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Short Communication

The Invisible Colours of Melanoma. A Telespectrophotometric Diagnostic Approach on Pigmented Skin Lesions

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Reflectance images of 43 pigmented lesions of the skin (18 melanomas, 17 common melanocytic naevi and eight dysplastic naevi) were acquired by a telespectrophotometric system and were analysed in the spectral range from 420 to 1040 nm, to discriminate melanoma from benign melanocytic entities. Different evaluations were carried out considering the whole spectrum, the visible and the near infra-red. A total of 33 (76.7%) lesions were correctly diagnosed by the telespectrophotometric system, compared with 35 (81.4%) correct clinical diagnoses. Reflectance in the infra-red band appears diagnostically relevant. A larger study is needed to prove the validity of this diagnostic method.

Key words: cutaneous melanoma, diagnosis, computer
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INTRODUCTION

DIFFERENTIAL CLINICAL diagnoses of pigmented lesions of the skin may be a difficult problem, even for experienced clinicians. Recent studies have suggested that an average of approximately 50% clinical accuracy in recognition of early melanoma can be achieved and that, in the hands of experts, accuracy can increase to 80 and 90% [1]. This fact suggests the need for new initiatives for a more reliable diagnosis of pigmented lesions.

In an attempt to objectively evaluate the colour of cutaneous pigmented lesions, one of the important clinical features used for the diagnosis of melanoma, a spectrophotometric method based on reflectance measurements has been developed [2] and successively improved [3]. The Telespectrophotometric System (TS), which is based on the use of a charge-coupled device (CCD) videocamera provided with a set of 17 interference filters, allows imaging of lesion reflectance at selected wavelengths of 420–1040 nm, during a measurement time of 15 min. Details on the system's features and methodology have been reported previously [3].

Here we report preliminary results obtained using the method to discriminate melanoma from benign melanocytic entities, focusing on the comparison between the instrumental and the clinical diagnosis.

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MATERIALS AND METHODS

Between March 1993 and October 1994, 45 patients (25 females and 20 males) with 54 pigmented lesions were enrolled in the study at the Istituto Nazionale Tumori of Milan. The treating surgeon made a clinical diagnosis of any lesion for excision, as well as recording clinical details. Complete clinical and histological information was available for 43 of these lesions; the other 11 lesions, not surgically removed, had only clinical diagnoses assigned (all clearly benign). Thirty-nine lesions (72%) were located on the trunk, 12 (22%) on the limbs and three (6%) on the face. The size of the lesions ranged from 4 to 40 mm in maximum linear extent, with a median value of 10 mm. Eighteen of the lesions were histologically diagnosed as melanoma, 17 as common melanocytic naevi and eight as dysplastic naevi. Of the 18 melanomas, 10 were thin lesions (tumour thickness <1 mm, level II or less). Reflectance measurements were performed on the 54 pigmented lesions. Although the 43 histologically defined lesions were examined to compare the instrumental and clinical diagnostic accuracy, reflectance images of the 11 clinically obvious benign naevi, not surgically removed, were also included. This population of 'reassuring lesions' was used as

