Dermatology Practical & Conceptual

Can Multispectral Dermoscopy Help In Distinguishing Blue Color?

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ABSTRACT

Introduction: The interpretation of colors is essential in the dermoscopic evaluation of skin lesions. The same blue color on white dermoscopy may indicate blood or pigment deep in the dermis. Contrary to white dermoscopy, multispectral dermoscopy uses different wavelengths of light to illuminate a lesion and is able to decompose the dermoscopic image into individual maps that allow to more clearly visualize specific skin structures such as pigment distribution (pigment map) and vasculature (blood map). These maps are called skin parameter maps.

Objectives: The aim of this research is to investigate whether skin parameter maps can be used to objectively identify and distinguish the presence of pigment and blood, by using blue naevi and angiomas as models for respectively pigment and blood.

Methods: We retrospectively analyzed 24 blue naevi and 79 angiomas. The skin parameter maps of each of the lesions were independently reviewed by 3 expert dermoscopists, in the absence of the regular white-light dermoscopic image.

Results: All the observers provided high levels of diagnostic accuracy for blue naevus and angioma based on skin parameter maps alone, and the dermoscopic diagnosis was considered substantially reliable because of the 79% of diagnostic K agreement. Percentages of blue naevi and angiomas that showed respectively deep pigment and blood were very high at 95.8% and 97.5%. There was a percentage of lesions that counterintuitively showed blood in blue naevi (37.5%) and deep pigment in angiomas (28.8%).

Conclusions: Skin parameter maps based on multispectral images can help to objectify the presence of deep pigment or blood in blue naevi and angiomas. The application of these skin parameter maps could help in the differential diagnosis between pigmented and vascular lesions.

Introduction

The interpretation of colors is essential in the dermoscopic evaluation of skin lesions. These colors result from different chromophores in the skin, such as pigment and blood. Depending on the location of pigment in the skin, white light dermoscopy reveals the following colors: brown (pigment at the dermo-epidermal junction), black (pigment in the stratum corneum or superficial epidermis), gray (pigment in the papillary dermis) or blue (pigment in the reticular dermis). A red, blue or purple color represents blood [1]. Consequently, the same blue color on white dermoscopy may indicate blood or pigment deep in the dermis [2]. In contrast to white light dermoscopy, multispectral dermoscopy uses different wavelengths of light to illuminate a lesion. This technique is able to decompose the dermoscopic image into individual maps that allow to more clearly visualize specific skin structures such as pigment distribution (pigment map) and vasculature (blood map). These visualizations can be generated in real-time and are called skin parameter maps (SPM) [3]. A further distinction between superficial and deep pigment can be made, based on their different spectral signature, which can be visualized with a superficial and deep pigment map.

Objectives

The aim of this research is to investigate whether skin parameter maps can be used to objectively identify and distinguish the presence of pigment and blood. We conducted a retrospective study on blue naevi and angiomas as prototypes of lesions with, respectively, pigment deep in the dermis (melanin-producing melanocytes deep in the dermis) and collection of capillaries in the dermis to validate the presence of pigment or blood in skin parameter maps.

Methods

We retrospectively analyzed all dermoscopic images taken of blue naevi and angiomas that were collected in two centers (UZ Leuven and UZ Gent) from February 2019 until January 2020 using a handheld digital dermatoscope (Barco Demetra®), after patients had given informed consent. Diagnosis was either histopathologically proven or made clinically (by LJ or SM). This study was conducted in accordance with good clinical practice guidelines. The research protocol was approved by the Ethics Committee of Leuven (s60193). A deep pigment and blood parameter map was created for all the lesions, aiming to highlight respectively the presence of deep pigment or blood. These two skin parameter maps of each lesion were independently reviewed by 3 expert dermoscopists (EV, LB and MG).

