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Adverse Histopathological Effects of Antiperspirant Aluminum Chloride on Skin

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Aluminium chloride is used as a catalyst in the process of Friedel Crafts. It is a salt of aluminium and chloride. It is widely used in the manufacturing of many petrochemicals, in the manufacturing pharmaceuticals, dyes intermediates and other organic chemicals, in the production of rubber; lubricants and wood preservatives, and in cosmetics as an astringent; active ingredient in antiperspirants.

Keywords: *dermis, follicle, keratin, glands, almunium chloride.*

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Adverse Histopathological Effects of Antiperspirant Aluminum Chloride on Skin

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I. Introduction

The use of chemicals is a wide spread practice worldwide for enhancing and improving lifestyle. But along the benefits of these products there is also the potential for adverse effects to the people and the environment.[4] It has been seen that daily transdermal exposure over long periods of time of metal containing compounds in personal care products has raised some health concern.[5-7]

The global cosmetic and skin care industry is a highly profitable market worldwide that is concerned with utilization of raw materials, product testing, sophisticated laboratory equipment and new technology testing that is said to focus within the safe limit parameters of cosmetics and toiletries usage development. As such, these cosmetic giant companies spend lavishly more on TV advertising than any other commercial enterprise. Consumers are introduced and used in various cosmetics and personal care products without full disclosure on its package labeling. The average person is misled to believe that such product ingredients have been adequately tested and are safe for public usage. Ironically, this is far from accurate.[8] Moreover, males and females individuals, from infancy to old age utilize a huge multivariate variety of shampoos, body soaps antiperspirants and skin creams preparations, some with no known peer knowledge or concern of the preparation's hazardous potential.

Thorough scanning of the available literature revealed, dearth of literature regarding the gross and histological effects of aluminium salts (aluminium nitrate and aluminium chloride) on skin. Therefore a curious desire developed to conduct evidence based study of the effects of aluminium chloride on the skin of mammal, the albino rabbit.

II. Materials and Methods

The present study was carried out on twenty four inbred adult albino rabbits. The numbers of animals used and procedures to minimize the suffering of the animals are in accordance with ethics committee on animal experiments of Government medical college Jammu. IEC no. pharma/2012/2818.The rabbits were procured from the Central Animal House of Government Medical College, Jammu. Animals were housed in with dust free rice husk as bedding material under laboratory conditions with controlled environment of temperature of 25±2℃, humidity (16% ± 10%) and 12 hours light/dark cycle (16- 18) as per committee for the purpose of control and supervision of experiment on animals (CPCSEA), Indian guidelines. They were provided standard feed and water ad libitum, before subjecting them for experimentation, animals were given a week's time to acclimatize with laboratory conditions.

The animals were divided into following three main groups (A, B and C) as follows:

Group A: Experimental group - 12 animals
Group B: Control group - 12 animals

These groups were further subdivided into group A1, A2, B1 and B2, containing 6 animals each.

Group A1 received 10% aluminium chloride.
Group A2 received 20% aluminium chloride.
Group B received distilled water.

Group B1 animals were taken as control for group A1 animals. Group B2 animals were taken as control for group A2 animals.

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About 2cm× 2cm area of skin on posterior surface of each ear of each rabbit was used as test areas. The test areas were shaved 24 hours prior to application of drug. Powdered form (98% purity) of aluminium nitrate and aluminium chloride was used. Solutions were prepared in distilled water at 10% and 20% concentrations daily before application.

