



Original Article

# Smear technique for intraoperative diagnosis of central nervous system neoplasms

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## Keywords:

Central nervous system;  
Neoplasms;  
Glioma;  
Meningioma;  
Crush smear.

## ABSTRACT

**Background:** Smear cytology has become increasingly popular as an alternative to frozen section for the rapid diagnosis of most of central nervous system lesions. The aim of this study was to assess the utility of smear technique for the rapid diagnosis in the neurosurgical biopsies and to compare the smear cytological features with the final histopathological examination.

**Materials and Methods:** This was a prospective study conducted in the Department of Pathology of BP Koirala Memorial cancer Hospital for a period of one year. Sixty cases of clinically suspected CNS tumors were sent for intraoperative smear cytological examination and histological examination. Both techniques were then compared for their ability to diagnose as well as grade the tumors.

**Results:** Gliomas (51.6%) were the most frequently occurring tumors in the total cases. Diagnostic accuracy of squash/smear technique achieved was 88 % ( 53/60) when compared with histopathological diagnoses. In two cases, smears comprised of blood clots and no opinion was possible in cytology. Complete discrepancy was seen in five cases that included two cases of atypical meningioma, a one case each of germinoma, glioblastoma and metastatic tumor.

**Conclusion:** Smear technique is a fairly accurate, rapid, easily reproducible and cost effective tool to diagnose brain tumours. Smear cytology is of great value in Intraoperative consultation of central nervous system lesions.

## INTRODUCTION

Squash technique in Central Nervous System (CNS) lesions is universally accepted method to obtain a rapid and accurate intraoperative diagnosis. The trend of using smear/squash technique for intraoperative consultation was started as far back as 1930 by Eisenhardt and Cushing. The

technique is superior in displaying abnormal cellularity, nuclear and cytoplasmic details and occasionally even tissue architecture.<sup>1,2</sup>

Use of smear technique safeguards the surgeon being in the wrong location, prevent sampling purely necrotic or reactive tissue, thereby avoiding a need for second anesthesia and invasive procedure. In cases of radical excision of diffusely infiltrating gliomas where margins are not obvious macroscopically, the intraoperative smear technique can be useful to define the margins.<sup>3</sup>

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Smear technique requires a very small amount of tissue, as small as 0.1cm for its preparation. With increase use of stereotactic technique in neurosurgical field, there is limitation of size if biopsy which might be inadequate for other technique such as frozen section. Therefore, smear cytology has gaining importance as alternative to frozen section for the rapid diagnosis of most of CNS lesions.<sup>2,4-6</sup>

## MATERIALS AND METHODS

This was a prospective interventional study conducted in BPKM Cancer Hospital for a period of one year. It included 60 consecutive cases that underwent for open craniotomy and burr hole biopsy in the neurosurgical department. The biopsy samples were transferred in isotonic saline. Smears were prepared by placing 1-2 mm of biopsy material on at one edge of a clean, dry and labeled slide and crushing with another slide with just enough pressure to spread the tissue into a thin film. The smear was immediately immersed in 95% ethanol and stained with Papanicolaou stain. Remaining biopsy was submitted for paraffin sections. Cytological features were studied in detail, radiological and operative findings were compared with cytological findings. All Smear cytological diagnoses were compared with histological findings. The tumors were classified according to the World Health Organization Classification of CNS.

## RESULTS

Overall diagnostic accuracy of smear technique for rapid diagnosis achieved in the present study was 88%. Complete correlation was considered for the cases in which the intraoperative cytological diagnosis was same as the histological diagnosis including the grading. Total discrepancy between cytological and histological diagnosis was in five cases (Table 1). The misdiagnosis in cytology were mainly due to sampling error and the lack of histological architecture. Four cases of gliomas showed partial discrepancy. Partial Discrepancy was considered for the cases where the grading of the tumor not same in cytology and histology diagnosis. In a total of 60 cases, Gliomas (51.6%) were the most frequently occurring tumor (Table 2).