Setting

The images of the skin parameter maps (deep pigment and blood) were presented in a mixed order to the observers and scored blinded to the white light dermoscopic image or diagnosis and without knowledge of any clinical data. In each case, the presence of deep pigment and blood was semiquantitatively scored as absent or present. Additionally, participants were asked to diagnose the lesion (blue naevus or angioma) based on the multispectral images alone and to assess in which of the two skin parameter maps the signal was highlighting most.

Outcomes

The primary outcome measure was the rate of lesions in which a signal in the blood and/or pigment map was observed. Secondary outcomes were correlation of intensity with a correct diagnosis, interobserver concordance and the accuracy rate in predicting angioma versus blue naevus.

Statistical Analysis

The prevalence of pigment or blood was compared among the 2 lesion groups (blue naevus, angioma) using the χ^2 test. All P values cited are two-sided, and values of P less than .05 were considered statistically significant. Sensitivity and specificity for the diagnosis of the skin lesions were calculated for each observer as compared to clinical or histopathologic diagnosis. The agreement between ratings made by 3 expert dermoscopists (interrater reliability) was estimated using Fleiss' kappa statistic with 95% confidence intervals. Statistical analysis was performed with SPSS statistics for Windows version 26 (IBM Corp).

Results

Images of 103 lesions, of which 24 blue naevi and 79 angiomas, were collected. Ten lesions (6 blue naevi and 4 angiomas) were histologically confirmed. For the other lesions,

the diagnosis was made clinically (by LJ or SM). An example of skin parameter maps as shown to the observers is shown in Figure 1. Out of the 24 blue naevi, 23 showed a signal on the deep pigment map (95.8%), whereas in only 22 out of the 79 angiomas (28.8%) a signal on the deep pigment map was observed ($p < 0.001$). In 77 out of 79 angiomas (97.5%) a signal was detected in the blood map, versus 9/24 (37.5%) in blue naevi ($p < 0.001$) (Table 1).

Next, we checked if the intensity of the signal of the skin parameter map correlates with the correct diagnosis. When choosing the most intense signal between the two skin parameter maps, we found that in 20 out of the 24 blue naevi (83.3%) the intensity of the signal was most pronounced in the deep pigment map. Of 79 angiomas, in 72 of them (91.1%) the most intense signal was seen in the blood map. To determine if there was agreement between the answers of the three experts a Fleiss' kappa was made. Overall, there was good agreement, κ = .792 (95% CI, .790 to .793). 84,5% of all questions (presence or absence of deep pigment or blood, most highlighted skin parameter map and diagnosis) were answered unanimously by the three experts. In the other 15.6% of cases, majority decision-making was used. As far as diagnosing blue naevi and angiomas based on the skin parameter maps alone, a sensitivity of 81% (64 out of 79 angiomas diagnosed correctly) and a specificity of 100% (24 out of 24 blue naevi diagnosed correctly) with an overall accuracy of 85.4% was reached. Of the 15 cases that were diagnosed incorrectly, 7 of them were not answered unanimously by the observers.

An illustration of blood and deep pigment maps of two blue naevi and an angioma, in addition to the information from regular white dermoscopy (which was not shown to the observers), is shown in Figure 2. In the skin parameter maps of Image A, only pigment is highlighted, as expected in a blue naevus. In Image B, a collision between a blue naevus and angioma, the angioma is highlighted in the blood contrast map, whereas the blue naevus is highlighted in the pigment contrast map. These two cases illustrate the possible use of these skin parameter maps to diagnose skin lesions. The use of skin parameter maps may not only be limited to blue naevi and angiomas, but could be useful in other types of skin lesions (e.g. basal cell carcinoma).