0.5ml of solution was applied daily with the help of a clean glass rod to the test areas on experimental animals. After application, each experimental animal was kept in individual cages until the applied solution dried up at ordinary room temperature and atmosphere. Procedure was repeated daily for next fifteen days whereas only distilled water was applied to the control groups. On day sixteenth of the treatment right sided test areas of all groups were first examined using a hand lens. Then after proper local anesthesia with 1ml of 2% xylocaine subcutaneously, 1cm^2 of the test areas were excised under proper aseptic conditions. The wounds left were properly cared for with povidine iodine till complete healing. Povidine iodine was applied twice a day locally on the wound. Left sided test areas were kept without treatment for next 30 days, on 46th day these test areas were first grossly examined using a hand lens and then 1cm^2 of the test areas were excised after proper local anesthesia again using 1ml of 2% xylocaine subcutaneously and wounds were taken care of with povidine iodine applied locally twice a day till they healed completely. The macroscopic or gross changes of the skin were seen with the help of hand lens while the histological changes were observed after the tissues were chemically fixed in neutral buffered formalin solution and later processed. Five-micron thick sections were sectioned and stained with Harris's Haematoxylin and eosin stain.

III. Observations

With low and high (10% and 20%) concentration aluminium chloride after 15 days of treatment: - Hyperplasia of epidermis along with hypertrophy of stratum corneum and intercellular oedema in epidermis was observed. Skin treated with 20% Aluminium nitrate showed marked no. of cysts filled with keratin along with epidermal erosions . Dermal oedema, widening of dermal papillae as well as vascularization in dermis was marked with aluminium nitrate 20% as compared to that with aluminium chloride 20%. There was decrease in number of hair follicles, sweat glands and sebaceous glands but increase in number of inflammatory cells and fibroblasts was observed

With low and high concentration of aluminium chloride after one month of stoppage of treatment:-

Slight hyperplasia of epidermis and slight hypertrophy of stratum corneum persisted .Dermis showed slight oedema. Hair follicles, sweat glands and sebaceous glands showed slight increase in number with decrease in number of fibroblasts and inflammatory cells `

IV. Discussion

The aim of the present study was to evaluate if there are any changes in the skin after use of antiperspirants. The results of present study compares favorably with previous studies.

Findings in epidermis with 10% aluminium chloride are consistent with the findings of the Lansdown[9], Nasir et al.[10] After one month of stoppage of treatment with 10% aluminium chloride the epidermal changes reverted back to normal skin in the present study. Similar results have also been reported by Nasir et al.[11]

The epidermis showed marked hypertrophy of stratum corneum and hyperplasia of epidermis along with marked intercellular oedema and keratin cysts in the present study after 15 days of treatment with 20% aluminium chloride. These findings are almost in accordance with the findings of Lansdown[9], Nasir et al.[11]

After one month of stoppage of treatment with aluminium chloride 20% the changes reverted back to normal with almost complete reversion. Similar changes were also demonstrated by Nasir et al.[11]

In the present study the dermis showed slight oedema and vascularization, few hair follicles and fibroblasts along with inflammatory cells, rare sweat and sebaceous glands after 15 days of treatment with 10% aluminium chloride whereas dermis showed moderate oedema, vascularization, inflammatory cells, slight fibroblasts and rare sweat and sebaceous glands after 15 days of treatment with 20% aluminium chloride. In addition dermal papillae were elongated and widened. After one month of stoppage of treatment with 10% aluminium chloride and 20% aluminium chloride findings were moderate hair follicles, however sweat and sebaceous glands, vascularization and fibroblast were slight. But there is no literature available to compare these findings.

V. Conclusion

The detailed study showing effects of Aluminium chloride (the antiperspirant) was conducted and the observations were noted, critically analyzed and discussed with the findings of previous workers and hence it was concluded that maintenance of a healthy life style is crucial in daily well being. The antiperspirants containing aluminium chloride even in low dose concentrations, may still cause well defined histological damage to the skin and its appendages, especially after a prolong time period of continuous application but the changes almost reverted back to normal after one month of stoppage of application. And

if the duration of application is further continued permanent histological changes are eminent.