## DISCUSSION

Inherent soft nature of CNS tissue of brain tissue and high water content renders poor quality frozen sections. A cytological examination has shown to be great value as an alternative method in intraoperative consultation of CNS pathology. Intraoperative consultation of brain lesions are requested to differentiate neoplastic from reactive lesions; to differentiate metastatic from primary lesions; to estimate the degree of malignancy and to determine the tumor margins.<sup>7,8</sup>

Diagnostic accuracy (88%) achieved in the present study

**Table 1: Discrepancy between cytological and histological diagnosis**

Cytological diagnosis	Histological diagnosis	Cause
Astrocytoma	Atypical Meningioma	Fibrillary background
Glioma	Germinoma	Sampling error
High grade Gliomas	Metastatic tumor	Lack of architecture
Metastatic tumor	Glioblastoma	Bizarre atypical cells
Astrocytoma	Atypical Meningioma	Fibrillary background

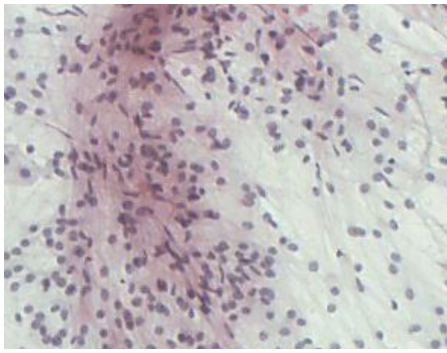
**Table 2: Frequency of various CNS tumors**

Type of tumor	Percentage
Glioma	31/60(51.7%)
Meningioma	12/60 (20%)
Metastatic Tumor	7/60 (11.8%)
Schwannoma	5/60 (8.4%)
Pituitary Adenoma	2/60 (3.3%)
Lymphoma	1/60 (1.6%)
Hemangioblastoma	1/60 (1.6%)
Germinoma	1/60 (1.6%)

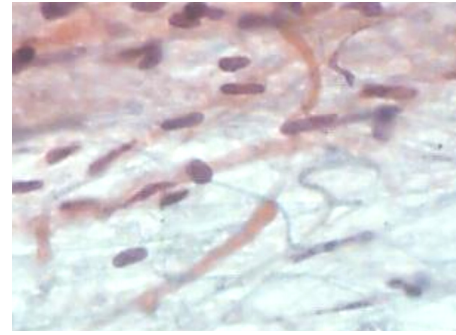
were comparable with the series of other studies (86% to 97%).<sup>4,9-11</sup> Most of the gliomas were easily identified in the smears. Presence of Fibrillary background in smear were very useful features to diagnose gliomas (fig. 1). Regarding grading of tumor in smear, Marshall et al have mentioned in his study that the high grade tumors are liable to undergraded in smear because necrotic tissue which is of the hallmark for high grade tumor in histology would be purposely avoided when selecting the small portion of biopsy to be smeared.<sup>12</sup> In the present study, four cases were undergraded due to lack of all the features. As Gliomas could be heterogeneous, many studies have also concluded that it would be unwise to grade the tumors in every cases in rapid diagnosis.<sup>1,7,10,12</sup>

In the study conducted by Jennifer et al, the most common and distinctive findings in 23 cases of pilocytic astrocytoma were markedly elongated bipolar cells, Rosenthal fibers and eosinophilic granular bodies.<sup>13</sup> All these features were evident in our case of pilocytic astrocytoma (fig. 2).

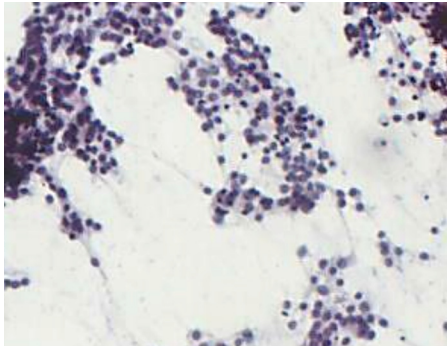
Similarly, cytological features of Oligodendrogliomas were very distinct in our cases as in the study of Roessler K et al.<sup>14</sup> Tumor cells were moderately pleomorphic, rather in monolayer sheets, well spreaded, with uniform oval nuclei and conspicuous nucleoli (fig. 3). But, histological features such as perinuclear halos and chicken wire like vascular channels were not evident in the smear.<sup>10</sup>



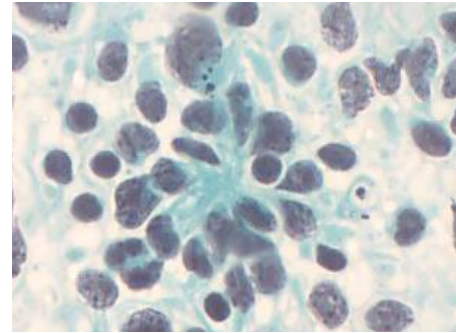
**Figure 1:** Fibrillary background of Glioma (Pap stain, X100).



