack of comprehensive data on CNS tumors, establishing a Comprehensive CNS Tumor Registry at tertiary care hospitals is crucial. Such a registry would provide valuable insights for planning and managing CNS tumors, as well as contribute to a better understanding of the epidemiology of these tumors in the Indian population.

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