

Role of crush cytology in the intraoperative diagnosis of meningioma

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Abstract

Background: Primary tumours of central nervous system constitutes less than 2 % of overall cancers in adults. Meningiomas form 24-30% of primary intracranial tumours. The crush/squash smear cytology acts as prelude for intraoperative neurosurgical consultation. It guides the neurosurgeon for lesion targeting and surgical resection. **Objective:** To assess the accuracy and utility of cytomorphological evaluation of meningiomas by crush/squash cytology and subsequent correlation with histopathology. **Materials and Methods:** This was both a retrospective and prospective study of eleven radiologically and clinically suspected meningiomas sent for intraoperative consultation by squash cytology. The biopsy specimens of these cases sent in normal saline were smeared and stained with toluidine blue and Hematoxylin and Eosin stain (HandE). The cytomorphological features of these tumours was then studied and correlated with histopathological sections. **Results:** Of the eleven cases of meningiomas we observed a slight female predilection with male to female ratio of 1:1.2. These tumours were more common in the age group of 41-60 yrs (6/11) followed by second peak in 61-80 yrs (3/11) and two cases between 20 to 40 yrs. Most common location of these tumours was cerebrum (6/11=55%) followed by cerebellopontine angle and posterior fossa (4/11=36%) and one in sellar location. Cytological and histological correlation was achieved in all the 11 cases with 100% correlation. **Conclusions:** Crush preparation is fairly accurate, relatively safe rapid, simple, easily reproducible and cost effective tool to diagnose meningiomas.

Keywords: Intraoperative consultation, meningiomas, crush/squash cytology.

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INTRODUCTION

Primary tumours of the central nervous system constitutes less than 2% of overall cancers in adults and they are second most frequently encountered tumours in children after leukemia. The prognosis of these tumours depends partly on the constituent cell type which is important for the classification of these tumours. Meningiomas form 24-30% of primary intracranial tumours.^{1,2} The role of

rapid intraoperative diagnosis in neurosurgery has increased with the development of minimally invasive surgeries especially stereotactic and endoscopic surgeries.³ Clinical diagnosis has improved with the high resolution imaging techniques, however 'definitive diagnosis' can be obtained by cytological or histopathological examination of tumour tissue.⁴ Smear technique allows the surgeon for multiple sampling of the tumour by stereotactic devices. Smear technique is a fairly accurate, relatively safe, rapid, simple, easily reproducible and cost effective tool to diagnose brain tumours.⁵ The diagnostic accuracy of the test is determined by comparison with paraffin embedded histopathological sections. The aim of the present study was to assess the accuracy and utility of cytomorphological evaluation of meningiomas by crush/squash cytology and subsequent correlation with histopathology.

MATERIALS AND MEHODS

We did both retrospective and prospective study of eleven radiologically and clinically suspected meningiomas sent for intraoperative consultation to the department of Father Muller Medical college, Mangalore during a period of three years, from January 2012 to August 2014. The intra-operative biopsy tissue was transported immediately from operation theatre to the laboratory in normal saline. To create crush smears, small bits of tissue measuring 1 to 2 mm or pinhead size of tissue is placed near one end of a slide and the flat surface of another slide is placed on top of the specimen and advanced with a uniform motion without exerting undue pressure.^{1,6,7,8} Minimum of 4 smears were made depending on the amount and sample of tissue received. Two smears were fixed in methanol and stained with rapid H and E stain and two air dried smears with Toluidine blue. An intraoperative diagnosis made on squash cytology was then compared with paraffin embedded histopathological sections of the residual tissue sample.

OBSERVATIONS AND RESULTS

Age and sex distribution

The meningiomas were more common in the age group of 41-60 years (6/11=55%) followed by second peak in 61-80 years (3/11=27%) and two cases between 20 to 40 years (2/11=18%). It is shown in **Figure no.1**. Male/female ratio was 1:1.2 irrespective of age group with slight female predilection. (females:6/11 and males:5/11). The sex distribution is shown in **Figure no.2**. The most common location of these tumours was cerebrum (6/11=55%), followed by cerebellopontine angle/posteriosfossa (4/11=36%) and then by sellar (1/11=9%) location. The same is depicted in **Figure no.3**. Complete correlation between intraoperative smear diagnosis and histopathology was achieved.