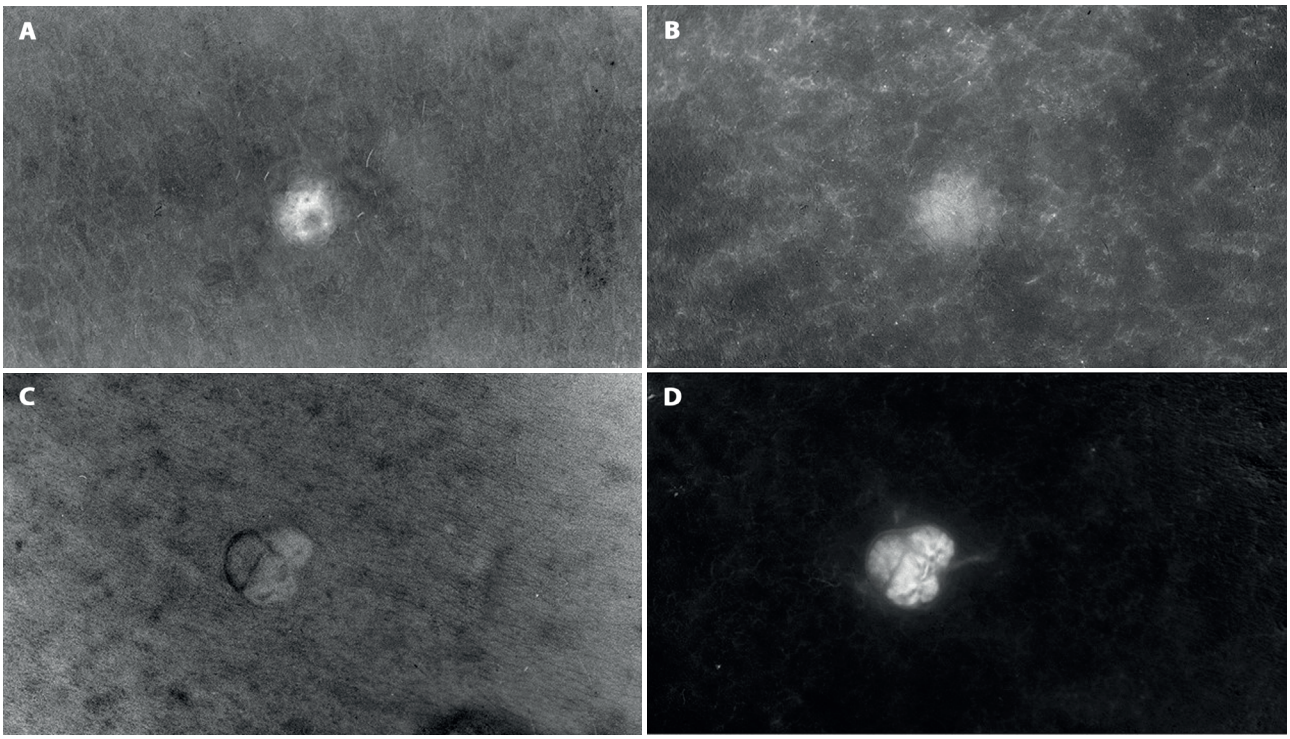

Figure 1. Skin parameter maps (left deep pigment map, right blood map) of a blue naevus (top row) and angioma (bottom row).

Table 1. Absolute and relative frequencies of presence of deep pigment and blood in the skin parameter maps of blue naevi and angiomas.

Skin parameter map	Lesion group		χ^2 test for comparisons among lesion group, P value
	Blue naevus (n = 24)	Angioma(n = 79)	
Deep pigment	23 (95.8%)	22 (28.8%)	<.001
Blood	9 (37.5%)	77 (97.5%)	<.001

