Clinical Application of Dynamic Telepathology in Mohs Surgery

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BACKGROUND. Telepathology is an expanding technology in multiple fields for remote pathology diagnosis and consultation. The use of telepathology in Mohs surgery has been very limited.

OBJECTIVE. To describe the clinical experience of using a telepathology system for intraoperative consultations on difficult frozen sections during Mohs surgery.

MATERIALS AND METHODS. Intraoperative consultation with a dermatopathologist was obtained using a dynamic telepathology system for all questions arising on frozen sections during Mohs surgery for nonmelanoma skin cancers during a 2-year period.

RESULTS. The most common reason for consultation was to distinguish basal cell carcinoma from a benign histologic simulant on Mohs frozen sections. Other uses included determining tumor histology and distinguishing inflammation from residual tumor.

CONCLUSION. Dynamic telepathology is a useful and convenient adjunct in the Mohs surgery practice for intraoperative consultations on difficult frozen sections.

SEAN A. SUKAL, MD, PHD, KLAUS J. BUSAM, MD, AND KISHWER S. NEHAL, MD, HAVE INDICATED NO SIGNIFICANT INTEREST WITH COMMERCIAL SUPPORTERS.

TELEPATHOLOGY IS the practice of pathology using a static or dynamic imaging system to transmit histopathologic images to a pathologist at a remote site for evaluation.[1] This technology is gaining wider acceptance as multiple studies of the diagnostic accuracy of telepathology for evaluation of paraffin-embedded permanent sections have shown high agreement between conventional light microscopy and remote telepathology diagnoses.[2–9] Use of telepathology for evaluation of frozen sections in a variety of tissue types has also proven to be effective and accurate in many studies.[10–17] Clinical use of telepathology has been described in various fields for multiple applications, including remote diagnosis, consultation, teaching, and quality assurance.[18–20]

During the course of a Mohs surgery case, questions pertaining to frozen section assessment may require consultation with a dermatopathologist, who may not always be located near the Mohs suite. The potential use of telepathology in Mohs surgery was first reported by our group in 2002.[21] Using a dynamic telepathology system, a single dermatopathologist at a remote site assessed the following cases: (1) 50 fixed-tissue slides of basal and squamous cell carcinomas for pathologic diagnosis, (2) 40 frozen section slides from Mohs surgery for the presence or absence of tumor, and (3) 20 frozen section slides from Mohs surgery for intraoperative consultation with the Mohs surgeon. All 110 slides were then randomly reviewed by the same dermatopathologist by conventional light microscopy. In this study, there was complete agreement between telepathology and conventional light microscopy diagnoses.

In 2004, Chandra and colleagues described the use of static telepathology for consultation with a remote pathologist during Mohs surgery for evaluation of three cases with challenging pathology and suggested that telepathology provides greater confidence in diagnosis in difficult cases.[22]

In this article, we describe our experience with a dynamic telepathology system for intraoperative consultations with a dermatopathologist during Mohs surgery in 61 nonmelanoma skin cancer cases during a 2-year period.

Methods

The dynamic telepathology system (MedMicro, Trestle Corp, Irvine, CA, USA) used in this study has been previously described.[21] The microscope transmission site in the Mohs laboratory consists of a video color camera mounted on a microscope with standard objectives and a motorized stage. The automated microscope is connected to a standard personal computer (PC) running *Windows*

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NT, version 4.0, and *MedMicro* software and a 21-inch color monitor. The remote viewing site in the dermatopathologist's office consists of a 17-inch monitor and a standard PC running the *MedMicro* software program. The Mohs laboratory and the remote viewing site are connected through a local area network and a wide area network. An entire glass slide is scanned in 1.5 minutes to create a virtual overview image of the glass slide.

Intraoperative consultation with a dermatopathologist was obtained using the MedMicro dynamic telepathology system for all diagnostic questions arising on frozen sections during Mohs surgery for nonmelanoma skin cancers at Memorial Sloan-Kettering Cancer Center's Manhattan campus during a 2-year period (2002–2004).

