Review: Melanoma Detection & Classification Based on Thickness using Dermascopic Images

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ABSTRACT

Melanoma is considered to be a deadliest form of skin cancer and the cancerous cell spreads very fast to other parts of the body. If it is recognized and diagnosed at early stage then it can be cured else it is fatal. Patient's survival chances depend on stage of melanoma cancer. Stage is identified by checking thickness of melanoma. Hence survival chances of patient depend on thickness of melanoma. There should be some non invasive method for estimation of thickness of melanoma before surgery. This paper detailed on classification of melanoma in different stages based on thickness of melanoma. Different techniques for identifying melanoma from dermoscopic images and classifying the stages of melanoma are specified.

Keywords: Dermoscopic images, classification, melanoma, stages, thickness.

1. INTRODUCTION

The skin is the main and biggest part of the body and protects against sunlight, heat, some harmful rays from sun, different infections and injuries. Skin plays important role to store water, vitamin D and fat and maintain body temperature. There are several skin layers; the two main layers are the epidermis which is outer layer of the skin and the dermis which is inner layer of the skin. Skin cancer starts in the epidermis and it is made up of three types of cells. They are:

- Squamous cells: Flat, thin cells form the top layer of the epidermis. They make up most of the cells in the outer layer of the skin that is epidermis, the passages of the digestive and respiratory tracts, and the linings of the hollow organs of the body.

- Basal cells: Round cells under the squamous cells. Basal cells are situated at the base of a multilayered tissue at the lowest layer of the epidermis.

- Melanocytes: Cells which produce melanin are in the inner part of the epidermis. The pigment melanin gives natural color to skin. Melanoma produces more melanin pigment when skin is exposed to the sun.

Melanoma is a malignancy of melanocytes. It means melanoma disease is formed due to cancer cells form in melanocytes and these melanocyte cells darkens the skin color. It can occur anywhere on the skin. Melanoma is the most serious and dangerous form of skin cancer. If detected and treated at early stage, then chances of getting cured will be more. Hence, survival chances of patient will increase. Melanoma gets metastasized very fast. Thickness of the melanoma plays important role for survival of melanoma patient as it is main factor for detecting stage of melanoma. There should be some non invasive method to estimate thickness of melanoma before surgery. Maximal diameter and maximal thickness of lesions are required to find the volume of tumor. Prognosis of melanoma patients depends on tumor thickness or depth at the time of surgery [1]. If tumor is only on epidermis then it is considered to be easily curable by surgery. As it grows

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deeper and deeper it becomes more fatal and survival chances of melanoma patient reduce drastically. Cancerous cells that grow deeper layer of dermis are called as invasive melanoma. While melanoma is not the common form of the skin cancers, it causes the most deaths [2]. American Cancer Society's estimations for the melanoma in the United States for the year 2016 are as follows [3]:

- About 76,380 new melanomas will be diagnosed.

- Approximately 10,130 people will die due to melanoma disease.

More than one life is asserted each hour in the U.S. The occurrence of melanoma is on the ascent in the U.S. furthermore, around the world. From last 30 years melanoma rates have been increasing steadily. It gets metastasized very fast. Therefore, it is important for physicians to detect and diagnose melanoma in its earliest stage. This may increase the chances of survival. The 5-year survival rate for confined melanoma in stage I and II is 98%; and this drops to 17% in situations where growth has metastasized to distant locales or organs.

Dermoscopy is non invasive method used to examine the skin lesion. It is skin imaging method that allows representation of components of pigmented melanocytic neoplasms that are not discernable by examination with the bare eye. Dermoscopy is more precise than bare eye examination for the analysis of cutaneous melanoma in suspicious skin lesions when performed in the clinical setting. [4]. There are many methods to detect melanoma or benign from dermoscopic images. If suspected lesion is found then it is necessary to estimate the thickness of melanoma to find the stage of melanoma cancer.