DISCUSSION

The purpose of this study was to assess the current role and to determine the diagnostic accuracy and utility of cytomorphological evaluation of meningiomas in neurosurgical consultation. The study demonstrated high diagnostic accuracy on smears with 100% correlation with histopathology. Meningiomas are meningotheialneopalsms, they resemble archnoidal cells in morphology and are typically seen attached to the inner aspect of dura. Most meningiomas are benign and correspond to WHO (World Health Organisation) grade 1. Certain meningiomas having specific combinations of morphological parameters, are seen associated with less favourable clinical outcomes and correspond to WHO grade 2 (atypical) and 3 (anaplastic or malignant).

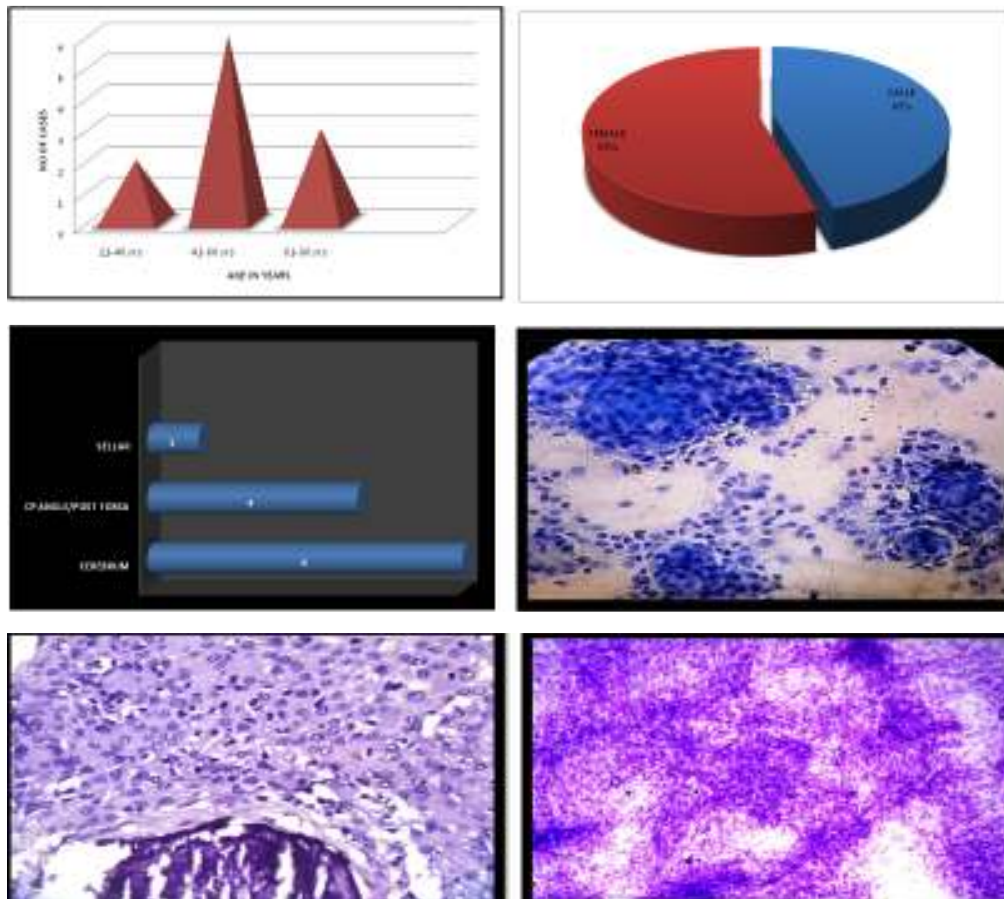
Meningiomas form 24 to 34% of primary intracranial tumours.² Meningiomas have the dualistic distinction of being both boring and interesting. They say that some can even be diagnosed in the wink of an eye. Others mimic many tumour types and require more extended study to identify and predict their behaviour.⁹ Meningiomas occur most commonly in middle aged and elderly patients with a peak during sixth and seventh decade. But they also occur in children. In the present study as well. Our first peak was between 4th to 6th decade and then second between 6th to 8th decade which coincided with literature.^{2,8} These tumours have a well known female predominance^{2,9}, in part due to their frequent expression of estrogen receptors.⁹ The female to male ratio being 1.7:1.² We also had a slight female predilection with female to male ratio of 1.2:1. Meningiomas are soft tumours and are easy to smear show varied cellularity high in syncytial type and low in fibrous meningiomas. In most tumours cells smear into clumps which vary in size have irregular margins and are unrelated to blood vessels. The nuclei are uniform round and ovoid with diffuse delicate chromatin, small or indistinct nucleoli and intranuclear inclusions and illdefined cytoplasm. Meningothelial (syncytial) meningiomas have cells arranged in whorls, lobules or sheets. Fibrous meningiomas have spindled cells with elongated nuclei lacking meningotheial morphology and arranged in ill defined fascicles. Transitional (mixed) meningiomas have pronounced whorl and lobule formation with spindle cells. Psammoma bodies with concentric lamination are seen commonly in this variant which appears unstained in toluidine preparations. Psammomatous meningiomas invariably occurs in spinal canal with numerous psammoma bodies and very few tumour cells.^{9,10} In our study, tissue of all the tumours was easy to smear. Only one case of fibrous meningiomas was relatively difficult to smear.^{9,10} Most of the tumours were either meningotheialmeningioma or transitional meningioma. These tumours were easy to smear and were highly cellular with meningotheial cells arranged in whorls, clusters and fascicles. Individual cells were oval to spindle with vesicular nucleus, inconspicuous to prominent nucleus and moderate amount of eosinophilic pale cytoplasm with indistinct cell borders. Occasional cells showed mild pleomorphic nucleus. Background of all the tumours had psammoma bodies and few of them showed glial cells and inflammatory cells. Few of the lesions also showed endothelial proliferation. (**figures.4,5**) Smears from fibrous meningioma was highly cellular and tumour cells were arranged in ill defined fascicles. Individual cells were spindle to oval shaped with elongated nucleus and scant to moderate eosinophilic cytoplasm. Background of psammomatous

