Application of Extracorporeal Shock Wave Therapy in Burn Rehabilitation Medicine

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Introduction

Although mortality rate has decreased due to the development of acute care in burn patients, the importance of chronic complications in terms of pain, pruritus, joint contracture, and esthetic aspects is increasing. On patients with partial or full-thickness burn injuries, autologous split-thickness skin grafting (STSG) are thought as the main treatment. Wound healing is a process for recovering the skin barrier, and involves a variety of cells. Many studies showed that dermal fibroblasts generate hypertrophic scarring by upregulating fibroblast responses and extracellular matrix protein deposition. Recovery of the dermis is important for healing process.

Although various therapeutic modalities have shown some efficacy, options remain limited in the treatment of hypertrophic scars. Some studies suggest that ESWT can induce the regeneration effects such as neoangiogenesis and antiinflammation. Some studies on ESWT intimate some beneficial regeneration effects in burn wounds. This project aimed to measure scar characteristics of the grafted skin with and without ESWT.

Matherial and Method

This was a double-blinded, randomized controlled trial. The participants who were transferred to the Department of Rehabilitation Medicine at Hangang Sacred Heart Hospital were enrolled after complete epithelialization on scars that underwent skin grafting.

Subjects in both groups received standard treatment for burn scars, which comprised occupational therapy to improve upper limb function, physical therapy to improve lower limb function, stretching exercises for scar contracture, drugs for pain or pruritus caused by hypertrophic scar, pressure therapy, and moisturizing cream and silicone gel application. ESWT was conducted using the Duolith SD-11 device (StorzMedical, Tägerwilen, Switzerland), with an electromagnetic cylindrical coil source used to focus the shock wave. ESWT was performed on treated scars, at an intensity of 100 impulses/cm^2, an energy flux density (EFD) of 0.05 to 0.30mJ/mm^2, and frequency of 4Hz. With regard to volume of treatment, 1000 to 2000 impulses were administered per session, for 6 sessions held at 1-week intervals. In the control group, standard treatment of burn scars except for ESWT was performed in the same manner as in the ESWT group. To evaluate the effect of ESWT, investigators compared the skin test results (thickness, melanin, erythema, TEWL, sebum, and skin elasticity levels) between the ESWT and control groups, from baseline measures immediately before the treatment and measures immediately after six weeks.

Results

We found improved changes (pre- to post-treatment) in scar thickness and erythema of the ESWT groups compared with the changes of the control group ($p=0.03$ and $p=0.03$). More changes in the scar thickness and erythema were found in the ESWT group compared with changes of the control group. We also found significant changes in sebum levels in the ESWT group compared with change of the control group ($p=0.02$). However, we found no differences between groups in any of the other measurements, including melanin, transepidermal water loss, distensibility, or elasticity. For the participants, some discomfort was mentioned during the treatment of ESWT, but no session was discontinued due to pain. No participants experienced adverse events such as ecchymosis, skin abrasion or worsening of swelling during ESWT.

Discussion

The purpose of this study was to explore the effects of ESWT for the management of hypertrophic scars. The mechanisms of hypertrophic scarring are persistent inflammation and fibroblast activation. Fibroblasts from hypertrophic scarring generate elevated collagen production. TGF-b1 plays a major role in the genesis of fibroblasts during fibrosis in tissues. ESWT on skin wound accelerates epithelialization by angiogenesis and the suppression of inflammation. TGF-b1, collagen, and fibronectin levels were reduced after ESWT. Zhao et el. showed that shock wave therapy improved scar characteristics by interfering with the TGF-b1/Smad signaling pathway. Many studies with ESWT investigated the potential to suppress fibrosis. These results demonstrate that ESWT is associated with suppression of some characteristics of hypertrophic scar. It was found that the erythema and sebum measurements from the epidermis and dermis were significantly improved in the ESWT group. This may be associate with the effect of ESWT on epidermal and dermal cell stimulation of hypertrophic scar tissue. The findings will provide further essential information that can help improve the management on hypertrophic scars. ESWT can be one of the modalities for improving scar characteristics.

- ESWT was conducted using the Duolith SD-11 device (StorzMedical, Tägerwilen, Switzerland), with an electromagnetic cylindrical coil source used to focus the shock wave.
- The authors declare no potential conflict of interest