1.1. Breslow Index

Breslow Index is measurement of the maximal thickness of the skin lesion that is measured in several slides from the top of the granular cell layer to the deepest point of invasion by using an ocular micrometer. If the skin lesion is already ulcerated, than the ulcer base over the deepest point of invasion is used instead of the top of the granular cell layer [5].

Pathological examination can be done using incisional or excisional biopsy of suspected skin lesion. Incisional biopsy is methodology in which a little region of tissue is taken to recognize the composition of skin lesion. Excisional biopsy is a methodology where the entire suspected skin lesion is removed. Before surgical excision it is required to measure thickness of melanoma to understand the risk of progression. The lack of reliability of tumor size in estimating prognosis may be due to considering size in only two dimensions; tumor volume has to be considered. Two melanomas skin lesions may have the same diameter but they may differ greatly in thickness. If diameter is same and differ in thickness then even stage of melanoma will differ [6].

Ashfaq A. Marghoob et al. divided tumor thicknesses into four categories, that is, thickness ≥ 0.75mm, 0.76–1.50mm, 1.51–4.00mm and <4.00 mm. Their results indicated that level is an important independent variable for thin melanomas and for all other ranges of thicknesses [7].

Table 1
Stages of Melanoma [8].

Stages	Thickness (mm)
0	-
IA	≤0.75
IB	0.76–1.5
IIA	1.51–4.00
IIB	>4.00
IIIA	≤30
IIIB	>30
IV	-

Melanoma with stage 0 is considered to be situ melanoma. This is very earliest stage of melanoma. The cancer cells are only on the epidermis and not started to spread into deeper layers of the skin. The stage IA melanoma thickness is less than 0.75mm thick. The covering layer of skin over the tumor is not broken and not ulcerated. The melanoma with stage IB, thickness is between 0.76 to 1.5mm. It is only on skin and not metastasized to other parts of the body. The melanoma with stage II may be ulcerated. The melanoma with stage IIIA may be metastasized up to 3 lymph nodes near the tumor and they can be seen under microscope. The melanoma with stage IIIB has metastasized to lymph nodes, ulcerated and nodes may be enlarged. The IV stage melanoma has been distant metastasis.

2. RELATED WORK

Mojdeh Rastgoo et al. proposed an automatic system for seperation of melanoma from dysplastic nevi. It includes automatic segmentation, feature extraction, feature modification and classification. The performance of the system was evaluated using global and local (bag of words) feature extraction approach and support vector machine, gradient boosting and random forest classifiers were used to classify. This system achieved the 98% of sensitivity and 70% of specificity [9].

Mr S. M. Sangve et al. described and reviewed different techniques for recognizing melanoma or benign from dermoscopic images. There are different techniques that use different features like color, texture, structure, presence of globules. There are different medical diagnosis algorithms such as ABCD rule, Menzies method, Seven-point checklist [10].

Paolo Carli et al. evaluated the total dermatoscopy score using ABCD rule of dermatoscopy for a series of skin lesions and it acts as a preoperative predictor for predicting thickness of melanoma. 84 cutaneous melanomas were used as database. From that 17 were situ melanomas and 67 invasive cases. As a preoperative strategy for the recognition of melanomas with a Breslow thickness > 0.75 mm, a total dermoscopy score cut-off point of 6.80 and results were sensitivity - 80%, specificity - 84%, and diagnostic accuracy – 82% [11]. Holger A. Haenssle et al. determined how to obtain scores with diagnosis methods from dermoscopic images using seven point checklists and related between score and tumor thickness [12].

Argenziano et al. pointed that diameter > 1.5mm, pigment network, atypical vascular pattern and gray-blue areas allowed prediction of thickness in 89% of melanomas and categorized in two categories: thickness less than 0.76 mm melanomas, and thickness greater than or equal than 0.76 mm [13]. Argenziano et al. demonstrated that the existence of blue and black color in the skin lesion is a dermoscopic sign to identify pigmented nodular melanoma and this presents a high thickness [14].