calcification and endothelial proliferation was also noted (**figure.6**) A case of atypical meningioma(WHO grade 2) reported in our study was a recurrent tumour. The tumour tissue was easy to smear and was highly cellular and arranged in tight and loose clusters, fascicles and whorls. Individual cells were medium sized round to oval with high N:C ratio, mildly pleomorphic nucleus, coarse chromatin, occasional prominent nucleoli and scant indistinct cytoplasm. Focal mitosis, necrosis and endothelial proliferation was seen. With all these findings a diagnosis of atypical meningioma WHO grade 2 was

given which correlated with histopathological diagnosis. We achieved 100% correlation in smear diagnosis in comparison with histopathology. Kumar SN *et al.* and Kini JR *et al.* also had achieved 100% correlation with regard to the intraoperative diagnosis of meningiomas by crush cytology^{1,4}. Roessler K *et al.* had got an accuracy of 97.9% in his similar study with regard to meningiomas.⁸ Shukla K *et al.* got a diagnostic accuracy of 95% in their study¹¹. The following table shows the literature contribution.(Table 1).

Table 1: Cyto-Histo Correlation Of Meningiomas From Literature

Sl.no	Study	No of cases of meningiomas	Accuracy (%)
1	CURRENT STUDY	11	100
2	Kumar SN <i>et al.</i>	16	100
3	Kini JR <i>et al.</i>	25	100
4	Roessler K <i>et al.</i>	559	97.9
5	Shukla K <i>et al.</i>	20	95



Legend

Figure 1: Age Distribution Of Meningiomas

Figure 2: Sex Distribution Of Meningiomas

Figure 3: Location Of Meningiomas

Figure 4: Transitional meningioma: Smear-Whorls of meningothelial cells.(TB;100X)

Figure 5: Transitional meningioma: Section-Whorls of meningothelial cells and calcification.(HandE;400X)

Figure 6: Fibrous meningioma:Smear: Fascicles of spindle cells.(HandE;100X)

SUMMARY AND CONCLUSION

We observed that meningiomas were most common between 40 to 60 years with 55% of total number of cases. Female predilection was seen with female to male ratio of 1.2:1. Most common location was cerebrum with 55% followed by cerebellopontine angle/posterior fossa with 36%. Complete histo-cyto correlation was achieved. (100%). Intraoperativesmear(squash/crush) provides a rapid, reliable intraoperative diagnosis and guidance to the neurosurgeon during surgical resection and lesion targeting. Smear technique is a fairly accurate, relatively safe, rapid, simple and easily reproducible and cost effective tool to diagnose various CNS lesions particularly meningiomas.

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