Table : Epidermal changes in the skin as treated with Aluminium Chloride

	Control	After 15 Days of Treatment		After One Month of Stoppage of Treatment	
Different Histological Findings		Aluminium Chloride 10%	Aluminium Chloride 20%	Aluminium Chloride 10%	Aluminium Chloride 20%
Hypertrophy of Stratum Corneum	Nil	Moderate	Marked	Slight	Slight
Hyperplasia of Epidermis	Nil	Moderate	Marked	Nil	Nil
Intercellular Oedema	Nil	Moderate	Marked	Nil	Nil
Cysts filled with Keratin	Nil	Slight	Slight	Nil	Nil
Erosion of Epidermis	Nil	Nil	Nil	Nil	Nil

Table : Dermal changes in the skin treated with Aluminium Chloride.

Changes		After 15 Days of Treatment		After One Month of Stopping of Treatment	
	Control	Aluminium Chloride 10%	Aluminium Chloride 20%	Aluminium Chloride 10%	Aluminium Chloride 20%
Oedema	Nil	Slight	Moderate	Rare	Rare
Vascularization	Nil	Slight	Moderate	Slight	Slight
Inflammatory cells	Nil	Slight	Moderate	Rare	Rare
Fibroblasts	Slight	Slight	Moderate	Slight	Slight
Hair follicles	Moderate	Slight	Slight	Moderate	Moderate
Sebaceous glands	Slight	Rare	Rare	Slight	Slight
Sweat glands	Slight	Rare	Rare	Slight	Slight

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Figures

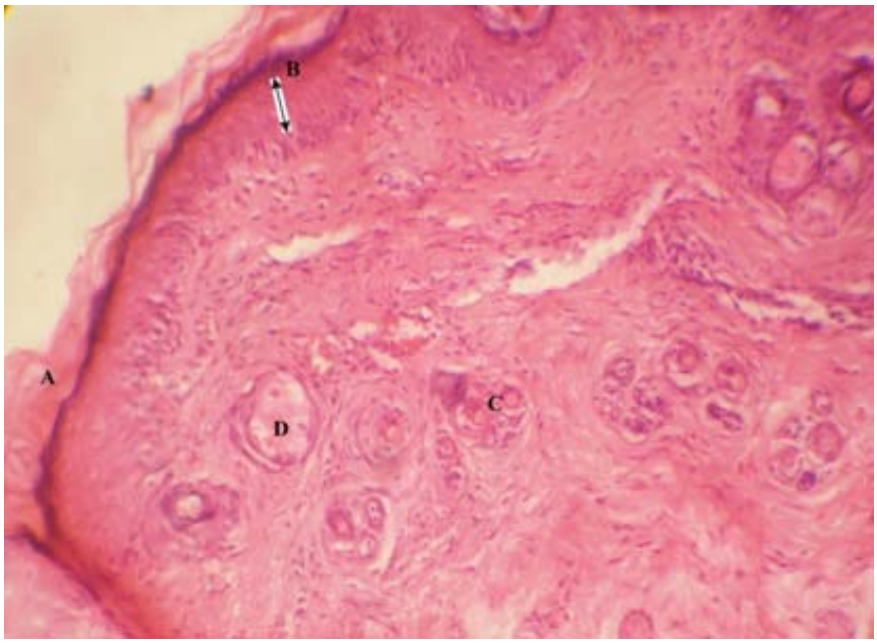

Figure 1: Photomicrograph of longitudinal section of right ear skin of Albino rabbit after 15 days of treatment with 10 % Aluminum chloride showing hypertrophy of Stratum Corneum(A), Epidermal hyperplasia(B), Sweat Glands(C) and Sebaceous Glands(D) (H & E Stain 200X)

