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Comparative Effectiveness of Silver Sulphadiazine and Beta-Sitosterol Ointment as Dressings for Second Degree Burns

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Abstract

Aim: *The purpose of this study was to investigate the comparative effectiveness of 1.0% silver sulphadiazine and 0.25% beta-sitosterol ointment as dressings for second-degree burns.*

Methodology: *This study was conducted at King Abdullah University Teaching Hospital in Irbid, Jordan, from May to November 2020. All participants were healthy patients with no known chronic medical conditions. All included patients had second-degree burns on any part of their body, not more than 2% of their total body surface area. Burns were analyzed for signs of infection, granulation formation, size reduction, and scar formation.*

Results: *0.25% beta-sitosterol ointment overall showed better therapeutic results compared with 1.0% silver sulphadiazine cream. In particular, beta-sitosterol demonstrated better prevention of wound infection and increased granulation formation.*

Conclusion*: The quest for the most effective burn therapy will continue to focus on the formulation of preparations that enhance tissue regeneration and act as antimicrobial agents. This study suggests that beta-sitosterol ointment may be a better burn treatment than – and serve as a valuable alternative to – traditional therapies such as silver sulphadiazine, particularly where wound infection is not a primary concern.*

Keywords — *Beta-sitosterol, burn wounds, ointment, silver sulphadiazine, ointment*

I. INTRODUCTION

Skin burn is a type of coagulative necrosis that results from exposure of the skin to thermal energy. Skin burn occurs for various reasons, but the most common causes are flames and hot liquids. Thermal injury can also be caused by chemicals and electricity (1). Skin burns are incredibly common throughout the world and account for a significant number of medical emergencies and hospital admissions (1, 2). In the past few years, a significant increase in fatalities due to skin burns involving more than 20% of the body surface has been observed. Burns cause remarkable changes to the cardiovascular, nervous, respiratory, and immune systems. The most common cause of mortality associated with skin burns is hypovolemic shock due to excessive plasma and wound infection (3).

Burned skin is exceptionally prone to bacterial infection because systemic delivery of antibiotics is impaired by blocked and occluded blood vessels. Therefore, topical treatment of burn wounds is recommended to avoid wound infection and associated mortality (4). Since 1960, the conventional way to topically treat burns has been with medicines and ointments containing silver compounds. Silver sulphadiazine and silver suspension are the most common forms of silver compound used for topical treatment of burn wounds (5). Sulphadiazine and other silver compounds are advantageous in treating burn wounds because they exhibit antibacterial and antifungal activity (6).

Beta-sitosterol is a plant steroid widely used for healing burn wounds in the Middle East and Asia. It is an analgesic, helps retain moisture in the burned tissue, and plays a role in forming new epithelial cells (7). A study comparing the healing properties of beta-sitosterol and silver sulphadiazine was carried out, which showed no remarkable differences in clinical or secondary infection in burned animals between treatment groups. However, when the tissue was examined histologically, the infiltration of inflammatory cells in burned tissue was higher in burn wounds treated with beta-sitosterol than those treated with silver sulphadiazine (1).

Silver sulfadiazine (1.0%) solution has been used extensively to treat burn wounds because of its antimicrobial properties (8). Previous research examining silver sulphadiazine's potential to heal burn wounds observed delayed healing as its primary adverse effect (9). Other side effects observed in the long-term application of silver compounds were renal toxicity, leukopenia, and silver sulphadiazine resistance (10).

In 1970, silver compounds (silver nitrate) and antibiotics (sodium sulphadiazine) were combined to make a formulation intended to cure burn wounds. Silver sulphadiazine was originally formulated as an ointment but later constituted as a hydrophilic cream. Because delayed healing is one of its side effects, silver sulphadiazine is not considered the gold standard of topical treatments for burn

wounds. Bacterial resistance to sulphadiazine is also a problem associated with silver sulphadiazine (11).

Beta-sitosterol was initially prepared to treat burn wounds at China's National Science and Technology Center (12). Beta-sitosterol exhibits very remarkable anti-inflammatory properties. Clinical trials have also investigated beta-sitosterol's analgesic and antibacterial properties. It also aids healing by retaining the moisture content of the burn-affected body part. Other clinical investigations have shown improved scar quality, debridement, and epithelialization with topical beta-sitosterol application (13). In a study comparing the healing effects of beta-sitosterol with other conventional occlusive dressings, patients treated with beta-sitosterol showed quicker and earlier wound healing in terms of scar quality and trans-epidermal water loss (14).

The present study seeks to compare the effectiveness of 1.0% silver sulphadiazine cream and 0.25% beta-sitosterol ointment as dressings for second-degree burns.

II. METHODOLOGY

This study was conducted at King Abdullah University Teaching Hospital in Irbid, Jordan, from May to November 2020.

