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Original Article

Utility of Squash Cytology in the intraoperative diagnosis of Central Nervous System lesions

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Abstract
Introduction: *Various Methods are used for intraoperative diagnosis of central nervous system leision.Squash cytology is one such method which is simple, rapid and accurate. This Study aims to evaluate the utility and accuracy of Squash Cytology in the intraoperative diagnosis of the central nervous system lesions and discuss its diagnostic pitfalls.*
Materials and Methods: *This Prospective study was conducted between Jan 2015 to dec2017.Rapid intraoperative diagnosis was given in 260 patients by squash cytology. Cytological diagnosis was later compared with Histopathological diagnosis.*
Results: *Majority of lesions were neoplastic accounting for 96.9% of cases whereas non-neoplastic lesions constituted 3.07% .Overall diagnostic accuracy rate was 95% on comparing with histopathology assuming it as a gold standard.*
Conclusion: *Squash Cytology is simple, rapid, reliable and effective method for diagnosing neoplastic as well as nonneoplastic lesions of the central nervous system thus helping Neurosurgeon to modify the operative procedure if necessary.*
Keywords: *Squash Cytology(SC), Intraoperative diagnosis, Central Nervous System lesions (CNS).*

Introduction

Rapid Pathological diagnosis is valuable to neurosurgeon during operative surgery. Eisenhardt L (1930)[1] gave first intraoperative diagnosis. The application of SC as a means of obtaining rapid intraoperative diagnosis for neurosurgical biopsies is well established[2]-[4]. It is a simple method where by diagnosis can be made within few minutes of tissue reaching the laboratory as biopsy material obtained is soft and easy to spread. There is superb preservation of nuclear and cytoplasmic details as it is a study of fresh cells which have not undergone changes due to fixation and cutting. It gives immediate idea of the tumour type permiating distinction between glial & non glial tumours,

different types of glial tumours and even the diagnosis of non tumourous lesions thus helping surgeon to modify operative procedure. The purpose of this study is to assess the diagnostic accuracy of SC by compare it with histopathology assuming it as gold standard and discuss the diagnostic pitfalls on cytology

Materials & Methods

This prospective study included 260 patients with ICSOL admitted in the department of Neurosurgery during a period of 3 years duration from Jan 2015 to Dec 2017.The open biopsy tissue samples in unfixed state were received intraoperatively to prepare squash smears cytology.1-2 mm of tissue was smeared between two glass slides with enough pressure to spread the tissue into a thin film. It was immediately fixed in 95% alcohol for 1-2 min and stained with rapid H & E .This entire process takes approximately 10 min. Relevant clinical and radiological details was noted in each case. Remaining tissue and more tissue received after craniotomy later on was fixed in 10% formalin and submitted for histopathology processing by routine method. All the tumours were classified according to WHO classification[5]. The diagnosis was considered to be correct if histology and grade was properly assessed.

Results

Total 260 patients had rapid intraoperative diagnosis made on SC. The youngest patient was 6 years old and oldest patient was 72 years old. The study shows M:F ratio of 2:1 ,Positive correlation with histopathology was obtained in 95% cases. Neoplatic lesions were common and constituted 96.9% cases whereas nonneoplastic lesions constituted 3.07% of cases Table[1]. Glial Tumour was the commonest tumour accounting for 61% of cases. Fig [1],[2],[3],[4] followed by Meningioma 15.3% fig[5] and Schwannoma 7.6% fig[6],Tuberculosis was the commonest inflammation. Neoplatic lesions were graded according to WHO classification of CNS tumours.

Complete correlation was seen in 247cases (95%) Table[2]

Diagnostics discrepancy was noted in 13cases (5%) Table [3], In the discrepant cases four cases were of frank error. In this cases cell lineage was wrongly diagnosed, Two cases of fibrous meningioma was misdiagnosed as Schwannomma, one case each of anaplastic ependymoma and hemangioblastoma was misdiagnosed as medulloblastoma and pilocytic astrocytoma respectively. Seven cases of high grade astrocytoma (anaplastic astrocytoma and Glioblastoma) were diagnosed as low grade astrocytoma, two cases of tuberculosis was misdiagnosed as chronic nonspecific inflammation.

Diagnostic accuracy for neoplastic lesions was 95.5% and for non neoplastics lesions was 83.3%.