During each consultation, the Mohs frozen section slide on which the diagnostic question arose was placed on the dynamic telepathology microscope by the Mohs surgeon and was scanned to obtain the virtual overview image on a PC monitor. Once connected through the network, the consultation between the Mohs surgeon and the dermatopathologist was initiated using the virtual slide image. The relevant Mohs surgery case details, including clinical patient and tumor information, fixed-tissue biopsy diagnosis, and Mohs findings, were discussed with the dermatopathologist via telephone. The specific area of question on the Mohs frozen section glass slide was identified by the Mohs surgeon. The dermatopathologist had the ability to remotely control all components of the Mohs microscope, including navigation of the entire glass slide, visualization of any tissue section on the glass slide, objective change, focus, and illumination in real time during the consultation. During the consultation, specific areas on the image could be circled through a pencil function for exact identification.

For each consultation, the following information was recorded: (1) the reason for requesting consultation by the Mohs surgeon, (2) assessment by the dermatopathologist, and (3) the impact on management of a Mohs case.

Results

Sixty-one intraoperative consultations on frozen sections were obtained during Mohs surgery during a 2-year period. All cases involved excisions with Mohs surgery for fixed-tissue biopsy-proven nonmelanoma skin cancers. The original diagnosis was basal cell carcinoma in 41 cases, squamous cell carcinoma in 16 cases, and other tumors in 4 cases.

Reasons for requesting intraoperative Mohs consultation were divided into four main categories: (1) further defining tumor histology in 25 cases, (2) benign epithelial lesion versus carcinoma in 22 cases, (3) basaloid follicular hamartoma versus basal cell carcinoma in 10 cases, and (4) inflammation versus inflamed residual tumor in 4 cases.

In the 25 cases relating to tumor histology questions, the intraoperative consultation was obtained predominantly to discuss tumor histology when the tumor on Mohs frozen tissue sections differed from the fixed-tissue biopsy diagnosis or if the original biopsy diagnosis was not definitive. In these cases, the telepathology consultation confirmed and documented tumor histology and often added prognostic information. Tumor histology questions included morpheaform and metatypical basal cell carcinoma, basosquamous carcinoma, degree of differentiation of squamous cell carcinoma, collision of a second tumor type, and the presence or absence of perineural invasion. In two of these cases, basal cell carcinoma with perineural involvement was identified by the dermatopathologist on telepathology consultation.

Of the 22 cases in which the diagnostic dilemma was a benign epithelial lesion versus a malignant tumor at the Mohs margin, the distinction of a basal cell carcinoma from a benign epithelial proliferation (eg, trichoblastoma, endophytic seborrheic keratosis/inverted follicular keratosis, pilar sheath acanthoma) was the most common question. In 18 cases, a definitive diagnosis of a benign lesion or a malignant tumor was rendered via telepathology, which guided subsequent Mohs surgery accordingly. In four cases, the diagnostic dilemma of benign lesion versus malignant tumor could not be settled during intraoperative frozen section consultation by telepathology. These cases included the distinction of eccrine adenoma from a basal cell carcinoma with eccrine differentiation (one case), irritated seborrheic keratosis from a keratotic basal cell carcinoma (two cases), and squamous cell carcinoma versus pseudoepitheliomatous hyperplasia (one case). An additional Mohs stage was performed in these equivocal cases.

In 10 cases of basaloid follicular hamartoma versus basal cell carcinoma, the nature of the proliferation could not be definitively diagnosed consistent with the lack of diagnostic consensus on this entity.[23–25] In these cases, further Mohs tissue excision was performed.

In the four cases in which the question related to the presence of residual inflamed tumor versus inflammatory infiltrate, all of the cases involved Mohs excisions for squamous cell carcinomas. In two cases, patients had underlying leukemia or lymphoma with leukemic infiltrate of the skin, making evaluation of frozen sections challenging. In all of these cases, telepathology consultation confirmed the absence of residual tumor, and further excision was not performed.

