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COMPARATIVE STUDY OF MACHINE LEARNING METHODS USED FOR SKIN CANCER DETECTION AND CLASSIFICATION

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Abstract

Contents

List of Figures

List of Tables

Chapter 1

General Introduction

Chapter 2

General Medecal Information

2.1 Skin

The skin is a complex organ a [9], it is interactive, self renewing and represents the first and primary defense line against hostile environment and it has several characteristics such as selective absoption, auto regeneration when injured, barrier to water loss, touch sensitivity ...etc [10]. It represents the largest sensory organ (15% of total body weight and a total area of 1.86 m^2) [11], it has a highly adaptive structure that makes it vital for the survival of the human body, the balance between its static and dynamic properties makes it highly adaptive to the variations of the outer world [12].

2.1.1 Skin Anatomy

The skin is primary composed of 3 main layers as shown in the figure 2.1, each layer has its unique properties and functions [11].

Epidermis the outer most layer which is constantly regenerating and it contains the pigment melanin that determins the skin color and it also represents a physical and biological barrier

Dermis the middle layer, it supports the flexibility and gives strength the epidermis and it is maily composed of connective tissue

Hypodermis the last layer which is composed of subcutaneous fat which gives it its properties of being a main support of the overall structure of the skin and shock absoption

2.1.2 Other entities also contained in the skin

Hair provides protection agains minor trauma, thermoregulation and filtering functions such as nasal hair and eyelashes

Sweat Glands it is foucd across the entire body, it provides lubrication, temprerature regulation and salt and water balance.

there anatomies are shown in the figure 2.2

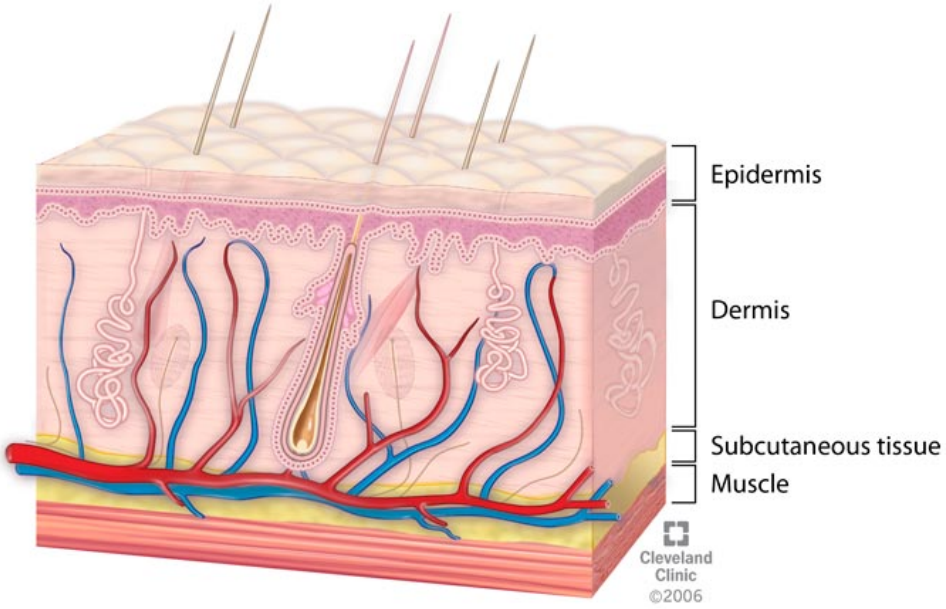

Figure 2.1: Skin Anatomy [1]

