A method for skin malformation classification by combining multispectral and skin autofluorescence imaging

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Abstract

In this study we combined multispectral p’ imaging and skin autofluorescence methods using self-made prototype with 4 LED illumination - 405 nm, 526 nm, 663 nm and 964 nm. Described method was tested on 6 skin lesion groups: melanomas (3 histologically confirmed cases), seborrheic keratosis (13 dermatologically confirmed cases), hyperkeratosis (8 histologically and 1 dermatologically confirmed cases), melanocytic nevi (23 dermatologically confirmed cases), basal cell carcinomas (2 histologically and 16 dermatologically confirmed cases) and hemangiomas (8 dermatologically confirmed cases). With this method we achieved 100% sensitivity and 100% specificity for distinguishing melanoma from the rest lesion groups. Unfortunately, with this method it is impossible to separate basal cell carcinomas from benign lesions.

Equipment

1st polarizer (in front of lightsource)

Diffuser

LEDs: 4 x 405 nm, 4 x 526 nm, 4 x 663 nm, 4 x 964 nm LEDs

2nd polarizer (transmission directions of polarizers are placed at right angles)

515 nm long pass filters

Lens (53mm)

Fig. 1. The prototype of data acquisition. Device consists of 4 x 405 nm, 4 x 526 nm, 4 x 663 nm, 4 x 964 nm LEDs, 2 linear polarizers placed at right angles, diffuser, 515 nm long pass filter, 5 Mpix IDS camera.

Results

Fig. 2. Autofluorescence (405 nm excitation, RGB image observed in spectral range from 515 nm to 700 nm) image (on the left) and p’ maps (on the right) for seborrheic keratosis and hyperkeratosis. All pictures are displayed in a.u.

Fig. 3. Autofluorescence (405 nm excitation, RGB image observed in spectral range from 515 nm to 700 nm) image (on the left) and p’ maps (on the right) for melanocytic nevi and hemangioma. All pictures are displayed in a.u.

Fig. 4. Autofluorescence (405 nm excitation, RGB image observed in spectral range from 515 nm to 700 nm) image (on the left) and p’ maps (on the right) for melanoma and BCC. All pictures are displayed in a.u.

Summary and Discussion

The presented study combines two imaging modalities of in-situ skin: autofluorescence imaging under 405 nm LED illumination and multispectral reflectance imaging under 526 nm, 663 nm, and 964 nm LED illumination. For the clinical measurements a custom designed prototype was used. Combining these methods, the criterion was set: mean p’max > 0.9 a.u. mean AF < 50 a.u. Using this criterion, we calculated that it is possible to discriminate melanomas from other lesion groups (seborrheic keratosis, hyperkeratosis, melanocytic nevi, BCC and hemangiomas) with sensitivity 100% and specificity 100%. However, only 3 melanomas data have been used in these calculations. Nevertheless, previous p’ map calculations for 30 melanoma data, using OD images [1], indicated a high potential for the separation of melanomas from other pigmented lesions. We expect that further melanoma data could show a similar trend as described in this article. By combining the p’ imaging with AF method it is possible to add seborrheic keratosis and hyperkeratosis groups and successfully distinguish them from melanomas. Unfortunately, currently this method is not sensitive to unpigmented BCC.

Conclusions

By combining p’ imaging with skin AF method, we obtained 100% sensitivity and 100% specificity for melanoma discrimination from seborrheic keratosis, hyperkeratosis, melanocytic nevi, BCC and hemangiomas. In order to use this method in practice, it would be necessary to obtain more melanoma data. This method is applicable for melanoma diagnostics. Adding the criterion that distinguishes BCC from benign skin lesions, it has a great potential to be used in primary care physicians’ practice.

References


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