

Basal cell carcinoma pathogenesis

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ABSTRACT

The most common type of skin cancer is Non Melanoma Skin Cancer (NMSC). Although skin malignancies can emerge from any host cell of the skin, Basal Cell Carcinoma (BCC) and Squamous Cell Carcinoma (SCC) are the most frequent NMSC, accounting for 70% and 25% of all NMSC, respectively. NMSC have a wide range of behavior, development, and metastatic potential; nonetheless, both BCC and SCC have a favorable prognosis, especially when identified early on. BCC has a negligible impact on the NMSC mortality rate (MR). Indeed, 1 case of metastatic BCC occurs every 14,000,000 people, and 2 patients every 14,000,000

die from locally advanced BCC. As a result, an MR of 0.02 per 10,000 is reasonable. BCC is the least aggressive of the NMSCs, with cells that resemble epidermal basal cells. Despite the ability of local invasion, tissue destruction, recurrence, and a limited potential for metastasis, BCC has a low degree of malignancy. Gender, age, immunosuppression, hereditary illnesses (e.g., Gorlin-Goltz syndrome), and Fitzpatrick skin types I and II are all risk factors for BCC. However, ultraviolet (UV) radiation is the most essential factor in BCC pathogenesis, despite the fact that the link between UV radiation and BCC growth is still debated.

Key Words: Actinic keratosis; Pathogenesis; Precancerous conditions; Skin neoplasms

INTRODUCTION

BCC is primarily found on sun-exposed skin. BCC is infrequently detected on the palmoplantar surfaces and never on the mucosa. Squamous Cell Carcinoma (SCC) is characterised by abnormal proliferation of invasive squamous cells that have the potential to spread. Furthermore, SCC has a high risk of recurrence, which is determined by tumor size, histological differentiation, lesion depth, perineural invasion, the patient's immune system, and anatomic location. Fitzpatrick skin types I and II, outdoor occupation, Human Papillomavirus (HPV) types 16, 18 and 31, and cutaneous genetically inherited skin illnesses such albinism, xeroderma pigmentosum and epidermodysplasia veruciformis have all been linked to SCC [1]. The key risk factor for cutaneous carcinogenesis, according to multiple articles, is cumulative UV exposure from sunlight and/or tanning beds, which causes UV-induced changes in skin protein expression. Because it impacts each stage of carcinogenesis, UV radiation is called a total carcinogen. Because of the suppression of cell-mediated immunological responses, the formation of Reactive Oxygen Species (ROS) and DNA modification, it really causes cellular harm. Keratinocyte death mediated by the p53/p21/bax/bcl-2 pathway occurs first, followed by a hyper proliferative phase that leads to epidermal hyperplasia. The most important risk factor in BCC pathogenesis is chronic exposure to nonionizing sun radiation, specifically UVA and UVB. UVB-induced carcinogenesis does, in fact, increase the incidence of BCC in immunocompromised patients and people with fitzpatrick skin types I and II [2].

UV irradiation of keratinocytes has been shown to increase the synthesis of the Pro-Opiomelanocortin Gene (POMC) and Melanocyte-Stimulating Hormone (MSH), which are crucial in determining whether the skin develops brown-black pigment (eumelanin) or red-yellow pigment (melanin) (pheomelanin).

Mast Cells (MCs) in the skin have been shown to respond more strongly to UV light as a result of IL-33 synthesis by keratinocytes and dermal fibroblasts. As a result, the number of MCs in the B cell regions of draining lymph nodes rises, stimulating IL-10-producing B cells to perform a regulatory, immunosuppressive function. The activation of heparanase, which induces the breakdown of heparin sulphate and increases the contact between the epidermal growth factor and the dermis, is thought to be determined by continuous UVB exposure [3]. The cutis is made up of Hyaluronic Acid (HA), Dermatan Sulphate (DS), Heparan Sulphate (HS), and Keratan Sulphate (KS), all of which are involved in various skin functions, including cell migration and proliferation. Sulfated Glycosaminoglycan's (GAGs) like Chondroitin Sulphate (CS), DS, KS, Heparin (HEP), and HS are sulfated, while non-sulfate GAGs such as hyaluronic acids are non-sulfate. GAGs interact with a variety of proteins, including chemokines and cytokines, to alter a variety of biological processes. Dermatan Sulphate (DS), Heparan Sulphate (HS) and Keratan Sulphate (KS), all of which are involved in numerous activities. The cutis is made up of Hyaluronic Acid (HA), Dermatan Sulphate (DS), Heparan Sulphate (HS) and Keratan Sulphate (KS), all of which are involved in various skin functions,