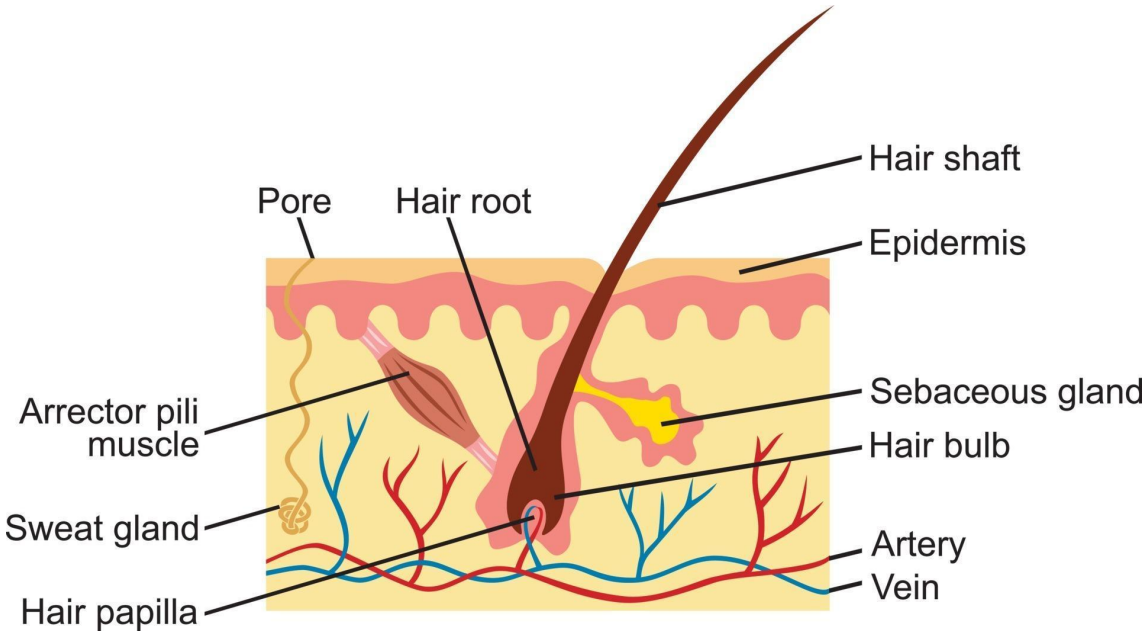

Figure 2.2: Hair and Sweat Glands Anatomy [2]

2.1.3 Functions of the Skin

The skin has 6 main functions that can be summarized as follows [11]

Protection the skin is a direct interface between the entarnal organs and the environment so it works as a protective barrier against harmful objects and pathogens (innate/adaptive immunity and unltra-violet light protection [10]) as shown in figure 2.3

Thermostat the skin works as a thermoregulator to keep the body at the optimal temperature of 37 C°, to achieve that is uses multiple strategies such as insensible perspiration, sweating ...etc

Neural relay network the skin contains a dense network of neural endings that works as receptors to various signals and provides sensations for touch, temperature and pain.

Expression and communication A more social function is the ability for skin to enable individuals to display emotions. It acts as an indicator of one's physical state. Skin is an important component of the stress response as it acts as an immediate stress perceiver and as a target of stress responses. the skin also works as a social tool for interactions between human beings by indicatings the physical state of the individual and by showing sign of stress.

Water storage this skin works as a conservative barrier agains water and body fluids leakage (18-20% of totla body water) as shown in figure 2.3

Synthesis of vitamin D the skin reperesents the main site of vitamin D production when exposed to the sun, it exists in the plasma membranes of basal and suprabasal keratinocytes in its inactive form then it is converted to previtamin D3 then to Vitamin D in the liver and kidneys [10] as shown in figure 2.4

2.2 Cancer

Cancer is an illness caused by the uncontrolled division and spreading of normal cells [13] unlike other diseases, cancer is caused by our own bodies and not by foreign entities, and it is one of the biggest causes of death among human beings nowadays (Table 2.1) and that is because of the ineffectiveness of traditional treatment methods such as hormones, surgery, radiation, and chemotherapy [14]. their ineffectiveness is due to there side effects that lead the body to deteriorate more and more. but it is worth mentioning that there are some new methods and approaches being developed by researchers, a couple of those methods are the study of stem cells in relation to cancer cells and the study of the normal cells that the cancer cells came from which are called "Cancer Origin Cells", the latter approach proposes that we should study these origin cells because of their big similarities with cancer cells which will give us a roadmap to its diagnosis and therapy [15]

2.2.1 Origin

One of the theories that discuss this is the "carcinogenesis multi-hit theory " which stipulates that for cancer to emerge there are some conditions (hits) that need to be

