EPILUMINESCENCE MICROSCOPY IN DERMATOLOGY

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INTRODUCTION:

The majority of pigmented skin lesions can be diagnosed correctly on the basis of clinical criteria. However, there remains a surprisingly high number of small pigmented lesions in which it is difficult with the naked eye to make the distinction between melanocytic and non-melanocytic and benign and malignant lesions[1].

Epiluminescence microscopy (ELM) has been established recently as a new, non-invasive technique for the clinical diagnosis of benign and malignant melanocytic tumours, especially when the lesions are small and cannot always be diagnosed correctly with the naked eye[2]. It represents true, non-invasive in vivo microscopy of the superficial skin layers, forming a link between the gross visual examination and histological examination[1,3].

HISTORICAL BACKGROUND

ELM (also known as skin surface microscopy, incident light microscopy, auflichtmikroskopie, dermatoscopy and dermoscopy) derives from a projector in which light is shone on an object and the reflected image is projected[4,5]. The term was coined by Steiner et al [1987][2,6]. When they used in vivo surface microscopy in combination with oil immersion in a systemic analysis of a wide array of new morphological features that became apparent with this technique[1].

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In 1933 Hinselman proposed the use of colposcope for high-power examination of skin and mucosal lesions[7] and Goldman in 1951[8] systematically used surface microscopy as a diagnostic procedure. Then it was forgotten for almost twenty years being used almost exclusively for nail bed capillary microscopy[9,10]. Skin microscopy for pigmented skin lesions was revived in 1971 by Mackie[11] who invited attempts to increase the resolution of the eye in clinical diagnosis by using ELM. In 1981 Fritsch and Pechlaner improved the technique and emphasised its potential importance in the differentiation of pigmented lesions[12]. Since then there has been considerable application of the method especially in Western Europe[13].

TYPES & TECHNIQUE

A thin layer of mineral oil is placed on the lesion and a glass slide is applied with slight pressure. Using x6 to x40 magnification the structures below the skin surface are inspected with a hand-lens, a hand-held scope, a stereo-microscope, a camera or an electronic imaging system. The oil eliminates surface reflection due to the refractive-index mismatch between air and skin and renders the stratum corneum transparent. This enables in vivo visualisation of the pigmented structures of the epidermis, dermoepidermal junction and the superficial papillary dermis[4].

Stereomicroscopes have disadvantages of size, weight, space requirements and, not least, expense[1]. Several hand-held devices for surface microscopy are now available for office use[14] (Dermatoscope, Heine-Delta Optotechnik, Herrsching, Germany; Episcope, Welsh Allyn Inc, Skaneatales, N.Y.). These are small easily handled monocular devices with an achromatic magnification up to ten times, and a battery-powered light source operating at an angle of twenty degrees[7].

Digital ELM offers a variety of potential improvements to simple ELM and its standards[13]. It is able to capture images in an almost endless array of colours and hues which can be transmitted electronically over long distances. Features can be enhanced

by electronic manipulation and it provides permanent records without degradation over time.

Potential applications of digital ELM include assistance in establishing the diagnosis of melanoma during screening, maintenance and retrieval of images in patients with pigmented lesions who are being followed clinically, and better understanding of clinical histopathological correlations[13].

USES

ELM is most useful in the following clinical circumstances[4].

1) Distinguishing between darkly pigmented clinically equivocal lesions such as melanoma, thrombosed haemangioma, spitz nevus, pigmented basal cel carcinoma, seborrhoeic keratosis, blue nevus.

2) Distinguishing between early melanoma and clinically atypical nevi.

3) Providing more objective clinical definition of potential melanoma precursors or markers including clinically atypical moles.

4) Providing objective clinical criteria for avoiding unnecessary surgery for benign non-melanocytic lesions and for low risk melanocytic lesions that could be followed clinically with ELM.

DIAGNOSTIC FEATURES

A new terminology has been devised to describe the images. The features include patterns, colours and intensities of pigmentation, and the configuration and regularity of the surface and margins of the lesion[6]. The presence or absence of these various features determines whether or not the pigmented lesion might be a melanoma[15].