Table 1: Intraoperative Squash Cytology finding

Cytological diagnosis	No. of Cases	Percentage
Astrocytoma (low grade)	31	11.92
Anaplastic Astrocytoma	40	15.38
Glioblastoma Multiforme	43	16.54
Pilocytic Astrocytoma	2	0.77
Ependymoma	25	9.62
Oligodendroglioma	17	6.53
Subependymal Giant cell astrocytoma	1	0.38
Medulloblastoma	10	3.85
Choroid plexus papilloma	5	1.92
Meningioma	40	15.38
Nerve sheath tumor	20	7.69
Pituitary Adenoma	14	5.38
Craniopharyngioma	4	1.54
Epidemoid Cyst	3	1.15
Tuberculosis	3	1.15
Chronic nonspecific inflammation	2	0.77
TOTAL	**260**	**100**

Table 2: Cyto-histopathological Correlation in the study

Histopathological diagnosis	SC Consistent cases	SC inconsistent Cases	Total No of cases	Accuracy (%)
Astrocytoma (low grade)	31	0	31	100
Pilocytic Astrocytoma	1	1	2	50
Anaplastic Astrocytoma	37	3	40	92.5
Glioblastoma Multiforme	39	4	43	90.69
Ependymoma	24	1	25	96
Oligodendroglioma	17	0	17	100
Subependymal Giant cell astrocytoma	1	0	1	100
Medulloblastoma	10	0	10	100
Choroid plexus papilloma	5	0	5	100
Meningioma	40	0	40	100
Nerve sheath tumor	18	2	20	90
Pituitary Adenoma	14	0	14	100
Craniopharyngioma	4	0	4	100
Epidemoid Cyst	3	0	3	100
Tuberculosis	3	0	3	100
chronic non specific inflammation	0	2	2	0
TOTAL	**247**	**13**	**260**	**95**

Table 3: Cases misdiagnosed on Cytology

Final histopathology diagnosis	Cytodiagnosis	No of cases
Fibrous meningioma	Schwannoma	2
Hemangioblastoma	Pilocytic Astrocytoma	1
Ependymoma	Medulloblastoma	1
Glioblastoma	Astrocytoma (low grade)	4
Anaplastic Astrocytoma	Astrocytoma (low grade)	3
Tuberculosis	Chronic nonspecific inflammation	2

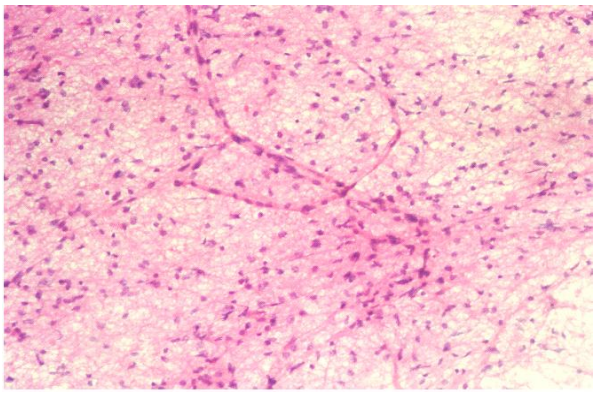

Fig.1 Low grade astrocytoma showing thin blood vessels with astrocytic cells

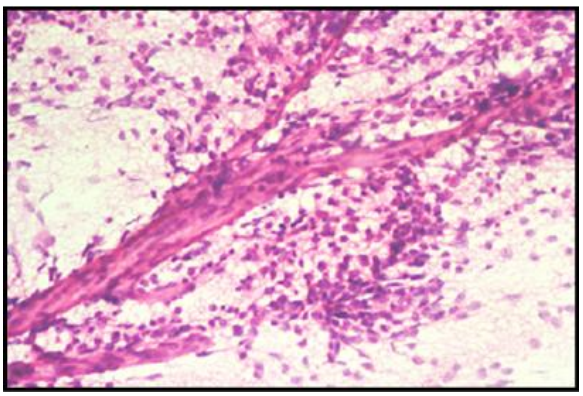

Fig.2 Glioblastoma showing micro vascular proliferation and pleomorphic cells

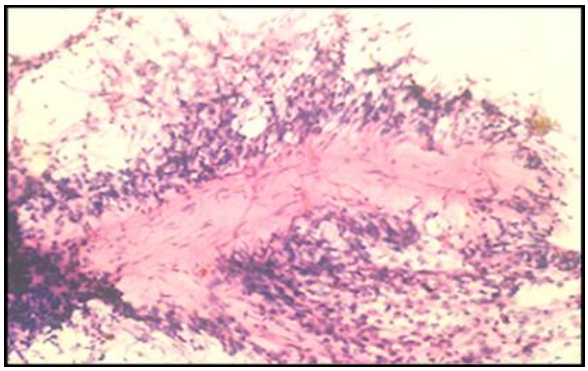

Fig.3 Ependymoma showing perivascular pseudorossesstes

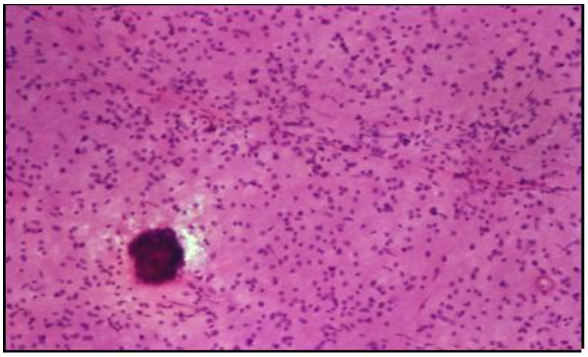

Fig. 4 Oligodendroglioma showing fine branching capillaries, oligodendroglial cells, focal areas of calcification.

