Original Research Article

Diagnostic accuracy of central nervous system tumors by squash cytology

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Abstract

Background: Squash cytology has shown to be of great value in intraoperative consultations of central nervous system lesions. Intraoperative smear cytology provide a rapid and reliable diagnosis and guidance to the neurosurgeon during surgical resection and lesion targeting. Squash smear technique saves time and amount of tissue needed.

Aim: To study the validity of rapid intraoperative diagnosis of central nervous system lesions by examining the squash cytologic smears of central nervous system lesions.

Materials and methods: A total of 111 cases of intracranial space occupying lesions were studied. This squash smears were prepared from the intraoperative biopsy samples and remaining tissue fixed in formalin and sent for histopathological examination. Squash smears were stained with toluidine blue and rapid haematoxylin and eosin. Squash smear cytological diagnosis was correlated with histopathological findings.

Results: Out of 111 cases, in 11 (9.9%) cases showing discordance was observed between squash smear diagnosis and histological diagnosis. In 100 (90.1%) cases, squash smear diagnosis was in accordance with the final histologic diagnosis. Thus the value of squash smear technique in rapid intraoperative diagnosis of neurosurgical biopsies was corroborated by above study and the accuracy of this study match with other studies done in the past on squash smear technique.

Conclusion: Squash smear cytology should be used regularly for rapid intraoperative diagnosis of central nervous system lesions, as squash smear technique is economical, reliable, feasible intraoperative rapid diagnostic method and has a place in determining the immediate management.

Key words

Squash smear cytology, Central nervous system lesions, Histopathological examinations.

Introduction

Smear cytology has become increasingly popular as an alternative approach or an adjunct to frozen sections for rapid intraoperative diagnosis in neuropathology in the recent years because the technique is very simple but accurate. The need for such a rapid diagnosis has been greatly enhanced with the advent of stereotactic brain tumour biopsies. Squash smear preparation consume very little tissue, allow better preparation of nuclear and cytoplasmic details (compared to frozen sections) demonstrate glial processes well, can be prepared more rapidly and do not require special equipment, hence economical.

The smear technique for brain biopsy is a simple method where by a diagnosis of normal or abnormal tissue can be made within minutes of the biopsy reaching the laboratory and it is also to be ensured that minimum injury is caused to the normal brain structures surrounding the intracranial neoplasm. The inherent soft nature of central nervous system renders poor quality frozen sections. The soft texture however aids the smear preparation often revealing exquisite cytological details.

Aim and objectives

- To study the validity of rapid intraoperative diagnosis of central nervous system lesions by examining the squash cytologic smears of central nervous system lesions.
- To compare squash smears with the histopathological diagnosis.
- To compare present study with the literature.

Materials and methods

Present study was conducted in the Department of Pathology, Gandhi Medical College, Secunderabad on patients admitted in the Department of Neurosurgery during January 2016 to December 2016. A total of 111 cases of central nervous system lesions were studied.

In every case age, sex, clinical history, duration of illness, findings on smear examination, radiological findings (CT/MRI) and operative notes were recorded.

Methods of preparing squash smears

From unfixed tissue in normal saline sent to the laboratory areas of interest were selected (usually 2 to 3 areas depending on the amount of tissue received) by naked eye examination.

A small sample of tissue 1-2 mm cube was dissected out with a scalpel blade and squashed between two glass slides. 3-4 smears were prepared by applying optimal pressure.

Staining methods

Aqueous toluidine blue method

1 or 2 smears were stained with 1% aqueous toluidine blue for 60 seconds

Rapid hematoxylin and eosin method

2 or 3 smears were fixed in absolute alcohol for 2 minutes, washed in water for 1 minute and stained with Harri's hematoxylin for 5 minutes. Smears were kept in 0.5% aqueous HCL for 10-20 seconds and rinsed in water for 2 minutes. Finally, smears were stained with eosin and dehydrated in graded alcohols, dried and mounted in DPX.

Depending upon the cytomorphological features, squash smears, the cyto-diagnosis of all cases was recorded in a predesigned proforma.

Histological sections were evaluated and final histological diagnosis was recorded in a predesigned proforma. Both cytological diagnosis and histopathological diagnosis were compared to assess the diagnosis accuracy of squash smears in CNS tumors. Special stains were used as and when required. There was no need for Immunohistochemistry and cytogenetic study during the entire study.