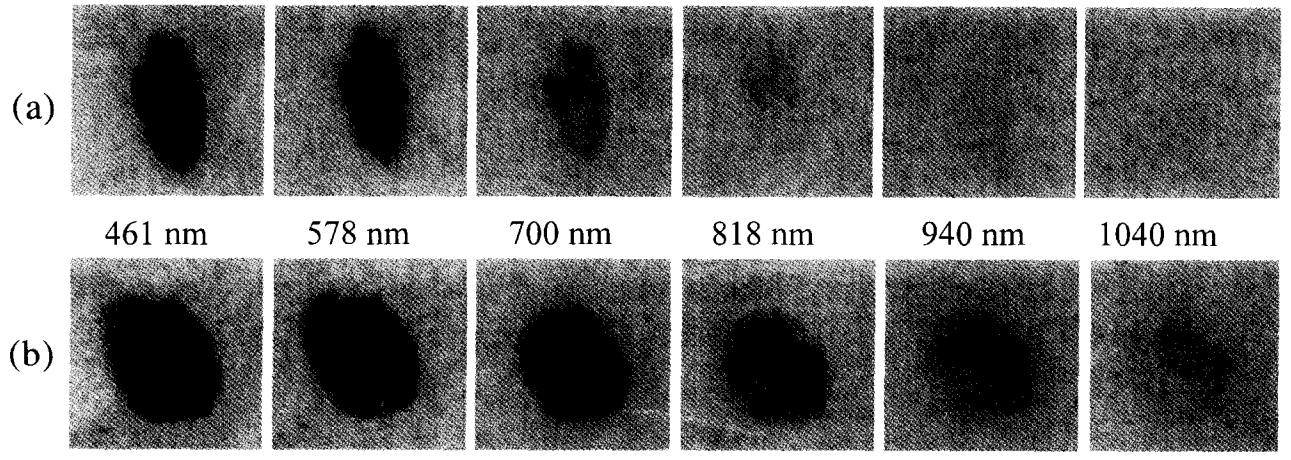

Figure 1. Typical images at selected wavelengths of a benign naevus (a) and a melanoma (b). Numerical values of grey levels are proportional to the reflectance. Above 700 nm (near infra-red), the benign naevus is no longer visible and shows a reflectance close to that of the surrounding normal skin. In contrast, pigmentation of the melanoma is detectable up to 1040 nm. Our recent unpublished data suggest that the reason why melanoma is still detectable up to 1040 nm is not merely related only to the pigment content (melanin), but also to the presence of other biological components (lymphocytes and other cells).

controls for the system, which would otherwise have only doubtful entities, with different chromatic characteristics (generally darker).

Data were elaborated using all the available wavelengths of 420–1040 nm, or from the visible and the near infra-red spectral bands, separately.

Diagnosis from TS data was performed using a stepwise discriminant analysis [4], which is a statistical procedure that provides, as output, a classification for the investigated cases.

RESULTS

Figure 1 shows typical reflectance of a benign naevus (A), and a cutaneous melanoma (B), when imaged at different selected wavelengths.

Of the 43 cases with a histological diagnosis, a total of 33 (76.7%) lesions were correctly evaluated by the TS compared with 35 (81.4%) correct by clinical diagnoses. 15 histologically proven cases of melanomas were correctly classified (83.3%) by the TS, whereas clinical diagnosis was correct in 16 cases (88.9%). Therefore, according to the TS measurements, sensitivity for melanoma was 83.3% (15 true-positive and three false-negative), whereas specificity was 72% (18 true-negative and seven false-positive). These values were slightly lower than the corresponding values based on the clinical diagnosis, i.e. 88.9% (16 true-positive and two false-negative) and 76% (19 true-negative and six false-positive).

Table 1 shows the diagnostic results of the TS technique by use of the whole spectrum, the infra-red band only and the visible band only.

2 of the 3 cases of melanoma misclassified by the TS were also misdiagnosed by the naked eye.

DISCUSSION

Results of the present study, although preliminary, suggest that TS may discriminate melanoma from melanocytic naevi. The results are also interesting because most of the melanomas excised in the study were shown histologically to be thin lesions.

Melanoma presents a wavelength-dependent reflectance different from the other investigated lesions. Our data showed that reflectance in the infra-red band appeared relevant in distinguishing between diagnostic groups, with less important chromatic information provided by reflectance in the visible band (Table 1). The accuracy in the clinical diagnosis of melanoma in our series is in accordance with the results of others [1].

The results of the study show that TS seems to reach diagnoses close to those reached clinically, but some considerations deserve further comment. The clinically doubtful cases of our series were selected but were lesions only melanocytic in nature. In the decision as to which lesions needed to be removed and which did not, only a clinical judgement of suspect or doubtful melanoma was considered. Although only diagnosis by the naked eye was considered for the calculation

Table 1. *Comparison of spectrophotometric diagnosis of* 43 *doubtful pigmented skin lesions by the use of different spectral bands*

		No. of correct diagnoses by TS		
Histology	No.	All spectrum	Infra-red only	Visible only
Melanoma	18	15 (83.3%)	15 (83.3%)	12 (66.7%)
Naevus	25	18 (72%)	17 (68%)	14 (56%)
Pigmented lesions (total)	43	33 (76.7%)	32 (74.4%)	26 (60%)

of diagnostic accuracy, the selection of cases to be enrolled in the study was also conditioned by the use of dermatoscopy. The technique is very helpful in distinguishing between melanocytic and non-melanocytic lesions [5]. However, our technique still has limitations for awkwardly situated lesions. In fact, a lesion may be more accurately measured if surrounded by a portion of nearly planar skin at least 1 cm distant from its margins. In addition, an undeniable diagnostic difficulty arises from inadequately pigmented entities, such as amelanocytic melanoma. Indeed, two of the three malignant lesions misdiagnosed by the TS in our series were minimally pigmented.

Although analysis of TS images seems able to mimic, to some extent, the personal experience of physicians, the practical utility of TS will have to be proven in an unselected larger series. If these data are confirmed the technique might be used as a diagnostic adjunct for practitioners or to instruct non-expert clinicians, without replacing the necessary clinical instruction.

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