Pattern analysis of normal skin

When viewed by ELM without oil immersion, normal skin displays a pattern of roughly rhomboid or square fields outlined by intersecting grooves. Depending on the region investigated, the structure and profile of the skin surface may vary considerably[12].

With oil ELM, the epidermis becomes translucent and discloses a network of subtle faint being lines corresponding to the skin grooves. With higher magnification capillaries can be seen as red dots or tiny lines[5].

The pattern and intensity of pigmentation depend upon race, the region of the body and the degree of tanning. Normal white skin and body regions that are not exposed to sunlight display a homogenous faint background tan with a discrete regular network of pigmented lines. In more pigmented or heavily tanned skin, the background becomes more intense and patchy and a faint pigment network emerges[9].

Pattern analysis of pigmented skin lesions

With ELM most pigmented skin lesions(PSL) appear more or less uniformly brown to black except for areas of hypopigmentation[8]. With oil immersion the standard criteria for ELM include pigment network, brown globules, black dots, radial streaming, pseudopods, margin of PSL, overall pigmentation and depigmentation[1,2,5]. Table 1 illustrates the histological substrate of the standard criteria and their patterns in benign and malignant PSL.

Pigment network

The pigment network represents melanin pigment in the epidermal basal cells and it appears as a reticular, usually honey-comb like pattern of network line segments and hypopigmented holes[4]. These holes correspond to the tips of dermal papillae from which the network itself arises from the projection of the pigmented rete ridges to the skin surface[1], except in certain regions of the body, such as the face, where they correspond to hair follicles[4].

The appearance of the pigment network is thus determined by size and configuration of the rete ridges, the degree of pigmentation and the nature of the pigmented skin lesion. It may be regular or irregular, delicate or prominent, and it may be well-defined or poorly defined at the margin of the lesion. Non-melanocytic and amelanocytic PSL do not have a recognisable pigment network[1].

Brown globules

These are round or oval, tan to dark brown spherical bodies that represent pigmented nevus cell nests

Table 1: **ELM Criteria For Pigmented Skin Lesions**

Standard Criteria	Histologic Substrate	Benign PSL	Malignant PSL
Pigment network	Pigment in the epidermal basal cell layer	Regular, delicate, narrow gradually thins at periphery	Irregular, prominent, wide abruptly ends at periphery
Brown globules	Nests of nevomelanocytes the epidermis	Uniform in size and shape, regularly distributed	Varied in size and shape in irregularly distributed
Black dots	Melanin in the cornified layer	Uniform in size and shape, regularly distributed center	Varied in size and shape, irregularly distributed at periphery
Radial streaming	Radial growth phase of melanoma	Absent	Present
Pseudopods	Radial growth phase of melanoma	Absent	Present
Overall pigmentation	Melanin pigment in epidermal or dermal cells	Regular, homogeneous, gradually thins at periphery	Irregular, inhomogeneous, abruptly ends at periphery
Depigmentation or regression	Absence of melanin pigment	Regular center	Irregular center and periphery
Gray-blue veil	Superficial fibrosis with melanophages and/or (malignant) pigment cells in the papillary dermis	Absent	Present
Reticular depigmentation (negative pigment network)		Present	Absent

at the junction or in the papillary dermis. They are uniform in size and regularly distributed in benign PSL but they vary in size, colour and shape and are irregularly arranged in dysplastic or malignant PSL[1]. Lesions that have a globular pattern without any pigment network patterns have a high probability of being compound or dermal. Lesions that have both globular and network patterns co-existing are likely to have both compound an lentiginous components. Such lesions should be carefully inspected for other ELM features[4].

Black dots

These are small black punctate or globular structures that correspond to focal accumulations of melanin pigment or pigment cells in the uppermost parts of the epidermis. They may be in the centre, the periphery or throughout the PSL[1].

Radial streaming and pseudopods

These are different morphological expressions of the radial growth phase of melanoma. Radial streaming describes the linear brown to black streaks or finely serrated extensions radiating from the border of the PSL into the surrounding normal skin. Pseudopods are also peripheral extensions of the heavily pigmented margin of the PSL but they are curved kinked figer-like extensions of the pigment network. Not all melanomas necessarily exhibit these features[1].