Results

In the present study, role of squash smear technique in the diagnosis of CNS tumours and

its correlation with histopathology has been evaluated. A total of 111 cases of central nervous system tumors, attending neurosurgery department during the period of 1 year at Gandhi Medical College, Secunderabad were selected for this study. Of these lesions 104 (96%) were intracranial space occupying lesions and 07 (6.3%) were spinal lesions.

Peak incidence of brain tumors were observed in middle life and they comprised 33 (29.7%) of tumors examined. Male and female ratio of all patients irrespective of age groups was 0.8:1. Age of youngest patient was 3 years and age of oldest patient was 74 years (**Table – 1**).

Table - 1: Age and sex distribution of patients (n=111).

Age distribution (years)	No. of cases	%	Male	Female
<10	4	3.6	3	1
11-20	5	4.5	2	3
21-30	16	14.4	11	6
31-40	15	13.5	5	10
41-50	33	29.7	13	11
51-60	23	20.7	9	14
61-70	14	12.6	6	8
>70	01	0.9	0	1
			49	62

Table - 2: Cytological evaluation of squash smears (n=111).

Diagnosis of squash smears	No. of cases	%
Low grade astrocytoma	26	23.4
Malignant glioma	20	18
Ependymoma	1	0.9
Pituitary adenoma	2	1.8
Medulloblastoma	2	1.8
Meningioma	28	25.2
Schwannoma	8	7.2
Craniopharyngioma	3	2.7
Metastasis	13	11.7
Reactive glial tissue	2	1.8
Epidermoid cyst	1	0.9
Small round cell tumour (SRCT)	1	0.9
Benign mesenchymal tumours	2	1.8
Choroid plexus papilloma	1	0.9
Neurofibroma	1	0.9

Following lesions were diagnosed by examining morphology of individual lesion on squash smears – as shown in **Table – 2**. Astrocytoma, Ependymoma, Pituitary adenoma, Medullobalstoma, Schwannoma, Meningioma, craniopharyngioma, Metastatic carcinoma and Epidermoid cyst. Though heamangioblastomas were difficult to squash because of hemorrhage and fibrosis hence on squash smears a diagnosis of benign mesenchymal tumour was given.

Histopathological evaluation of biopsies from 111 cases revealed that 42 (37.8%) cases had morphological features of astrocytomas (low grade and high grade), of which 14 cases were grade II astrocytomas, 17 were grade III

astrocytoma and 2 were glioblastoma. In 1 (0.9%) case diagnosis of oligodendroglioma was given, In 3 (2.7%) cases diagnosis of ependymoma was given, In 27 (24.3%) cases diagnosis of meningioma was given, in 10 (9%) cases diagnosis of Schwannoma was given, in 3 (2.7%) cases diagnosis of Medullobalstoma was given, in 2 (1.8%) cases diagnosis of pituitary adenoma was given, and in 3 (2.7%) cases diagnosis of Craniopharyngioma was given. In 2 (1.8%) cases diagnosis of hemangioblastoma was given, and in 1 (0.9%) cases diagnosis of Epidermoid cyst was given. In 13(11.7%) cases a diagnosis of metastatic carcinoma was given. One case each from oligoastrocytoma, oligodendroglioma, and epidermoid cyst, choroidplexus papilloma and Gliosarcoma was recorded (**Table – 3**).

Table – 3: Histopathological evaluation of lesions (n = 111).

Histopathological diagnosis	**No. Of cases**	**%**
Astrocytoma grade I	9	8.1
Astrocytoma grade II	14	12.6
Astrocytoma grade III	17	15.3
Glioblastoma multiforme (GBM)	2	1.8
Gliosarcoma	1	0.9
Mixed oligo astrocytoma	1	0.9
Oligodendroglioma	1	0.9
Ependymoma	3	2.7
Pituitary adenoma	2	1.8
Medullobalstoma	3	2.7
Meningioma	27	24.3
Schwannoma	10	9
Chroid plexus papilloma	1	0.9
Craniopharyngioma	3	2.7
Hemangioblastoma	2	1.8
Metastatic carcinoma	13	11.7
Epidermoid cyst	1	0.9
Reactive glial tissue	1	0.9

Of these 111 cases, 11(9.9%) cases showed discordant findings on cytological and histopathological examination (**Table – 4**). Of these, four cases diagnosed as low grade astrocytoma on squash smears, were subsequently diagnosed as - one case as mixed glioma (oligoastrocytoma), one case as oligodendroglioma and two cases as ependymoma on histopathological examination (**Table – 5**).

One malignant glioma on squash smear was diagnosed as gliosarcoma on histopathological examination. In two cases where diagnosis of benign mesenchymal tumor was given on squash smears were diagnosed finally on histopathological examination as hemangioblastoma.