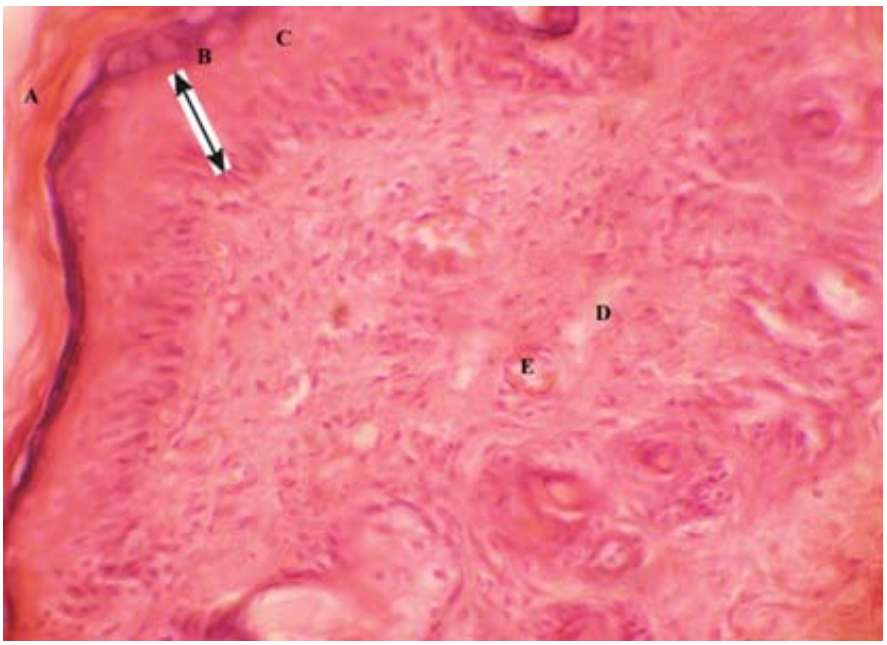

Figure 2 : Photomicrograph of longitudinal section of right ear skin of Albino rabbit after 15 days of treatment with 10 % Aluminum chloride showing hypertrophy of Stratum Corneum(A), Epidermal hyperplasia (B), intercellular edema in Epidermis (C), Dermal Edema (D) and Vascularization (E) (H & E Stain 200X)

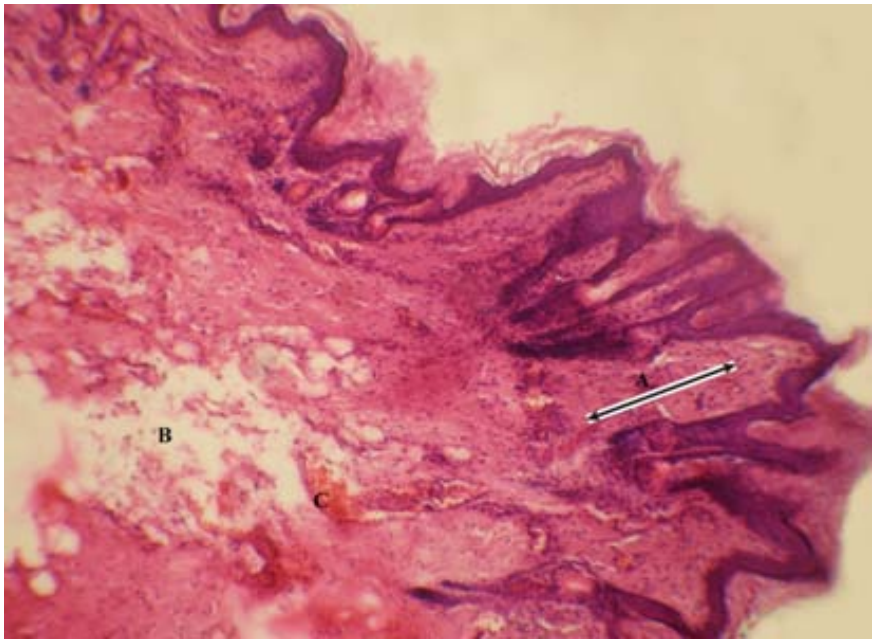

Figure 3 : Photomicrograph of longitudinal section of right ear skin of Albino rabbit after 15 days of treatment with 20 % Aluminum chloride showing elongation of dermal papillae(A), Dermal Edema(B) and Vascularization(C) (H & E Stain 100X)