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including cell migration and proliferation. Sulfated Glycosaminoglycans (GAGs) like Chondroitin Sulphate (CS), DS, KS, Heparin (HEP), and HS are sulfated, while non-sulfate GAGs such as hyaluronic acid are non-sulfate. GAGs interact with a variety of proteins, including chemokines and cytokines, to alter a variety of biological processes. Protein scaffolds and GAG strains make up Proteoglycans (PGs) [4]. PGs influence the development and organization of the extracellular matrix, as well as the organization of collagen fibres. Heparan Sulphate Proteoglycans (HSPG) are important components of the extracellular matrix, regulating cellular membrane integrity.

Function of X-rays

X-rays play a role in the etiology of NMSCs, according to various articles. Therapeutic Ionizing Radiations (IRs), such as X-rays, contribute to an increase in both BCC and SCC is a possibility. Radiation therapy for acne, in particular, has been linked to a threefold increase in the chance of developing a new BCC. Occupational, medicinal and atomic bomb exposure to IRs has all been linked to an elevated risk of skin cancer. Furthermore, it has been found that those who got radiation therapy at a younger age have a higher risk of developing NMSC. In addition, a relative risk of 1.7 for new BCC lesions and 1.0 for new SCC lesions has been documented in patients who received ionizing radiation therapy. Although it is difficult to distinguish the effects of latency from those of age at treatment and type of therapy received, the latency time between the initial exposure and the development of NMSCs is at least 20 years. The risk of developing BCC and SCC is limited to the anatomic area that has been irradiated. Ionizing radiation absorption causes direct chemical bond breaking or the formation of radicals, which cause significant damage to biological components such as lipids and nucleic acids. Exogenous damage, particularly single or double-stranded fractures, is frequently caused by IR exposure (DSBs). DSBs are DNA changes that cause cell death [5]. To repair the damage caused by DSBs, the histone H2AX travels to the affected area and is transformed into the phosphorylated-H2AX form. After IRs exposure, the accumulation of p53 after the cellular injury has also been observed to increase cellular mass. Cell cycle halt, DNA repair, or apoptosis are all possible outcomes of P53 accumulation. Cutaneous HPV Role HPV is divided into 3 types: alpha, beta, and gamma. In immunocompromised patients, beta-HPV is suggested to be a cofactor in SCC development. Much research has confirmed this. Multiple β -HPV kinds were found in SCC lesions, leading to the conclusion that β -HPV species 2 is a high-risk subtype. β -papillomaviruses are hypothesized to play a role in the early stages of SCC carcinogenesis, changing cell cycle progression, DNA repair, and immune surveillance, resulting in keratinocyte clonal proliferation and UV-induced DNA damage. Furthermore, some α -HPV strains have been linked to SCC [6].

Chemicals that cause cancer and arsenic are two of the most common carcinogens. Exposure to carcinogenic substances, particularly arsenic, increases the likelihood of developing SCC. In vitro arsenic exposure does indeed boost the expression of numerous proteins, including keratin. Involucrin, on the other hand, is produced less. After topical treatment of 12-O-Tetradecanoylphorbol-13-Acetate (TPA), a powerful promoter of carcinogenesis, multiple proteins were raised in C57BL/6-resistant and DBA/2 sensitive mice models, including S100, proteins A8 and A9. These proteins, such as Tumor Necrosis Factor (TNF) and Nuclear Factor (NF)- κ B, were linked to inflammatory pathways that influence skin neoplasm formation. Non-Melanoma Skin Cancers (NMSCs) are the most frequent cancer in the world, with Basal Cell Carcinomas (BCCs) and squamous cell carcinomas (SCCs) accounting for 99% of all cases. NMSCs are largely non-lethal and surgery-curable, hence they are rarely reported in most cancer registries around the world.

