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Diagnostic Utility of Intraoperative Squash Smear Technique in Neurosurgical Biopsies by Comparing Squash Smear Versus Paraffin Sections

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Abstract

Background: Squash smear technique is reliable diagnostic tool which provides neurosurgeons with rapid intraoperative diagnosis and helps them to modify their surgical approach. This study was done to assess the accuracy and diagnostic utility of squash smear technique by comparing with histopathological diagnsosis. *Materials and Methods*: Our study included 33 patients who underwent operation in neurosurgical department, Narayana Medical college and hospital, Nellore. Squash smear technique was used to provide intraoperative diagnosis and was correlated with histopathological diagnosis. *Results*: 33 cases were studied, out of which 2 were inflammatory lesions and 31 were neoplastic. Neoplastic lesions included astrocytomas (42.4%), meningiomas (27.3%), oligodendrogliomas (3.03%), ependymoma (3.03%), chordoma (3.03%), schwannoma (9.09%), choroid plexus papilloma (3.03%), pituitary adenoma (3.03%). Non neoplastic cases were 2 cases of tuberculoma (6.06%). Accuracy rate of squash smear technique was 87.9% in our study. 100% accuracy was found in astrocytomas which were maximum in our study followed by meningiomas. *Conclusion*: squash cytology provides reliable and rapid diagnosis for neurosurgeons. Accuracy is good in astrocytomas when compared to inflammatory conditions and rare tumors like ependymoma and chordoma. Clinical features and radiological findings should be considered to increase the accuracy of squash cytology.

Keywords: Squash Cytology; Intraoperative Diagnosis.

Introduction

The intraoperative squash smear preparing technique was introduced by Eisenhardt and Cushing in 1930. Later in 1937 this technique was mastered by Russel et al from United kingdom [1].

Most of the intracranial lesions which can be due to malignancies or inflammatory conditions produces similar clinical features and have inconclusive radiological features, thus making it difficult for surgeon to take decision about the treatment. As it is not possible to perform the fine needle aspiration for intracranial space occupying lesions, squash cytology may provide neurosurgeons with rapid diagnosis intraoperatively, thus helping them to decide the treatment modality and extent of surgical resection. Brain tissue is soft in nature due to high water content, which facilitates the preparation of smears revealing the cytomorphological details [2].

The present study was carried out to assess the diagnostic efficacy of intraoperative squash smear study in various intracranial lesions by comparing with histopathological diagnosis on paraffin sections.

Materials and Methods

This study was done in Narayana Medical College and Hospital, Nellore. Our study included 33 patients who attended neurosurgery department with features of intracranial space occupying lesions. The patients has undergone radio imaging, hematological examinations HIV screening. During the operative procedure the main mass was removed. 2 to 3 tissue bits from various sites of the tumor were taken for the

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preparation of squash cytology. The main bulk of tissue was kept in 10% formalin for routine histopathological examination.

For preparing squash smears, a small tissue bit is crushed in between two glass slides and pulled apart with gentle pressure to prepare thin smears. Immediately smears are fixed in 95% alcohol and then stained by rapid Haematoxylin and Eosin stain. Smears are rinsed in water followed by staining in Harris haematoxylin for 1minute. Then the slides are kept in acid alcohol (1% Hydrochloric acid in 70% alcohol) for differentiation followed by wash in tap water and counter stained by Eosin (0.5%) for 30 seconds. Then the slides are washed in water and mounted. After examining the squash smears, an intraoperative diagnosis was made which was then compared with diagnosis made on paraffin embedded sections. Accuracy of squash smears is then assessed.

Results

33 patients with intracranial lesions and spinal lesions were included in our study. Patients with different age groups were included with maximum number of cases in 51– 60 years. Tumors showed slight male predominance with male to female ratio of 1.06:1 (Table 1).

Out of 33 cases, 31 cases were of neoplastic lesions and 2 were inflammatory lesions. Among the neoplastic lesions astrocytomas (42.4%) (Figure 1,2) were the most common lesion with meningiomas (27.3%) (Figure 3, 4) and schwannomas (9.09%) next in frequency of occurrence. Single case of ependymoma, choroid plexus papilloma (Figure 5, 6), oligodendroglioma and pituitary adenoma (Figure 7, 8) were seen in our study. Two cases of tuberculomas were encountered in our study in which one was misdiagnosed as low grade astrocytoma. The cytological features of these lesions were compared with histopathological diagnosis on paraffin embedded tissue sections (Table 2).