P. Rubegni et al. proposed a system which classifies tumors into two classes based on thickness of melanoma as thin and thick melanomas. Digital dermoscopy analysis makes use of computerized analysis of digital images and it offers analysis of morphological aspects of skin lesions by means of integration with software. Melanoma images were evaluated for 49 different features such as color, structure, texture and integration of these. 141 images of melanoma were used and 86.5% of accuracy. 97 of 108 were thin melanomas and 25 of 33 were thick melanomas [15].

Vanessa Priscilla Martins da Silva et al. described most of features of situ melanomas, thin melanomas, and invasive melanomas. Situ Melanomas may have up to 2 colors, no milky red area and no blue-white cover. Thin melanomas may have asymmetry in the two axes, at least 3 colors, atypical dots and atypical network or streaks. Invasive melanomas may have 3 or more colors, a milky red area, abnormal network or streaks and blue-white cover [16].

Aurora Sáez et al. proposed a computerized system to estimate the melanoma thickness from dermocospic images. The two supervised classification schemes were proposed. In first scheme a binary classification

classifies melanoma into thin or thick. The binary classification distinguishes between melanomas situ (thickness < 0.76mm) and thick ones (thickness ≥ 0.76mm). The second scheme is a three-class scheme, classifies as thin, intermediate, and thick. The three-class scheme, melanoma are considered in three stages of depth: thin (thickness < 0.76mm), intermediate (0.76 mm ≥ thickness ≥ 1.5 mm) and thick (thickness > 1.5mm). Logistic regression using Initial variables and Product Units (LIPU) model is combination of logistic regression with artificial neural networks is used in this paper. It leads to interpretable probabilistic models and maintains a considerable level of accuracy. Results show that LIPU model obtains accurate results for the binary as well as three-class versions of the problem [17].

3.   CONCLUSION

This paper describes about different stages of melanoma. The survival chances of patient will be more if the cancer is detected and treated at early stage. Before surgical excision it is important to find the thickness of melanoma from skin lesion. Survival chances of patient depend on thickness of melanoma. This paper describes about different methods to classify melanoma based on thickness of melanoma. There should be some non invasive technique to predict the thickness of melanoma from dermoscopic images and from features of skin lesion. There are many different techniques to detect melanoma or benign from dermoscopic images. Very few techniques are available for detection of thickness of melanoma. Thickness is very important factor for prognosis of melanoma and hence survival of melanoma patient.

REFERENCES

[1]   Pizzichetta M. A., Argenziano G., Talamini R., Piccolo D., Gatti A., Trevisan G., Sasso G., Veronesi A., Carbone A., Soyer H.P.: Dermoscopic criteria for melanoma in situ are similar to those for early invasive melanoma. Cancer, vol. 91, pp. 992–997, (2001).

[2]   C. M. Balch, A. C. Buzaid, S. J. Soong, M. B. Atkins, N. Cascinelli, D. G. Coit, I. D. Fleming, J. E. Gershenwald, A. Jr. Houghton, J. M. Kirkwood, K. M. McMasters, M. F. Mihm, D. L. Morton, D. S. Reintgen, M. I. Ross, A. Sober, J. A. Thompson, and J. F. Thompson: Final version of the American Joint Committee on Cancer staging system for cutaneous melanoma. J. Clin. Oncol., vol. 19, pp. 3635–3648, (2001).

[3]   (Oct. 13, 2016). American Cancer Society, Cancer Facts & Figures. [Online]. Available: http://www.cancerresearch.org/cancerimmunotherapy/impacting-all-cancers/melanoma.

[4]   M. Vestergaard, P. Macaskill, P. Holt, and S. Menzies: Dermoscopy compared with naked eye examination for the diagnosis of primary melanoma: A meta-analysis of studies performed in a clinical setting. Brit. J. Dermatol., vol. 159, pp. 669–676, (2008).

[5]   M. Amouroux and W. Blondel, M. Y. Cao, Ed. Non-invasive determination of Breslow index. Current Manage Malignant Melanoma InTech, pp. 29–44, (2011).

