

Role of Stromal Vascular Fraction in Wound Healing

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ABSTRACT

Wound is a common problem following burn, trauma or infection. There are various methods to limit the infection and to cover the raw area. But there is no well-established method that accelerates the wound healing rate. Stem cell therapy is most recent technique that is claimed to hasten the healing. Stromal vascular fraction (SVF) is a source of stem cells. Stromal vascular fraction improves wound healing by increasing cell proliferation and vascularization as well as by reducing inflammation and increasing fibroblastic activity. This article highlights the role of SVF in wound healing.

KEYWORDS

Stromal vascular fraction; Wound; Management

1. INTRODUCTION

Wound is a common problem encountered by plastic surgeon. Many methods do exist with varying success. However, large wounds, under adverse local and systemic conditions (low vascularization, metabolic disease, etc.) respond poorly and slowly to these treatments. Different modalities have been claimed to accelerate the wound healing. Adipose-derived stem cell-based therapy is one of the most recent therapeutic strategies for wound healing that affects all aspect of wound healing i.e. re-epithelization, angiogenesis, and immunomodulation. In review of literature we have seen very few Indian studies on SVF in wound management. We share our experience on SVF in wound management.

2. Methodology

This is case report of use of SVF in post burn raw area. This study was conducted in a tertiary care hospital in 2019. The patient was 20-year female with post thermal burn raw area on thigh. Patient was thoroughly investigated. Wound tissue culture was sent, and appropriate antibiotic therapy was given. Regular cleaning and dressing were done. To promote the healing decision was made to give trial therapy of SVF therapy. Digital planimetry was done to assess the wound.

Under anaesthesia tumescent was infiltrated in abdominal wall. A stab incision was given at umbilicus and 20 ml of lipoaspirate was harvested. 4ml of Phosphate buffer solution was added to lipoaspirate Mechanical method

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was used to separate SVF from adipose cell by vigorously shaking the fluid in a tube for 1-2 minutes. When the tissue is separated, the aqueous infra-natant is saved in tube. The tissue was washed for another 2-3 times each time saving the supernatant (fat to be processed separately). The conical tubes with the infra-natant were centrifuged at 1200 rpm for 5 min at room temperature. The SVF pellet will be noted at the lowermost layer in centrifugation tube.

The SVF containing fluid was given in the bed of the wound and at the margin. Weekly assessment of wound was done. Remnant raw area was recalculated (Figure 1- Figure 3).



Figure 1: Fat being harvested.



Figure 2: Lipoaspirate after mechanical shaking. Lower most layer contains SVF.

3. Results

SVF treated wound on thigh region showed accelerated wound healing. At two weeks raw area became less than 50%. Weekly assessment of wound revealed quicker healing process and complete healing was achieved in 6 weeks. The resultant scar was also of better quality as

compared to non-treated site. Patient was also satisfied with result (Figure 4).



Figure 3: SVF being injected into raw area.



Figure 4: Well healed scar after 6 weeks.

4. DISCUSSION

The spectrum of modalities available to manage a wound is very wide. Conveniently it can be grouped into four categories - conventional therapy, novel therapy, reconstructive therapy and cell based. Conventional therapies include - conventional dressings with or without topical application of antimicrobial agents, growth factors; various biological dressings such as silver and alginate; hyperbaric oxygen etc. Novel therapies include the use of platelet-rich plasma, negative pressure wound therapy (NPWT), and skin substitutes. These are minimally invasive with much better healing efficacy than conventional therapies. reconstructive therapy, such as skin and flap grafting, are invasive and damage the normal tissue also. Cell based therapy is rapidly emerging as a part of wound management but is seldom

used alone. These cells can be harvested from bone marrow or adipose tissue.

The clinical use of autologous adipose-derived stem cells (ASCs) is rapidly expanding. Applications as diverse as myocardial infarction, cosmetic surgery, osteoarthritis and bone regeneration, inflammatory bowel disease and chronic wounds. ASCs demonstrably survive after transplantation, show pluripotential and exhibit anti-apoptotic, anti-inflammatory, antiangiogenic effects. It promote wound healing via epithelial differentiation that lead to accelerated epithelialization of the wound. These cells also have capacity of differentiation into endothelial cells and secretion of endogenic growth factor that contribute to increased neovascularization.

There are various growth factors that are present in SVF. These are involved in all three phases of wound healing and may affect the outcomes of scarring. In the first phase of wound healing (inflammatory phase), SVF decreases the levels of mast cells and myofibroblasts through immunosuppressive and anti-inflammatory effects, leading to reduced active scar formation. In the proliferative phase of wound healing, the differentiation of adipose-derived stem cells and numerous growth factors contained in SVF helps in wound healing. In the maturation phase, excessive collagen synthesis is suppressed, and remodeling of collagen is induced by chemokines such as (TGF: transforming growth factor) beta 3 and matrix metalloproteinases. The presence of growth factors (i.e. PDGF: platelet-derived growth factor), (IGF: insulin-like growth factor), (KGF: keratinocyte growth factor), (b FGF: basic fibroblast growth factor), and vascular endothelial growth factor [VEGF] accelerates wound healing and is generally favorable for scar formation. Modulation of collagen synthesis may also explain the favorable changes observed in pliability caused by SVF through a process involving the downregulation of MMP1 and migration of human dermal fibroblasts.

Stromal vascular fraction (SVF) is a heterogeneous mixture of cells resulting from the mechanical or enzymatic processing of aspirated adipose tissue. SVF contains macrophages, various blood cells, fibroblasts, smooth muscle cells, vascular endothelial progenitors and adipose-derived stem cells. In the mid-1960s, Rod bell first isolated SVF from rats. Later 1970s Wagner isolated EC from SVF. Significant advance was made in 1980s when Jarell, William, et al. isolated SVF from human adipose tissue. Since then SVF has been investigated for various clinical applications.

4.1 SVF can be prepared by two methods

4.1.1 Enzymatic

This method used to manually process adipose tissue using collagenase. Lipoaspirate is washed 2–3 times using an aqueous salt solution such as PBS, Lactated Ringer's solution, or Hank's Balanced Salt Solution (HBSS). The washed lipoaspirate is then incubated with a collagenase solution of variable concentration and composition, depending on the method and tissue dissociation enzyme product used. Enzymatic digestion is typically carried out in a heated shaker to provide constant agitation at 37 °C for 30 min to 2 h. The digested adipose tissue is then centrifuged, which separates the processed lipoaspirate into three main layers, the oil/adipose tissue layer, the aqueous layer, and the pellet. The SVF is contained within the pellet, so the other layers are discarded.

4.1.2 Mechanical method

Mechanical methods seek alternative non-enzymatic means of removing SVF cells from the adipose tissue and tend to be focused around washing and shaking/vibrating lipoaspirate followed by centrifugation in order to concentrate the SVF cells.

There are automated and semi-automated systems which are able to carry out each step of the process with little or no interference from a technician. Benefits offered by

many of these systems is increased sterility through the use of a closed system.

5. CONCLUSION

In this study we found that SVF has role in healing of the wound and the wound heals at faster rate. The resultant scar was also of better quality. But since it is a single

case study, definite conclusion cannot be made. Large randomized control trials are required to confirm the efficacy of SVF in wound healing.

6. CONFLICT OF INTEREST

The authors do not point out any conflict of interest regarding this article.

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