Accuracy of the squash smear cytological diagnosis was found to be 87.9%. However discordance was noted in 4 cases out of 33 cases (Table 3). Our study correlated with study done by Asha T et al [3], Kini JR et al [4], and Sundaram S et al [5] (Table 4). Discordant cases were studied in detail and the cause of discordance was analyzed.

Table 1: Age and sex distribution in different intracranial lesions

Age in years	Females (n=16)	Male (n=17)	Total (n=33)
0-10	-	-	-
11-20	-	3	3
21-30	3	2	5
31-40	2	1	3
41-50	1	1	2
51-60	6	7	13
61-70	3	2	5
71-80	1	1	2

Table 2: Comparision of squash smear diagnosis with histopathological diagnosis

S. No	Histopathological Diagnosis	Total number of cases	Squash smear diagnosis	Squash smear accuracy
1	Astrocytoma	14 (42.4%)	14	100%
2	Meningioma	9 (27.3%)	9	100%
3	Oligodendroglioma	1 (3.03%)	1	100%
4	Ependymoma	1 (3.03%)	0	0
5	Chordoma	1 (3.03%)	0	0
6	Schwannoma	3 (9.09%)	2	66.67%
7	Choroid plexus papilloma	1 (3.03%)	1	100%
8	Pituitary adenoma	1 (3.03%)	1	100%
9	Tuberculoma	2 (6.06%)	1	50%
	Total	33	29	87.9%

Table 3: Discordant cases in our study

Squash Smear Diagnosis	Histopathological Diagnosis	Number of Cases
Meningiomas	Schwannoma	1
Pilomyxoid astrocytoma	Chordoma	1
High grade glioma	Ependymoma	1
Low grade astrocytoma	Tuberculoma	1

Table 4: Concordance and discordance rate in different studies

Studies	Concordance rate	Discordance rate
Asha et al	87%	13%
Kini JR et al	86%	14%
Sundaram S et al	89%	11%
Our study	87.9%	12.1%

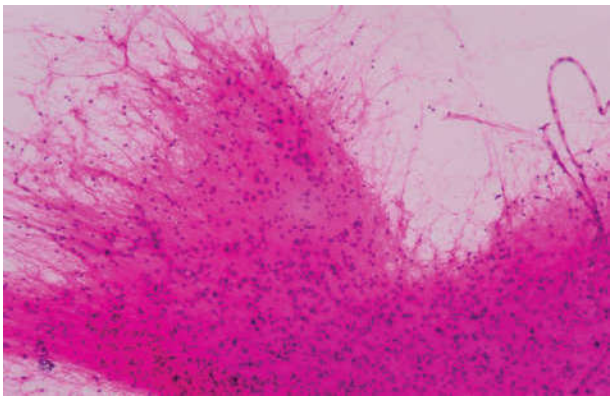

Fig. 1: Smears showing astrocytes with increased cellularity and fibrillary background (H&E,X100)

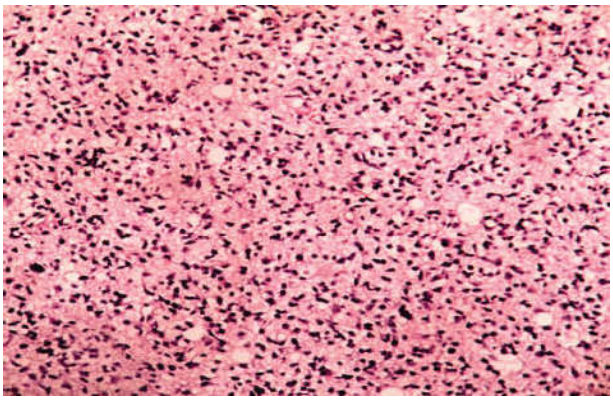

Fig. 2: Astrocytoma with increased cellularity and mild nuclear atypia in the fibrillary background (H&E,X100)

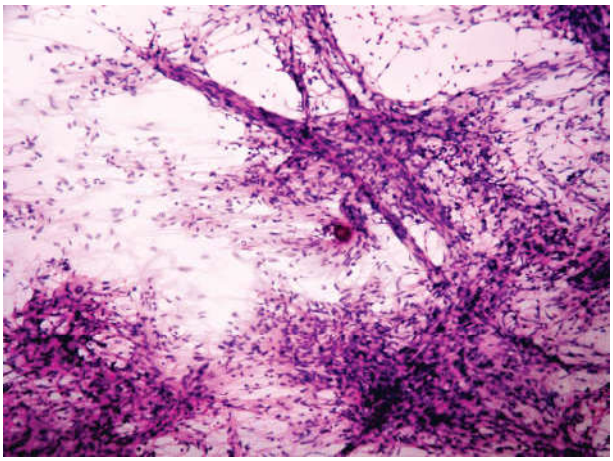

Fig. 3: Smears showing spindle shaped cells and a psammoma body (H&E,X100)