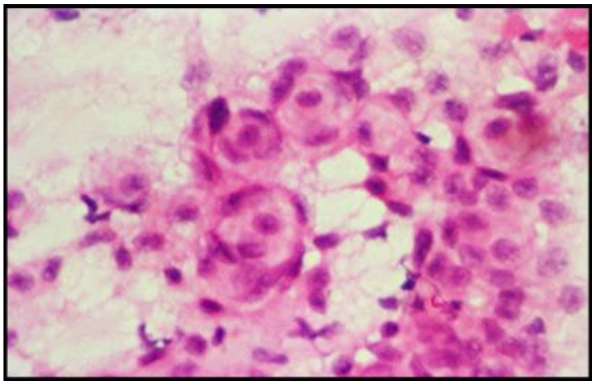

Fig.5 Meningioma showing cellular whorls of meningotheliai cells

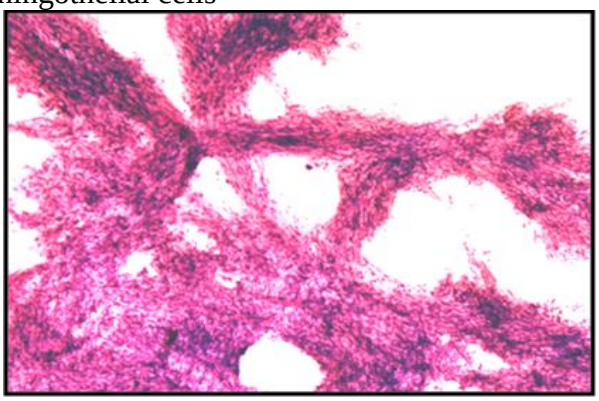

Fig.6 Schwannomma showing spindle cells in twisted rope pattern

Discussion

Squash cytology for the rapid diagnosis of nervous system lesions is gaining wide acceptance in neuropathology because it allows high degree of diagnostic accuracy. Other advantages of this method includes requirement of small amount of tissue for diagnosis, better cellular details and higher quality preparation than those obtained by frozen sections[6] .The goal of a pathologist is to diagnose and if possible grade lesions definitely to optimize the surgery. The overall diagnostic accuracy in our study was 95%.Other studies have also reported diagnostic accuracy ranging from 76%-96% [3]-[17]

In our study out of 260 cases, 13 cases were misdiagnosed on cytology. In discrepant cases high grade gliomas like glioblastoma and anaplastic astrocytoma were diagnosed as low grade astrocytoma. It may be due to the nonrepresentative sample from low grade area. Any high grade glial tumour is not uniformly high grade, grade varies from region to regions. Hence sampling error can easily lead to incorrect under diagnosis of tumour .Similar findings were noticed by Shukla et al[10]. Goel et al[2] also found partial correlation in glia tumours due to grades and mixed histology. One case of anaplastic ependymoma was misdiagnosed as medulloblastoma as cytology failed to show typical longitudinal arrangement of tumour cells forming pseudorossestes in ependymoma which was identified on histopathology. One case of hemangioblastoma was misdiagnosed as pilocytic astrocytoma due to sampling error. Both presented as mural nodule. Smears from the peripheral areas showed only reactive piloid gliosis. Similar findings were also noted by Goel et al [2], Distinction between schwannoma and fibrous meningioma was the most common difficulty. It may be due to spindle shape cells arranged in fascicles, absence of psammoma bodies and whorls. Similiar findings has been reported by Mitra et al[6] and Goel et al[2] Two cases of tuberculosis was misdiagnosed as inflammatory lesions on cytology. Smears showed only fibous tissue and few lymphocytes. Representative area was missed due to extensive fibrosis. Similar finding were observed by Iqbal et al[7]. Diagnostic discrepancies in our study did not have any effect on immediate management decisions by the neurosurgeons. Discordance in our study was mainly due to sampling error, partial correlation and difficulty in interpretation due to firmness of tissue.

Conclusion

Intraoperative squash cytology in neurosurgery is not only easy, rapid, inexpensive but also fairly accurate and dependable tool to diagnose CNS lesions. Overall diagnostic accuracy in our study is 95%.Prior clinicoradiological details will definitely improve the diagnostic accuracy. Thus we conclude that intraoperative squash cytology is rapid ,accurate, inexpensive and valuable technique helping neurosurgeon to modify or plan further management on operating table where the facility of frozen sections are not available.

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