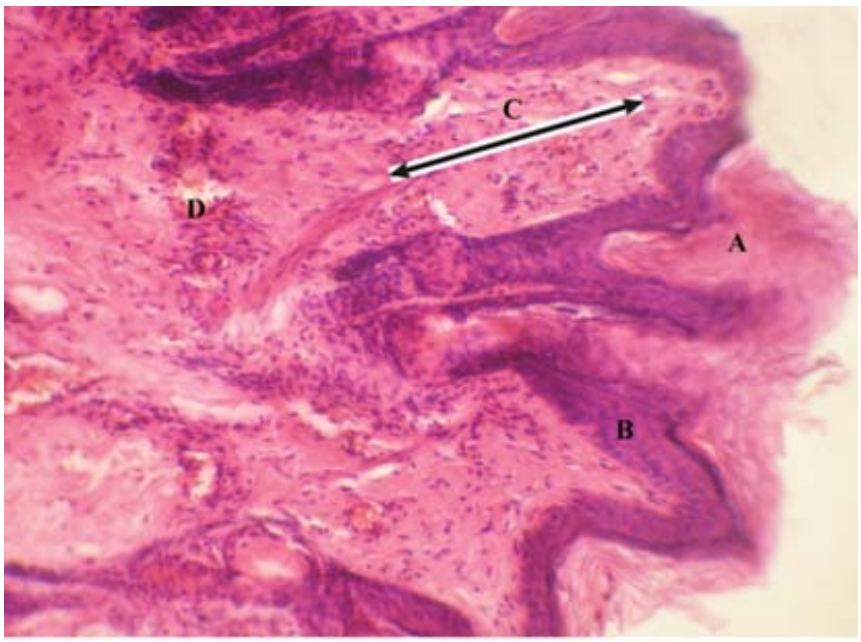

Figure 4 : Photomicrograph of longitudinal section of right ear skin of Albino rabbit after 15 days of treatment with 20 % Aluminum chloride showing hypertrophy of Stratum Corneum(A), hyperplasia of Epidermis(B), elongation of dermal papillae (C)) and Vascularization(D) (H & E Stain 200X)

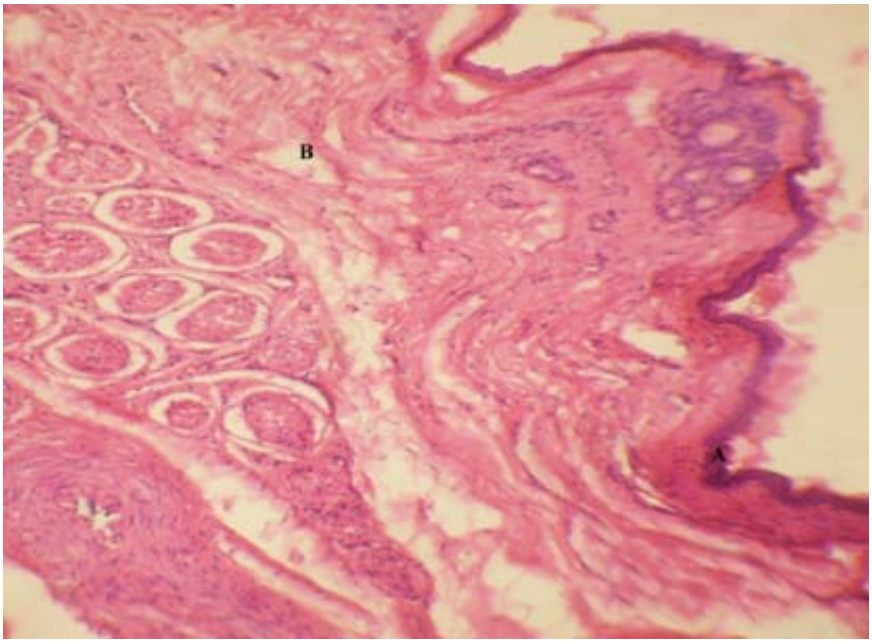

Figure 5 : Photomicrograph of longitudinal section of right ear skin of Albino rabbit after 15 days of treatment with 20 % Aluminum chloride showing slight Epidermal hyperplasia (A) and Dermal Edema(B) (H & E Stain 100X)