

The Basics of Intraoperative Diagnosis in Neuropathology



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KEYWORDS

- Intraoperative diagnosis • Neuropathology • Neurosurgery • Biopsy • Cytologic smear
- Frozen section

ABSTRACT

Intraoperative pathologic consultation continues to be an essential tool during neurosurgical procedures, helping to ensure adequacy of material for achieving a pathologic diagnosis and to guide surgeons. For pathologists, successful consultation with central nervous system lesions involves not only a basic familiarity with the pathologic features of such lesions but also an understanding of their clinical and radiologic context. This review discusses a basic approach to intraoperative diagnosis for practicing pathologists, including preparation for, performance of, and interpretation of an intraoperative neuropathologic evaluation. The cytologic and frozen section features of select examples of common pathologic entities are described.

OVERVIEW

Intraoperative diagnosis has long played an important role in guiding neurosurgical biopsies and resections, and a high degree of accuracy in such rapid diagnoses is the norm.¹ Stereotactic biopsies may yield nondiagnostic tissue in 33% of the first specimens, and intraoperative evaluation of this material helps assure that a sufficient number of biopsies and diagnostic tissue are obtained.² Studies suggest that a minimum of 4 core biopsy specimens may be necessary to ensure the highest diagnostic yield ($\geq 89\%$).^{2,3}

Discrepancies between intraoperative diagnoses and final diagnoses may occur in less than 3% of cases.⁴ These discrepancies are most commonly encountered with spindle cell lesions, in distinguishing astrocytoma versus oligodendroglioma, in differential diagnosis of lymphoma, grading of tumors, and in distinguishing reactive lesions from neoplasms.⁴ Recent advances in neuroradiologic techniques have improved the preoperative understanding of neurosurgical lesions and aid the interpreting pathologist in forming a preoperative differential diagnosis (for a more detailed discussion, see the article by Glastonbury and Tihan elsewhere in this issue). Regardless of the certainty of a radiologic diagnosis, intraoperative evaluation still serves to ensure that the surgically obtained tissue is sufficient enough for accurate diagnosis.

This review discusses an approach to the performance and evaluation of neuropathologic intraoperative diagnoses. First, critical issues in some of the key clinical and radiologic details of the patient and the lesion are presented as well as the necessity for familiarity with the procedure. Some technical insights to intraoperative specimen handling are also provided. Finally, the cytologic and frozen section features of some of the common lesions encountered in general practice are discussed. A more detailed understanding of the clinical, radiologic, and pathologic features of central nervous system (CNS) lesions is referred to other comprehensive sources.^{5–7}

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PREPARING FOR AN INTRAOPERATIVE DIAGNOSIS: WHAT TO KNOW BEFORE

IS THE PROCEDURE A BIOPSY OR A RESECTION?

The diagnostic goal of intraoperative consultation varies with the type of surgery performed: biopsy or resection. With a biopsy, be it stereotactic core biopsy or open biopsy, intraoperative consultation serves primarily to confirm the presence of diagnostic material in the tissue. A precise diagnosis or grading is typically unnecessary and communicating the presence of “lesional tissue” is often sufficient. However, the potential need for ancillary studies in particular for microbiologic cultures, should be carefully considered. The observation of numerous inflammatory cells should raise the possibility of an infectious/inflammatory process in the differential diagnosis, and communication with the surgeon should include a discussion of tissue submitted for microbiology. Consideration should also be given to whether the pathologic findings are representative of the expected clinical and radiologic abnormalities. In addition, cases often require immunohistochemical work-up, and the presence of quantitatively sufficient tissue is critical when addressing adequacy and communicating this to the surgeon. Acquisition of sufficient amounts of tissue is becoming increasingly important in the current age of molecular pathology, where many molecular/genetic analyses are required as a standard of care rather than a luxury (**Box 1**).

Intraoperative consultation during a neurosurgical procedure not only confirms the presence of lesional tissue but also should serve to help guide a surgeon’s approach. Confirmation of the preoperative diagnosis with intraoperative consultation certainly helps support the rationale for the resection of a lesion and informs the surgeon that the management approach has been appropriate.

The intraoperative diagnosis communicated to the surgeon during a definitive procedure typically requires a more specific diagnosis than simply

Box 1 Adequacy in a biopsy specimen

1. Pathologically lesional tissue is present.
2. Pathologic features are likely representative of the preoperative differential diagnosis.
3. Adequate amount of tissue is available for ancillary work-up.

“abnormal tissue.” In this context, it is important to distinguish types of lesions for which total resection is not necessarily indicated, as opposed to those that warrant an attempt at gross total resection. The former should prompt strong consideration by the surgeon to limit the extent of resection. Key examples of such lesions include infections, inflammatory lesions such as multiple sclerosis (MS), and some tumors such as malignant lymphoma. Certain neoplastic processes, typically those that respond to radiation therapy and/or chemotherapy, also obviate resection, such as germ cell tumors, Langerhans cell histiocytosis, and small cell carcinoma. In addition, it is also helpful to try to distinguish infiltrating gliomas from gliomas or glioneuronal tumors that are categorized as “circumscribed.” Some common examples of such circumscribed primary neoplasms include ganglioglioma, pleomorphic xanthoastrocytoma (PXA), ependymoma, and pilocytic astrocytoma, where gross total resection is usually desirable and achievable. Although gross total resection could be the goal for infiltrating gliomas (and correlates with prognosis), given the diffusely infiltrative nature of these neoplasms and potential involvement of critical structures, gross total resection may not always be practical (**Boxes 2 and 3**).

WHAT ARE THE BASIC CLINICAL AND RADIOLOGIC FEATURES OF THE PATIENT AND LESION?

A basic awareness of the radiologic features of a lesion remains a key part of the understanding of the nature of the disease, and pathologic-radiologic correlation helps confirm whether the tissue evaluated for intraoperative diagnosis is representative. The combination of patient demographics, location of the lesion, and other basic radiologic features form the basis of preoperative diagnosis. Understanding the radioimaging

Box 2 Typical CNS lesions that do not require gross total resection

Infection and other inflammatory lesions
Demyelination
Lymphoma
Germ cell tumors
Langerhans cell histiocytosis
Small cell carcinoma

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