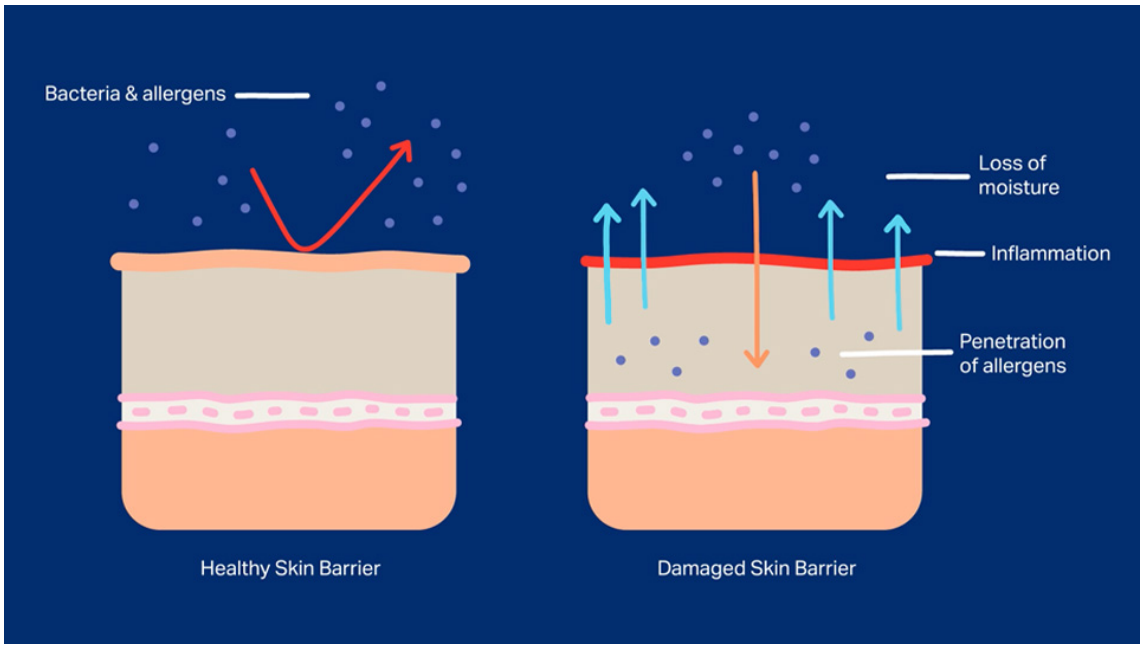

Figure 2.3: Protective/moisture Barrier Functions [3]

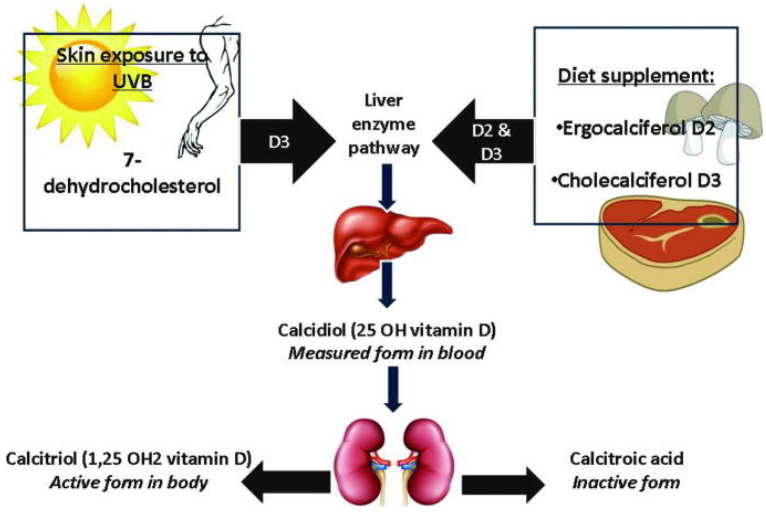

Figure 2.4: Hair and Sweat Glands Anatomy [4]

Deaths in 2020	nealry 10 million
Type	**New Cases** (millions) in 2020
Breast	2.26
Lung	2.21
Colon and Rectum	1.93
Prostate	1.41
Skin	1.20
Stomach	1.09