Conclusion

The success of Mohs surgery in achieving tumor-free margins in a tissue-sparing manner depends on the accurate and rapid assessment of intraoperative frozen sections. Misdiagnosis of a positive margin can result in tumor

recurrence. Additional stages excised owing to uncertainty can have cosmetic and functional implications. Sending tissue for permanent sections can delay subsequent reconstructive surgery. Questions that arise on frozen sections during the course of Mohs surgery can potentially impact immediate surgical treatment decisions or follow-up treatment and prognosis. In many Mohs practice settings, consultation with an on-site dermatopathologist on difficult cases is not always possible.

In an initial feasibility study, we established the diagnostic accuracy of a dynamic telepathology system in the setting of Mohs surgery, which offered the potential for immediate access to a dermatopathologist at a remote site.[21] In this article, we describe our experience with using this dynamic telepathology system for intraoperative consultations with a dermatopathologist during Mohs surgery in 61 nonmelanoma skin cancer cases during a 2-year period.

This study delineates the scope of questions that can arise during assessment of Mohs frozen sections. Although articles have reviewed potential pitfalls in Mohs frozen section interpretation,[26] the true frequency of these diagnostic dilemmas has not been studied formally in an actual clinical setting to date. The use of telepathology for further discussion of tumor histology was the most frequent presentation. In these cases, the consultation confirmed and documented tumor type when it significantly differed from the original biopsy diagnosis and often conferred additional prognostic information, which resulted in more frequent clinical surveillance of the surgical site.

Another common reason for telepathology consultation with a dermatopathologist was to distinguish a benign epithelial proliferation from a malignant tumor. The diagnostic distinction of a benign epithelial proliferation from a basal cell carcinoma was the most frequent question. Distinctions, such as trichoepithelioma or pilar sheath acanthoma from basal cell carcinoma, were readily accomplished with telepathology.

This study identifies the problematic dilemma in distinguishing a basaloid follicular hamartoma from a basal cell carcinoma. This dilemma did not represent a telepathology limitation and is not a problem unique to Mohs frozen sections because it is also encountered on paraffin-embedded permanent sections. Even those arguing in favor of "basaloid follicular hamartoma" representing a distinct entity separate from basal cell carcinoma require, at times, step sections, clinical correlation, or even ancillary studies for a definitive diagnosis. For others, this issue is a "pseudoproblem" because "basaloid follicular hamartoma" cannot be distinguished from basal cell carcinoma because it is viewed as an infundibulocystic variant of basal cell carcinoma.[23–25]

Telepathology consultation was also obtained in a few cases to rule out residual inflamed tumor in the setting of inflammatory infiltrates. This question is particularly relevant in cases in which the patient has an underlying hematologic malignancy, such as chronic lymphocytic leukemia, in which inflammatory tumor cells can infiltrate the skin and make assessment of squamous cell carcinoma margins challenging.[27,28]

Overall, the use of telepathology in this Mohs surgery practice enhanced the quality of patient care by providing immediate consultation in a convenient manner. In cases of definitive benign findings, further unnecessary excision was avoided and normal tissue was preserved. In cases of definitive malignant findings, further excisions were performed with confidence and without delay, achieving accurate tumor clearance. Although the decision to excise additional tissue was made in equivocal cases, the consultation provided justification for further treatment given the ambiguity of the findings. Dynamic telepathology has the additional advantage of offering a unique educational and collaborative opportunity between the dermatopathologist and the Mohs surgeon.

The main limitation to more widespread use of telepathology in Mohs surgery is the expense associated with the telepathology equipment. Furthermore, the consultation with the dermatopathologist cannot be billed because the reimbursement for Mohs surgery is based on the Mohs surgeon performing both the surgical and pathology assessment components.

In conclusion, this study suggests that using dynamic telepathology for intraoperative consultations in difficult Mohs cases is useful and convenient and can enhance the quality of Mohs surgery and patient care.

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