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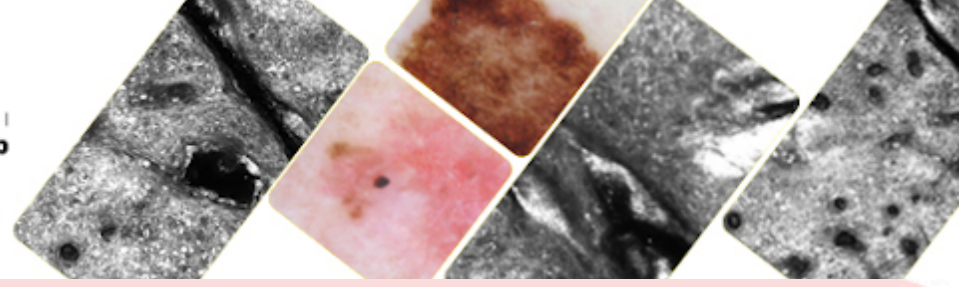

Correlation of vascular patterns in skin lesions between line-field confocal optical coherence tomography and dermatoscopy with a tridimensional perspective

C. Lenoir[1] | M. Suppa[2,3] | S. Puig[1] | C. Orte Cano[2] | G. Diet[2] | M. Fontaine[2] | E. Cinotti[3,4] | L. Tognetti[4] | P. Rubegni[4] | J. Perrot[5] | V. Del Marmol[2] | J. Malvehy[1] | J. Perez-anker[1]

1. Dermatology Department, Hospital Clinic de Barcelona, Universitat de Barcelona, IDIBAPS, Barcelona, Spain.
2. Department of Dermatology, Hôpitaux Universitaires de Bruxelles, Université Libre de Bruxelles, Brussels, Belgium.
3. Groupe d'Imagerie Cutanée Non Invasive (GICNI) of the Société Française de Dermatologie (SFD), Paris, France.
4. Dermatology Unit, Department of Medical, Surgical and Neurological Sciences, University of Siena, Siena, Italy.
5. Department of Dermatology, University Hospital of Saint-Etienne, Saint-Etienne, France.

Introduction & Objectives

The accurate diagnosis of skin lesions is crucial for effective patient management, as clinical examination alone often fails to distinguish between benign and malignant conditions. Dermatoscopy, a valuable tool in dermatology, has improved early detection rates of skin cancers by identifying specific vascular patterns associated with various skin lesions.[1,2] These patterns are especially important for diagnosing hypopigmented lesions, where pigment-based criteria are less clear. Recently, line-field confocal optical coherence tomography (LC-OCT) has provided high-resolution, three-dimensional images of skin's microarchitecture.

This study aims to correlate vascular patterns observed in dermatoscopy with real-time, in vivo imaging using LC-OCT to better understand their tridimensional structure.

Materials & Methods

From June 2023 to March 2024, adult patients with skin lesions exhibiting typical vascular patterns were selected in a clinical setting. Cases included red lacunae in cherry angiomas, crown vessels in sebaceous glandular hyperplasia, arborizing vessels in nodular BCC, short fine telangiectasias in superficial BCC, a combination of both in infiltrative BCC, hairpin vessels in seborrheic keratosis (SK), string of pearls pattern in clear cell acanthoma (CCA), glomerular vessels in Bowen's disease, comma vessels in dermal nevi, linear irregular vessels in invasive melanoma, and polymorphous vessels in both invasive melanoma and squamous cell carcinoma (SCC). High-resolution, three-dimensional images were obtained using LC-OCT. Vessel segmentation involved converting images into a "negative" format and using ImageJ software for 3D reconstruction. All lesions underwent biopsy or excision for histological confirmation.

Results

The study identified distinct vascular patterns that correlated well with dermatoscopy. Nodular BCC showed large, tortuously branched arborizing vessels crossing tumor lobules, suggesting aggressive invasion, whereas superficial BCC had finer capillaries, indicating lower invasiveness.[3] Infiltrative BCC combined arborizing vessels and short fine telangiectasias. SK had hairpin vessels looping within diagonally oriented dermal papillae, compressed by an acanthotic epidermis. While CCA, with a similar acanthotic epidermis, showed glomerular vessels in a string of pearls pattern, Bowen's disease had more densely packed glomerular vessels within a premalignant acanthotic epidermis. These similarities and differences between those three keratinizing lesions suggest that vascular morphology is influenced by factors beyond microarchitecture or biological behavior alone.[4-6] Sebaceous glandular hyperplasia showed crown vessels radially arranged around glandular lobules. Dermal nevi had horizontal comma vessels underneath a flattened dermoepidermal junction free of any junctional melanocytic activity. The most aggressive tumors, melanoma and SCC, exhibited highly disorganized, dense vascular networks in three dimensions, with chaotic structures corresponding to polymorpheous vessels in dermatoscopy, aligning with their invasive potential and metastasis risk.[7-8]

Conclusions

This study demonstrates the potential of line-field confocal optical coherence tomography (LC-OCT) to enhance understanding of the microvascular architecture in skin lesions, with the potential to provide measurable quantitative data on vessel caliber, density, and distribution, which may correlate with tumor aggressiveness. The development of AI algorithms trained on manually delineated images could further improve the automatic identification and analysis of complex vascular patterns. Combining insights from angiogenesis biology with non-invasive imaging like LC-OCT presents a promising approach to better understand tumoral angiogenesis, potentially leading to more accurate diagnostic and prognostic assessments and improved patient outcomes.

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