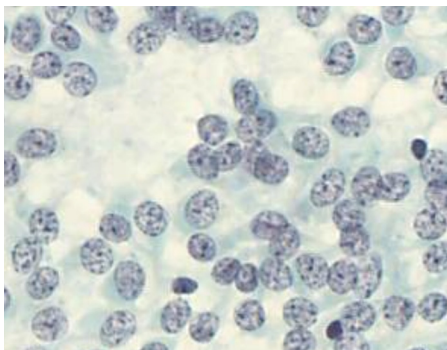
**Figure 2:** Pilocytic astrocytoma (Pap stain, X400).



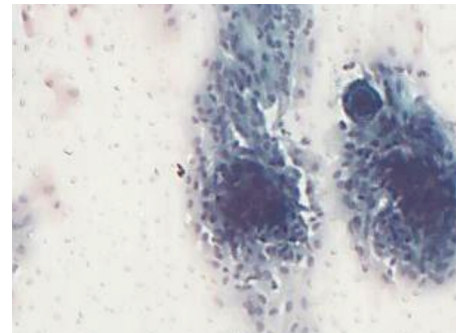
**Figure 3:** Oligodendroglioma (Pap stain, X100).



**Figure 4:** Ependymoma (Pap stain, X400).



**Figure 5:** Pituitary adenoma (Pap stain, X400).



**Figure 6:** Meningioma (Pap stain, X100).

Two cases of ependymoma were correctly diagnosed in the smear (fig. 4). Poorly formed rosettes, mildly pleomorphic glial cells and calcifications were evident in the smears. In contrast to present study; Sidawy et al felt difficulty in distinguishing Ependymoma. The author emphasized the importance of definitive diagnosis of ependymoma, because a surgeon will try to go for complete resection in case of Ependymoma whereas in Diffuse Astrocytoma, surgery usually is terminated in favor of radiotherapy.<sup>10,11</sup>

Misinterpretation of Glioblastoma as metastatic tumor was seen in one case due to presence of bizarre cells, the lack of fibrillary background and lack of architecture. Similar error was encountered in the study of Mouriquand et al. In our study, Out of Seven metastatic lesion, one case of the metastatic tumor was misdiagnosed as Glioblastoma due

to presence of abundant gliofibrillary background in the smear.<sup>8,9</sup>

Each case of Hemangioblastoma and lymphoma and two cases of pituitary adenoma were easily identified in the smear. Discohesive round cells lying discretely in absence of fibrillary background with presence of lymph granular bodies in toluidine blue stain were the features of lymphoma. Pituitary adenoma showed cellular smear consist of round cells with salt and pepper chromatin (fig. 5). Meticulous correlation with clinical and radiological features helped to achieve high accuracy in the present study.

Meningiomas were the second most common tumors in our studies (fig. 6). In Most of the cases, meningeothelial cells were easily identifiable. Meningeothelial cells were oval to

round containing vesicular nuclei with conspicuous nucleoli and ill defined wispy cytoplasm. Psammoma bodies, whirling pattern, microcalcification, intracytoplasmic inclusions were readily appreciated in the smears as mentioned in the study of Kobayashi S et al. Two cases of atypical Meningioma were misinterpreted as low grade gliomas due to hyperchromatic irregular cells and prominent fibrillary in the background.<sup>15</sup>

## CONCLUSION

The current study also found smear /squash technique to be accurate and reliable for the rapid diagnosis of CNS tumors. It is highly recommended technique and can be safely practiced as an alternative to frozen sections. Lastly, the goal of the pathologist while using this technique in intraoperative set up is to give sufficient preliminary information to optimize the surgery.

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