In one case, diagnosis of small round cell tumour on squash smear was finally diagnosed as medulloblastoma on histopathological examination.

In one case, diagnosis of meningioma on squash smear was diagnosed as schwannoma on histopathological examination.

In one case, diagnosis of neurofibroma on squash smear was diagnosed as schwannoma on histopathological examination.

Table – 4: Comparative analysis of cytological and histopathological diagnosis.

Diagnosis	Squash smear diagnosis	Histopathological diagnosis	% accuracy
Astrocytoma	46	42	91.3
Oligodendroglioma	-	1	-
Ependymoma	1	3	33.3
Gliosarcoma	-	1	-
Oligoastrocytoma	-	1	-
Pituitary adenoma	2	2	100
Medulloblastoma	2	3	66.6
Meningioma	28	27	96.4
Schwannoma	8	10	80
Craniopharyngioma	3	3	100
Hemangioblastoma	-	2	-
Metastatic carcinoma	13	13	100
Epidermoid cyst	1	1	100
Choroid plexus papilloma	1	1	100
Reactive glial tissue	2	1	50

Table – 5: Discordant results (11 cases).

Squash smear diagnosis	Histopathological diagnosis
Low grade astrocytoma	Mixed oligo astrocytoma
Low grade astrocytoma	Oligodendroglioma
Reactive glial tissue	Low grade astrocytoma
High grade astrocytoma	Gliosarcoma
Low grade astrocytoma (2 cases)	Ependymoma (2 cases)
Benign mesenchymal tumor (2 cases)	Hemangioblastoma (2 cases)
Small round cell tumor	Medulloblastoma
Meningioma	Schwannoma
Neurofibroma	Schwannoma

In one case, diagnosis of reactive glial tissue was diagnosed as low grade astrocytoma on histopathological examination.

In rest of the other tumors like pituitory adenoma, craniopharyngioma, metastatic carcinoma, epidermoid cyst and choroid pluxus papilloma, squash smear diagnosis was in accordance with final histopathological diagnosis. Thus the diagnostic accuracy of squash smear technique in this study is 90.1%.

Discussion

Primary tumours of central nervous system constitute less than 2% of overall human cancers in adults, however they constitutes second most common frequently encountered tumours in children after leukaemia [1] which represents 20-30% of all cases of childhood cancer [2, 3].

It is utmost important to classify these tumours as prognosis is partly dependent on the cell type. Equally important to recognise certain primary brain tumors, which responds to aggressive radiotherapy or chemotherapy. Thus, rapid intraoperative diagnosis is of immense value to select treatment options [4, 5].

Clinical diagnosis has improved with advent of high resolution imaging techniques. However, the definitive diagnosis can be made by

cytological and histopathological examination of tumour tissue only. Use of smear technique has been described for many years on specimens obtained with stereotactic devices, which allow multiple sampling for the diagnosis of deep seated lesions. The technique is also helpful to identify various non-neoplastic space occupying lesions and radiation induced necrosis versus recurrent tumours [6].

Squash smear technique is an economical diagnostic method and needs very little amount of tissue [7]. The intraoperative cytology preparation was first introduced by Eisen hardt L in 1930 and by Badt in 1937 [8]. Present work has been undertaken to study the diagnostic accuracy and squash smear technique for rapid intraoperative diagnosis of neurosurgical biopsies. A total of 111 cases were examined in this study. In all cases history, laboratory investigations, radiological findings and previous investigations if any were recorded. Biopsy material obtained by craniotomy from these cases intraoperatively and was subjected to squash smear technique followed by subsequent histopathological examination of the remaining material [9].

The study showed that the peak incidence of brain tumours was in the middle life and they constitute about 33 (29.7%) of all the tumours examined. Male and female ratio of all the patients irrespective of age group was 0.8:1. Age of youngest patient was 3 years and age of oldest patient was 74 years. Females showed a slightly greater incidence of brain tumours as compared to males. In this present study, accuracy rate of 90.1% is comparable to the other studies conducted in the past [10-15].

Conclusion

Squash smear technique is a economical, reliable, feasible, intraoperative rapid diagnostic method of diagnosis of central nervous system lesions and has a place in determining the immediate management. The accuracy of this study (90.1%) matched with other studies done in the past on the squash smear technique.

The capability of examining a small bit of tissue obtained from a biopsy needles and being confident within 5 minutes is impossible or impractical with frozen sections. So, we recommend squash smear technique to use regularly for rapid intraoperative diagnosis of central nervous system lesions.

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