Diffuse Pigmentation

Diffuse pigmentation that is so heavy as to preclude the recognition of a pigment network may be regular or irregular in its distribution and homogeneous or inhomogeneous. Assymetrical pigmentation indicates a dysplastic or malignat lesion[1].

Depigmentation

Depigmentation, absence or diminution of pigment within a pigmented lesion, is always relative

to the overall brown or black colour of the lesion. It may be regular or irregular and it may be present in the centre or at the periphery of a given lesion[1].

Gray-blue veil

This is an ill-defined usually bluish or gray-blue area within pigmented or non-pigmented areas of a PSL[1]. It has a "ground-glass appearing" haze or veil over an area and may be uniform and diffuse or focally variable and irregular[3].

Reticular degpigmentation or negative network

This represents an inverse pigment network with a pale net against a dark pigmented background. It is found almost exclusively in a pigmented spitz nevus[1].

It must be emphasised that the above criteria can be seen in the centre, or near to the centre of a pigmented lesion only if the overall pigmentation is not so heavy as to obscure them. In the case of the latter the criteria can be seen only on the margin of the lesion or they may not be seen at all[1].

Pattern analysis of some pigmented skin lesions

Common Nevi

These are characterised by a high frequency of occurrence of a regular discrete (lightly pigmented) pigment network, regularly arranged brown globules of uniform size, a gradual thinning of a regular margin of the pigment network at the periphery and a regular overall pigmentation. Black dots, radial streaming and pseudopods are rare or absent[14].

Dysplastic Nevi

These show a high frequency of occurrence of an irregular discrete pigment network, irregularly arranged brown globules of variable size, a gradual thinning of an irregular margin of pigment network at the periphery and an irregular overall pigmentation. Black dots, pseudopods, radial streaming and irregular depigmentaiton are usualy absent[14].

Malignant Melanomas

Characteristic features of these are an irregular (darkly pigmented) pigment network, brown globules that are irregularly arranged and variable in size, black dots, radial streaming, pseudopods, an irregular margin of the pigment network ending abruptly, an irregular overall pigmentation and an irregular depigmentatin at the periphery[14].

Spitz Nevi

A characteristic finding is a central retiform bizarre depigmentation and brown globules of different sizes as well as black dots in an irregular distribution throughout the lesion. The margin of the lesion is well defined and regular without pseudopods or radial streaming and a peripheral rim of large brown globules is characteristic[5].

Pattern Analysis in Non-melanocytic Pigmented Lesions

The features of angioma, pigmented basal cell carcinoma and seborrhoeic keratosis are listed in Table 2.

Comment

In PSL the most important question is whether or not the lesion is malignant. The use of ELM has greatly reinforced the clinical diagnostic facilities for pigmented skin lesions and it has increased the chances of detecting or ruling out melanoma in the early stages. A subsidiary result is that it can reduce the number of biopsies required for borderline lesions[2].

When PSL are examined by ELM several rules should be observed[1].

1. The presence of a criterion is more important than its absence
2. One criterion alone is insufficient for a diagnosis.
3. Some criteria are more significant than others
4. The absence of defined criteria (i.e. their non-visibility owing to heavy overall pigmentation) does not permit a diagnosis by ELM.

Table 2: **Patterns in Non-Melanocytic pigmented lesions**

ELM Criteria	Angioma	Pigmented basal cell carcinoma	Seborrheoic Keratosis
Pigment Network	Absent	Absent	Absent
Diffuse Pigmentation	Absent	Irregular, inhomogeneous, thins at periphery	Regular, homogeneous, abruptly ends at periphery
Depigmentation	Absent	Irregular center and periphery	Absent
Brown globules	Absent	Absent	Absent
Black dots	Absent	May be present	Absent
Radial streaming	Absent	Absent	Absent
Pseudopods	Absent	Absent	Absent
Gray-blue veil	Absent	May be present	Absent
Others	Reddish-blue lacunes, extremely sharply defined	Telangiectasia	Horny cysts, Keratotic plugs

However, ELM does have its limitations. It does not provide complete diagnostic accuracy and it is of little help in small maximally pigmented lesions that do not reveal the criteria necessary for a diagnosis. ELM does not replace histopathology[1]. Biopsy remains the ultimate arbiter for distinguishing cutaneous melanoma from lesions of similar appearance[2].

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