[6]   A. Breslow: Thickness, cross-sectional areas and depth of invasion in the prognosis of cutaneous melanoma. Ann. Surg., vol. 172, pp. 902–908, (1970).

[7]   Ashfaq A. Marghoob, Karen Koenig, Flavia V. Bittencourt, Alfred W. Kopf, Robert S. Bart.: Breslow Thickness and Clark Level in Melanoma Support for Including Level in Pathology Reports and in America Joint Committee on Cancer Staging. Cancer Volume 88, Issue 3, pp- 589-595, (2000).

[8]   Fleming I.D., Cooper J.S., Henson D.E., Hutter RVP, Kennedy B.J., Murphy G.P.: American Joint Committee on Cancer staging manual. 5th edition, Philadelphia: JB Lippincott, (1997).

[9]   Mojdeh Rastgoo, Rafael Garciaa, Olivier Morelb, Franck Marzani.: Automatic differentiation of melanoma from dysplastic nevi. Computerized Medical Imaging and Graphics 43, pp. 44–52, (2015).

[10] Mr. S. M. Sangve, Ms. Patil Rashmi R.: Competitive Analysis for the Detection of Melanomas in Dermoscopy Images. International Journal of Engineering Research & Technology (IJERT), ISSN: 2278-0181, Vol. 3, pp. 351-354, (2014).

[11] Paolo Carli, Vincenzo de Giorgi, Domenico Palli, Vanni Giannotti, Benvenuto Giannotti.: Preoperative assessment of melanoma thickness by ABCD score of dermatoscopy. Journal of the American Academy of Dermatology, Volume 43, pp. 459–466, (2000).

[12] Holger A. Haenssle, Bianca Korpas, Christian Hansen-Hagge, Timo Buhl, Kjell M. Kaune, Albert Rosenberger, Ullrich Krueger, Michael P. Schön, Steffen Emmert: Seven-point checklist for dermatoscopy: Performance during 10 years of

prospective surveillance of patients at increased melanoma risk. Journal of the American Academy of Dermatology, Volume 62, pp. 785–793, (2010).

[13] Giuseppe Argenziano, Gabriella Fabbrocini, Paolo Carli, Mario Delfino: Clinical and dermoscopic criteria for the preoperative evaluation of cutaneous melanoma thickness. Journal of the American Academy of Dermatology, vol. 40, pp. 61–68, (1999).

[14] G. Argenziano, C. Longo, A. Cameron, S. Cavicchini, J. Y. Gourhant, A. Lallas, I. McColl, C. Rosendahl, L. Thomas, D. Tiodorovic-Zivkovic, P. Zaballos, I. Zalaudek: Blue-black rule: A simple dermoscopic clue to recognize pigmented nodular melanoma. British Journal of Dermatology, vol. 165, pp. 1251–1255, (2011).

[15] Pietro Rubegni, Gabriele Cevenini, Paolo Sbano, Marco Burroni, Iris Zalaudek, Massimiliano Risulo, Giordana Dell'Eva, Niccolò Nami, Antonia Martino, Michele Fimiani: Evaluation of cutaneous melanoma thickness by digital dermoscopy analysis: A retrospective study. Melanoma Res., vol. 20, pp. 212–217, (2010).

[16] V. da Silva, J. Ikino, M. Sens, D. Nunes, and G. Di Giunta: Dermoscopic features of thin melanomas: A comparative study of melanoma in situ and invasive melanomas smaller than or equal to 1 mm, caractersticas dermatoscpicas de melanomas finos: Estudo comparativo entre melanomas in situ e melanomas invasivos menores ou iguais a 1 mm. Anais Brasileiros de Dermatologia, vol. 88, pp. 712–717, (2013).

[17] Aurora Sáez, Javier Sánchez-Monedero, Pedro Antonio Gutiérrez, César Hervás-Martínez: Machine Learning Methods for Binary and Multiclass Classification of Melanoma Thickness from Dermoscopic Images. IEEE Transactions on Medical Imaging, Vol. 35, pp. 1036-1045, (2016).