To be eligible for the study, participants had to be at least one year and less than or equal to 40 years of age; be healthy, with no known chronic medical conditions; and have second-degree burns covering no more than 2% of their total body surface area. Patients who did not meet these criteria were excluded from the study. Also excluded were patients exhibiting circumferential burns; those whose burns were caused by chemical agents, friction, or electrical discharge; and those whose burn area covered the eyes, face, genitalia, hands, or feet. Patients were categorized into four age groups: toddlers (1–5 years old), children (6–15 years old), young adults (16–20 years old), and adults (20–40 years old). Of the initial 102 patients selected for the study, 75 of them continued follow-up for 15 days.

All dressing procedures were performed under strict aseptic conditions using aseptic techniques. Tetanus toxoid vaccinations were administered before burn dressing, and procedures were performed under local anesthesia. Second-day follow-ups were carried out to confirm that the degree of the burn was not under-or overestimated.

Out of 75 patients, 40 patients were treated with 1.0% silver sulphadiazine cream, and 35 patients were treated with 0.25% beta-sitosterol ointment. A nurse performed daily wound dressing for fifteen days. The doctors' follow-ups were on day 2, day 5, day 7, and day 15 after the start of treatment unless otherwise required.

III. ETHICAL CONSIDERATIONS

Prior approval by the University's research ethics committee was obtained to conduct this study. Participants (or their guardians) participated in this study as volunteers, and all participants signed a written informed consent form. The data was obtained and analyzed anonymously, and all collected information was kept secure and confidential.

IV. RESULTS

A total of 75 patients completed all follow-up sessions and were included in these results. Among them, 60% were female, and 40% were male. Most patients (36%) fell into the adult age category, followed by toddlers (33%), then children (20%); the young adult group had the lowest number of patients (11%).

Several patients exhibited signs of infection in both the silver sulphadiazine and the beta-sitosterol treatment groups during their follow-up visits. Burns was evaluated on day 2 for signs of infection, and there were no infections in either group. In the 0.25% beta-sitosterol group, 6% of patients had signs of infection on day 5, but on day 7 and day 15, all patients in this group were free of infection. On the other hand, in the 1.0% silver sulphadiazine group, 10% of patients displayed signs of infection on day 5, 3% had signs of infection on day 7, and none had signs of infection on day 15.

A 10–70% reduction in the burn area's size was observed in both treatment groups. By this parameter, as well, 0.25% beta-sitosterol ointment showed better results: 46%, 77%, and 97% of patients displayed reduced burn size on day 5, day 7, and day 15, respectively, compared with 43%, 65% and 93% in the 1.0% silver sulphadiazine group.

Similarly, burn healing and granulation tissue formation was more prominent in the 0.25% beta-sitosterol ointment group: about 49%, 66%, and 91% of patients showed granulation formation on day 5, day 7, and day 15, respectively. Meanwhile, in the 1.0% silver sulphadiazine cream group, only about 30%, 55%, and 83% of patients showed granulation formation on day 5, day 7, and day 15, respectively. These results indicate that 0.25% of beta-sitosterol ointment promotes granulation formation and healing better than 1.0% silver sulphadiazine cream.

There were no obvious differences in scar formation or contracture between the treatment groups. Only about 3% of patients in each group displayed scar formation by day 15.

V. DISCUSSIONS

Burns expose the deep tissues of the skin and make them prone to microbial attack. Ideally, ointments and creams used in treating burn wounds should contain antibiotic properties and act as a healing booster. For many decades, silver compounds have been used as a key ingredient in topical ointments for burn wounds (15). However, many chemical components obstruct the healing process.

This study investigated the comparative effects of 1.0% silver sulphadiazine cream and 0.25% beta-sitosterol ointment. Overall, 0.25% of beta-sitosterol ointment showed better therapeutic results than 1.0% silver sulphadiazine cream. The silver ions in silver sulphadiazine cream can kill all microbes, including fungi, by inhibiting their cellular

respiratory pathways and depleting their energy (16). However, the presence of silver nitrate can cause electrolyte imbalance. Moreover, its absorption into blood circulation modifies the acid-base level. Silver also induces neutropenia (18).

Our results demonstrated that 0.25% of beta-sitosterol ointment prevents burn wound infection and promotes granulation formation better than 1.0% silver sulphadiazine. Our results are supported by previous studies (1, 7) in which beta-sitosterol showed antimicrobial activity and promoted quick re-epithelialization.

There were no obvious differences in scar formation or contracture between treatment groups. Only about 3% of patients in each group displayed scar formation by day 15. The mean healing time was the same in both groups, despite previous studies showing that silver sulphadiazine can delay the wound healing process. One of these studies showed that healing time with silver sulphadiazine was normal when used in split-thickness donor sites but considerably slower in deep wounds (13). The exact mechanism behind this delay is still unclear.

VI. CONCLUSIONS

Invasive wound infection is one of the most prominent causes of burn-induced fatalities, particularly in children. The quest for the appropriate burn therapy will focus on the formulation of preparations that can enhance tissue regeneration with minimal tissue damage while acting as an antimicrobial agent. Our data suggest that 0.25% of Beta-sitosterol ointment can be a better burn treatment and can be a valuable alternative to traditional therapies like silver sulphadiazine, particularly when wound infection is not the main concern.

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