However, their increased occurrence is posing an expanding worldwide healthcare challenge. Keratinocytes include both basal and squamous cells, hence BCC and SCC are sometimes referred to as keratinocyte cancer. These three cancers have many similarities, although they are highly different from one another in terms of genesis and course. One thing that all skin cancers have in common is that, according to popular belief, they are all caused by ultraviolet light from the sun or artificial sources (UVR). UVA and UVB rays from the sun The principal UV bands that reach the earth's surface are UVR [7]. Both UV kinds cause DNA damage and immunological suppression, which are important factors in the development of skin cancer. UVB can be absorbed directly by DNA molecules, resulting in UV-signature DNA damage. UVA, on the other hand, may work by causing oxidative DNA damage by producing cellular ROS. Several articles have proven the presence of genetic and molecular modifications involved in skin carcinogenesis, even though the process is still not fully understood. Furthermore, a large number of NMSC risk factors are now established, allowing for efficient NMSC prevention, particularly in the elderly.

CHEMOPREVENTION

Prevention is an essential aspect of NMSC management, and it is a hot topic of research right now. Because the etiology of most NMSC is recognized, it can be substantially avoided if appropriate strategies are adopted. Avoiding excessive UV radiation particularly extended or midday sunlight exposure and wearing sun-protective caps, eyewear, and clothing are the first lines of defense [8]. Retinoid, Vitamin A (retinol) derivatives are known as a retinoid. Proliferation, differentiation and apoptosis are all regulated by retinoid. Retinoid are an effective chemo preventive therapy for NMSCs in several clinical trials.

However, retinoid and vitamin A are linked to a variety of side effects, including dry lips, mucous membranes, and skin; bone toxicity, including arthralgia, hyperosmotic changes, calcinosis and osteoporosis; hair loss; elevated blood cholesterol and triglycerides and hepatotoxicity. Oral retinoid are also teratogenic, thus they should be avoided by pregnant women and women of reproductive age who do not use effective contraception. Non-steroidal Anti-Inflammatory Medicines (NSAIDs) are a type of nonsteroidal anti-inflammatory. Overexpression of the enzyme Cyclooxygenase-2 (COX-2), which produces prostaglandins, has been linked to a variety of malignancies. COX-2 is an endogenous skin cancer promoter [9]. COX-2 inhibitions by Non-Steroidal Anti-Inflammatory Medicines (NSAIDs) have sparked a lot of attention as a chemo preventive therapy for skin cancers and interior malignancies. Recent systematic evaluations have discovered that taking aspirin regularly lowers the incidence of several malignancies, cancer death, and cancer metastasis.

Topical diclofenac, which is licensed for clinical usage, can minimize the amount of AKs. Nicotinamide is the amide form of vitamin B3 and the precursor of NAD, a crucial coenzyme for ATP synthesis. The highly energy-dependent process of DNA repair and chromatin remodeling, which allows repair enzymes to access damaged DNA, relies heavily on the availability of NAD and ATP.

Immune responses to tumor development are likewise high-energy processes. Nicotinamide is also the sole substrate of the UV-activated nuclear DNA repair enzyme poly-ADP-Ribose Polymerase-1 (PARP-1), as well as an inhibitor at high quantities [10]. When used as a lotion 178 or given orally, it has been found to reduce UV-induced immunosuppression in people. In Australia, NMSC is the most commonly diagnosed and most expensive cancer. UV radiation from the sun is the most common cause of NMSCs, which is caused by mechanisms such as DNA damage and immunosuppression.

CONCLUSION

The development of efficient chemo preventive medicines against NMSCs has piqued the interest of researchers. A wide range of possible agents has been investigated. Retinoid for example, have been demonstrated to be effective. Their side effect profiles, on the other hand, limit their application to high-risk patients. As a result, further study is needed right now to develop an optimum chemo preventive drug that is effective, safe, and easy to use.

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