Table 2.1: Cancer Statistic [8]

satisfied these hits are produced by genetic mutations (figure 2.5) or rearrangements (figure 2.6) that occur over many years and the number of hits necessary is minimal ranging from 3 to 7 only [15]. but it is only fair to mention that there are some exceptions to the rule as there are some cancers caused by only one hit. and to go a step further these mutations can be caused by various elements in our environment such as chemicals in tobacco, ultraviolet rays...etc [13]

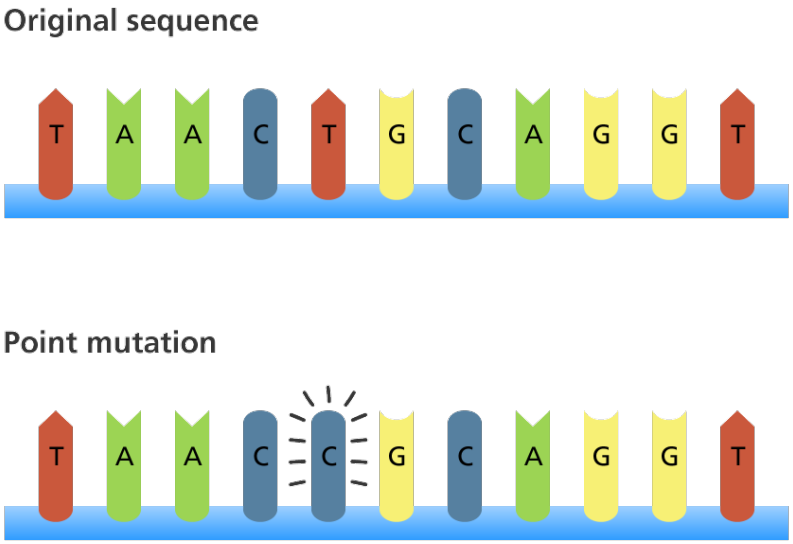

Figure 2.5: DNA Mutation [5]

2.2.2 Types

according to fatality

benign tumors are not very harmful because they do not spread to other organs and do not invade nearby tissue, and after removal, they usually don't grow back [13] as shown in figure 2.7

malignant tumors fatal if not treated, because they travel to distant places and form other tumors and invade nearby tissue [13] which makes it very hard to remove all its parts, as shown in figure 2.7

according to origin

cancer is also categorized according to where it originated or its origin cells, in this category, there are over 100 types because of the different places it can appear (lung cancer, brain cancer ...)and the different origin cells that it can come from [13].

carcinoma most common type formed by epithelial cells

sarcoma form in bone and soft tissue

leukemia form in bone marrow, this type does form a tumor but travels in the blood