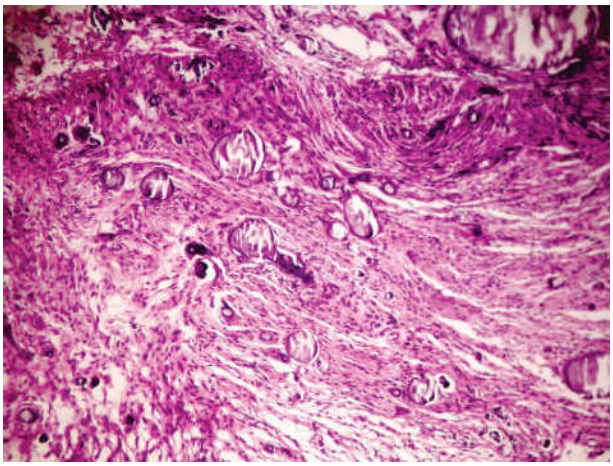

Fig. 4: Meningioma with Spindle shaped cells and psammoma bodies (H&E,X100)

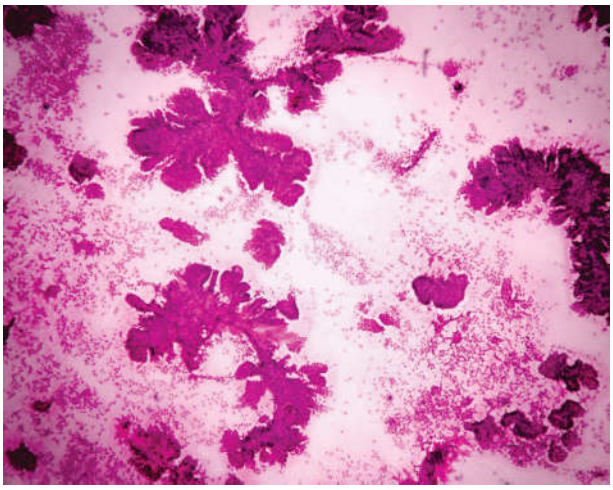

Fig. 6: Choroid plexus papilloma showing papillary fronds with delicate fibrovascular core lined by single layer of cuboidal to columnar epithelium (H&E,X100)

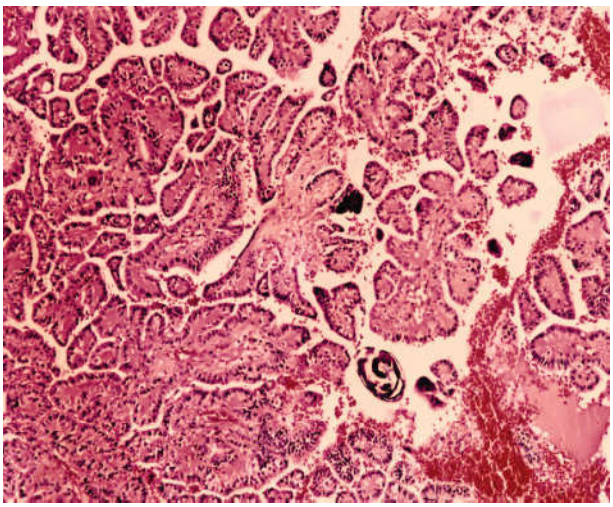

Fig. 7: Smears showing tumor cells having eosinophilic to amphophilic cytoplasm (H&E,X400)

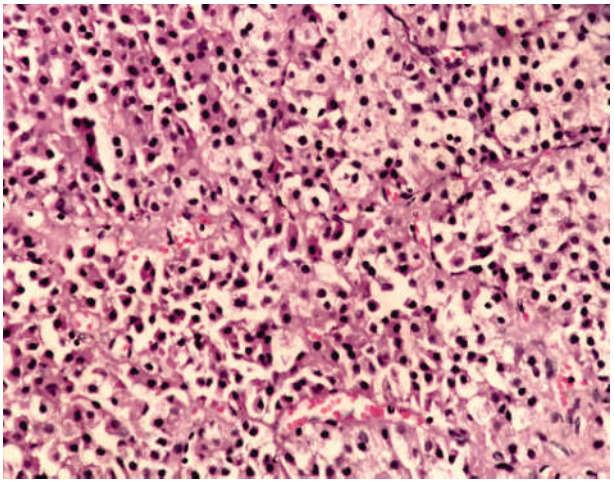

Fig. 8: Pituitory adenoma having eosinophilic cells and chromophobic cells (H&E,X400)

Discussion

During the operative procedure, neurosurgeon requires information regarding whether the lesion is infectious or neoplastic. If it is neoplastic then whether it is glial or non glial tumors and grade of the tumors. This information helps him to decide the extent of surgery required by the patient. Stereotactic biopsies yield tiny tissue on which the lesion has to be interpreted. Pathologists require simple and rapid technique which can reveal the cellular morphology in such small biopsy bits. Frozen sections may not be helpful in providing accurate diagnosis by the pathologist, as freezing the soft brain tissue results in ice crystal formation which produces artifact [6].