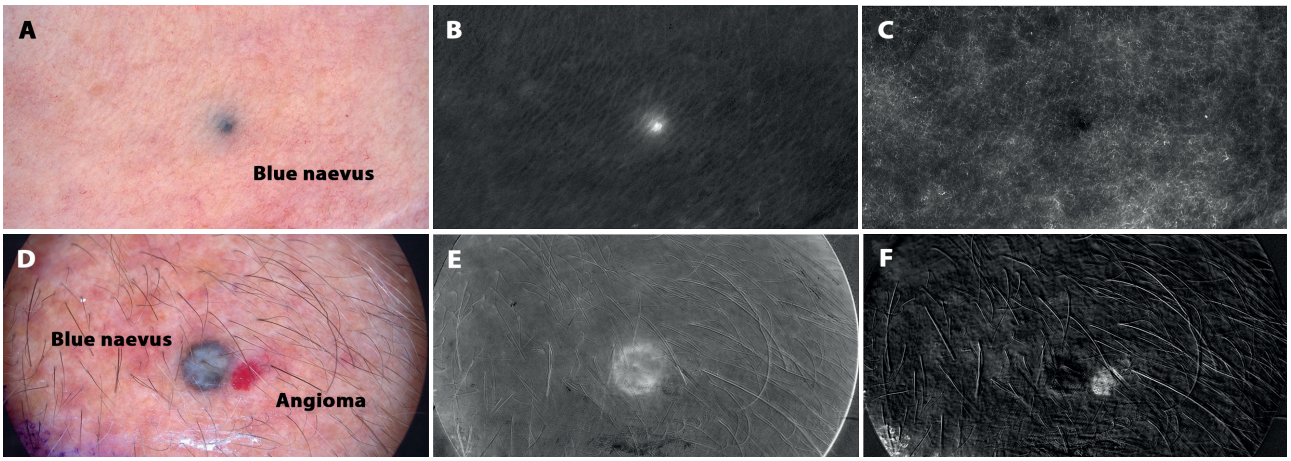

Figure 2. White light dermoscopic image (left column), deep pigment map (middle column) and blood map (right column) of a blue naevus (top row) and collision between a blue naevus and angioma (bottom row).

Discussion

In this study, we investigated the use of skin parameter maps as a tool to semi-quantitively score the presence or absence of blood or deep pigment in skin lesions. We validated the presence of blood and deep pigment, as indicated by highlighted areas in the skin parameter maps in two types of skin lesions: blue naevus and angioma.

Three dermoscopy experts assessed the skin parameter maps of 103 lesions, of which 24 blue naevi and 79 angiomas, for presence or absence of deep pigment or blood, most highlighted skin parameter map and diagnosis. All observers provided high levels of diagnostic accuracy for blue naevus and angioma based on skin parameter maps alone, and the dermoscopic diagnosis was considered substantially reliable because of the 79% of diagnostic K agreement. Percentages of blue naevi and angiomas that showed respectively deep pigment and blood were very high at 95.8% and 97.5%. There is a percentage of lesions that counterintuitively shows blood in blue naevi (37.5%) and deep pigment in angiomas (28.8%). The presence of vascularity in blue naevi suggests a vascular component, which is reported in literature [2]. We have no explanation for the presence of deep pigment in some angiomas, but further research on this will be done. A limitation of this research is that not all of the lesions were histologically proven, which could mean that there are diagnostic errors. Regarding the practical use of these skin parameters maps, we recognize that both angiomas and blue naevi are benign lesions which, most of the time, are easily diagnosable clinically or with white light dermoscopy. Nevertheless, in some cases, it may be difficult to differentiate angiomas from blue naevi or from malignancies such as cutaneous melanoma metastasis (angioma-like metastasis [4]) with white light dermoscopy. In these cases, skin parameter maps could help to determine if the lesion is a vascular or pigmented lesion. Despite the fact that it was not an objective to use the skin parameter maps without the corresponding white light image, this research indicates that the sensitivity and specificity are good when using skin parameter maps on their own for these skin lesions. Our recommendation for the application of skin parameter maps in general practice would still be to use them in conjunction with the white light image.

Conclusion

Skin parameter maps based on multispectral images can help to objectify the presence of deep pigment or blood in blue naevi and angiomas. Application of these skin parameter maps could help in the differential diagnosis between pigmented and vascular lesions. These skin parameter maps should be used complementary to regular dermoscopy, but assessment based on the skin parameter maps alone results in good diagnostic accuracy.

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