Basics of Confocal Microscopy and the Complexity of Diagnosing Skin Tumors

New Imaging Tools in Clinical Practice, Diagnostic Workflows, Cost-Estimate, and New Trends

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KEYWORDS

• Confocal microscopy • Melanoma • Nonmelanoma skin cancer • Cost-estimates • Standard of care • Medicolegal issues

KEY POINTS

- A review of the literature shows that the overall sensitivity of RCM for melanoma detection is 91% to 100%, with a specificity ranging from 68% to 98%. The overall RCM sensitivity for BCC is 85% to 97%, with a specificity ranging from 89% to 99%.
- A cost-benefit analysis performed in Europe showed that RCM reduced the number of unnecessary biopsies and led to an overall cost savings in the management of melanoma and nonmelanoma skin cancer.
- Barriers to the adoption of RCM include the image processing time, limited depth of imaging, need for extensive training to master image interpretation, and potential medicolegal risks.
- Proposed methods for overcoming barriers include the continued development of RCM devices to improve speed, diagnostic accuracy, and ease of use; incorporation of RCM training into dermatology residencies and dermatopathology fellowships; and further research studies to justify the use of RCM in dermatology.

INTRODUCTION

The incidence rate of melanoma and nonmelanoma skin cancer is increasing in the United States and in most parts of Europe.[1,2] With this increased burden on the health care system, strides have been made to reduce costs while maintaining a high quality of care. This article examines the complexity of diagnosing skin cancers, discusses

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the diagnostic workflows and current standards of care in the United States and Europe, and assesses the role of reflectance confocal microscopy (RCM) and other similar technological innovations in the enhancement of dermatologic care.

COMPLEXITY OF DIAGNOSING SKIN TUMORS

Skin cancers can sometimes be difficult, even for experienced dermatologists, to recognize and diagnose. Basal cell carcinomas (BCCs) often resemble scars, intradermal nevi, benign lichenoid keratoses, and benign adnexal neoplasms. Squamous cell carcinomas (SCCs) may be difficult to differentiate from hyperplastic actinic keratoses or irritated seborrheic keratoses.

Although some melanomas are diagnosed by gestalt, the diagnosis of many melanocytic lesions is indeterminate without a multidimensional analytical approach that entails assessment of patient history, pattern analysis, comparison with neighboring lesions on the patient, and evaluation of subtle changes over time.[3] Diagnostic algorithms and technological innovations can aid the clinician in developing a clinical impression.

The clinician's ultimate goal is to diagnose skin cancers at an early stage while maintaining a high enough specificity to differentiate between malignant and benign lesions. The number needed to excise (NNE), also known as the number needed to treat (NNT), is a useful measure of diagnostic accuracy. The NNE expresses the ratio between the number of benign lesions biopsied to rule out skin cancer and the number of actual skin cancers biopsied during the same timeframe. Technological innovations, such as RCM, have made it possible to increase diagnostic accuracy and reduce the NNE, thereby decreasing the number of unnecessary procedures.

UNITED STATES STANDARD APPROACH TO SKIN CANCER

Skin Cancer Screening

Several studies have shown that physician detection of melanoma is associated with thinner tumors at the time of diagnosis.[4–6] Nevertheless, there is no consensus in the United States about who should be screened or the frequency with which these patients should be screened.[7] In 2009, the US Preventive Services Task Force concluded there is not enough evidence to recommend for or against routine skin cancer screening in the adult general population.[8] Patient populations that should regularly be screened for skin cancer have the following risk factors: fairer skin types, older age, the presence of atypical moles or more than 50 moles, family history of melanoma, personal history, and sunburns. A sentinel study performed in Germany, however, demonstrated that in general skin cancer screening decreased melanoma mortality by 47% to 49% compared with adjacent communities not undergoing screenings.[9]

Dermoscopy and total body photography (TBP) allow the clinician to diagnose skin cancers more effectively than unaided visual inspection, making them relatively mainstream methods for skin cancer screening.[10] One meta-analysis established that dermoscopy could raise the sensitivity of melanoma diagnosis from 74% to 90%, while maintaining the specificity associated with unaided visual inspection.[11] Dermoscopy can also decrease the number of benign lesions biopsied by dermatologists.[12] The use of dermoscopy in the United States is increasing, with a recent survey in 2014 showing that 80.7% of surveyed US dermatologists used dermoscopy, a rate higher than previously reported.[13]

TBP is also used by 67% of US dermatologists,[14] especially in patients with several risk factors for melanoma. TBP involves taking a series of photographs covering the full body surface area and monitoring for the development of new melanocytic nevi or any change in existing nevi. When used as an adjunct to dermoscopy in high-risk patients, TBP can help detect de novo melanomas[15] and leads to the diagnosis of thinner melanomas.[16]

Melanoma

The American Academy of Dermatology has published a set of guidelines for the management of primary cutaneous melanoma.[17] For a lesion clinically suspicious for melanoma, the ideal biopsy is a narrow excisional biopsy with 1- to 3-mm margins. For very large lesions and for lesions on the face or acral sites, an incisional biopsy of the most atypical portion is acceptable. If this initial biopsy is inadequate to make a diagnosis or to stage the lesion, a repeat biopsy is indicated.

Surgical excision is the standard of care for the treatment of melanoma, with recommended margins based on prospective randomized controlled trials or consensus opinion[16]; follow-up and diagnosis of eventual regional or distant metastases are outlined by the National Comprehensive Cancer Network.[18]

Nonmelanoma Skin Cancer

In 2015, the American Society for Dermatologic Surgery published its consensus statement on