As the brain tissue is inherently soft in nature with high water content, it is easy to prepare squash smears by crushing the tissue and spreading on the slide providing detailed cytological morphology to the pathologist which aids in accurate intraoperative diagnosis [7].

The squash cytology has gained importance as the technique is simple and rapid providing good details of cellular morphology. This technique needs minimum technical skills and equipment. It can be done at operative site and tiny tissue bit is enough for this procedure, which is important for the surgical procedures done on intracranial lesions, localized in the functional areas of brain [8].

Another advantage is, as the tiny tissue bit is sufficient for squash cytology, remaining tissue bit can be used for preparing paraffin embedded tissue sections, which can also be utilized for immunohistochemistry. Squash smear technique also gives information regarding the consistency of the lesion. The lesions which are rubbery to firm like meningiomas and schwannomas are resistant to smearing where as glial tumors are smooth and spread without resistance on smearing [9].

In our study, astrocytomas were diagnosed with 100% accuracy on squash cytology which coincided with study done by Rani H et al [10]. Astrocytomas revealed moderately cellular smears with minimal anisocytosis. The cells have fine to coarse granular chromatin and inconspicuous nucleoli. Background shows fibrillary processes.

Meningiomas were also diagnosed with 100% accuracy. The smears were cellular and had cells with vesicular round to oval nuclei and moderate eosinophilic cytoplasm. Some of the cells show nuclear pseudoinclusions. Psammoma bodies were seen in some of the cases.

Oligodendrogliomas showed uniform round cells in the smear. The cells had well defined margins and had discohesive pattern. Prominent thin walled vessels were seen. Fibrillary background was not seen in the background.

Ependymomas show smears with cells having round to oval nuclei with conspicuous nucleoli. The cells may be arranged in papillary pattern and also around the blood vessels forming perivascular pseudorosettes. In our study we diagnosed a case of ependymoma as high grade glioma.

One case of choroid plexus papilloma was diagnosed in our study. The smears in choroid plexus papilloma show fine papillae lined by single or multilayered cuboidal to columnar epithelial cells. The cells were bland without any nuclear atypia.

Schwannomas showed cohesive fragments of spindle shaped cells having elongated wavy nuclei. In our study one case of schwannoma was misdiagnosed as fibroblastic meningioma due to predominance of spindle shaped cells. Similar discordance was seen in the study done by Kalpana deshpandey et al [1].

Smears from pituitary adenomas show monomorphic cells with round to oval nuclei having finely dispersed chromatin and with single conspicuous nucleoli. The cells have acidophilic to faintly basophilic cytoplasm. Mild nuclear hyperchromatism may be noted. In our study one case of pituitary adenoma was diagnosed on squash smear.

One case of chordoma was diagnosed as pilomyxoid astrocytoma in our study. Due to myxoid background, elongated cells and absence of physaliferous cells we considered it as pilomyxoid asrocytoma. But on paraffin embedded sections, the

diagnosis was given as chondroid chordoma. The diagnosis was supported by performing immuno-histochemistry.

In the non-neopalstic conditions, 2 cases of tuberculomas were encountered in our study. One case showed multinucleated langhans giant cells and epithelioid cells, which helped in the diagnosis of tuberculoma. Other case was misdiagnosed as low grade astrocytoma due to predominance of reactive glial cells from the adjacent tissue. This may be due to sampling error which was also seen in the study done by Kini et al [4].

In our study, discordance rate between the squash cytological intraoperative diagnosis and histopathological diagnosis was 12.1% and concordance rate was 87.9%. The concordance rate is increased by correlating with clinical and radiological findings .

Conclusion

Squash smear technique is simple, which does not require technical skills and is very economical, as no costly equipment is required. It is helpful in giving rapid intraoperative diagnosis. Though few matrix rich tumors like schwannomas may be resistant to smear and few rare tumors like chordomas are difficult to diagnose, overall accuracy rate for the common tumors is high. The accuracy rate can be increased by taking in to consideration detailed clinical history and radiological findings.

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