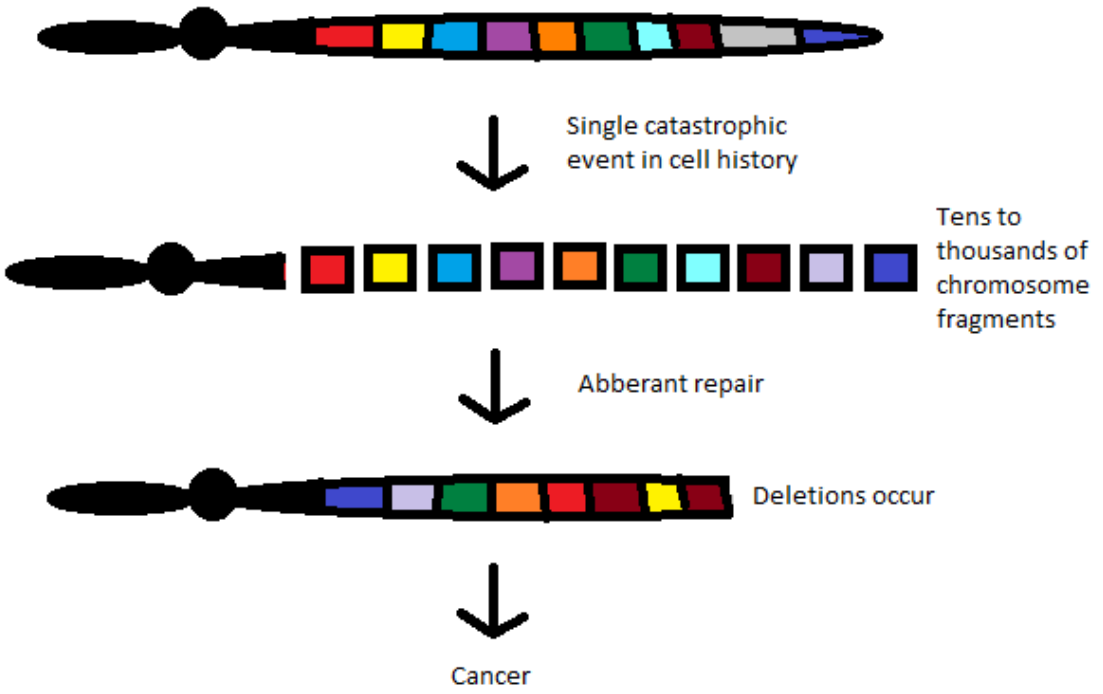

Figure 2.6: DNA Rearrangements [6]

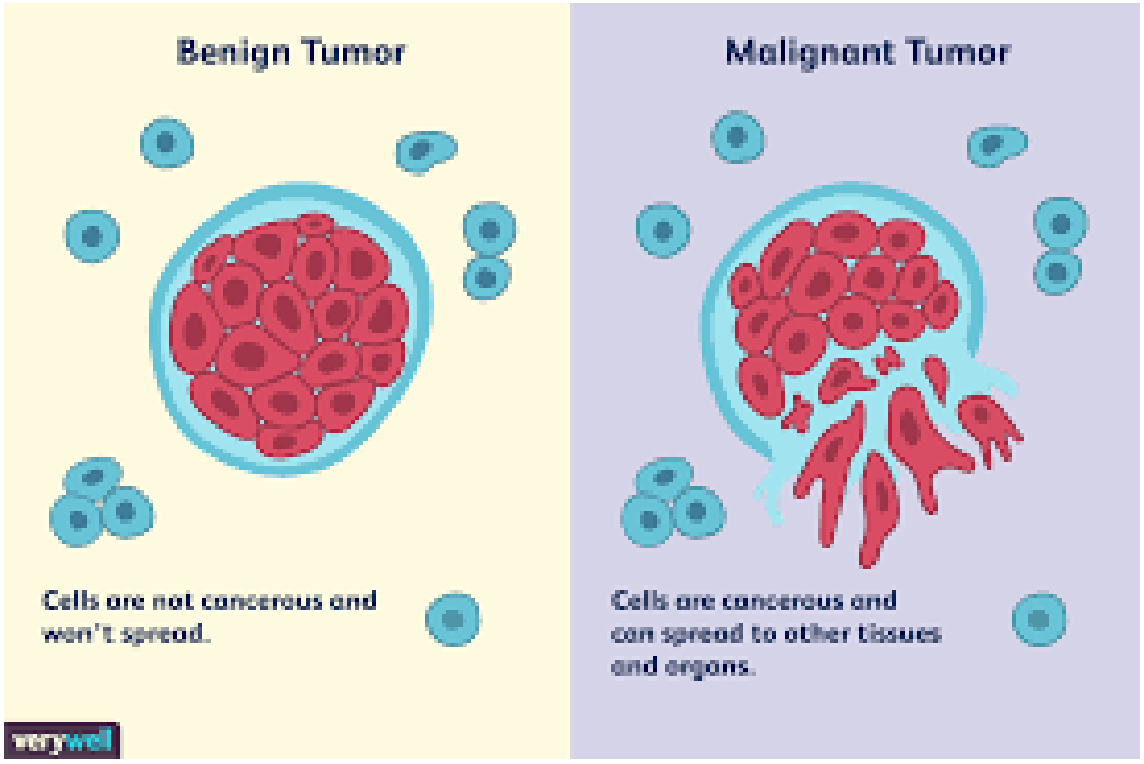

Figure 2.7: Benign and Malignant tumors [7]

melanoma formed by melanocytes (cells that make melanin that gives the skin its color)
...etc

Chapter 3

Artificial Intelligence

Chapter 4

State Of The Art

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