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Role of Autologous Bone Marrow Aspiration Therapy in Preventing Flap Necrosis in Electrical Burns

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Abstract

Flaps are vital in wound, surgery, and infection repair. Flap necrosis is a common complication that increases hospital stays and morbidity. Stem cell treatment improves flap angiogenesis by secreting growth factors and cytokines. Autologous Bone Marrow Aspiration Therapy (ABMAT) uses stem cells from bone marrow to increase cell proliferation, vascularization, inflammation reduction, and fibroblastic activity. This article highlights the role of Autologous Bone Marrow Aspiraion Therapy (ABMAT) in prevention of flap necrosis in electrical burns.

Keywords: Autologous Bone Marrow Aspiration Therapy (ABMAT); Prevention; flap; Necrosis; Electrical burns.

INTRODUCTION

Burns are a global public health problem and a commonly encountered emergency. Burns are a type of painful wound caused by thermal, electrical, chemical or radiation.[1,2] Flaps are important part of reconstruction ladder for wounds and defects following trauma, surgery and infection. Flap necrosis is a common complication encountered and an important cause of prolonging the hospital stay and morbidity. Stem cell therapy is a novel technique to improve angiogenesis in flaps by secretion of endothelial growth factors and other angiogenic cytokines. Autologous Bone Marrow Aspiration Therapy (ABMAT) is a source of stem cells derived from bone marrow and is supposed to improve flap survival by increasing cell proliferation and vascularization as well as by reducing inflammation and increasing fibroblastic activity. This article highlights the role of Autologous Bone Marrow Aspiration Therapy in prevention of flap necrosis in electrical burns.

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MATERIALS AND METHODS

This study was conducted in a tertiary care hospital after obtaining approval from department scientific and ethical committee. This is a prospective, descriptive, observational case study. Informed consent was obtained from the patient. This case report is about a 45 year old

male who sustained electrical burn injury by 220 volts alternating current to the vertex region of the scalp (entry zone) and the left leg (exit zone). The patient was disoriented and unconscious at the time of admission with a Glasgow score of 12 and was intubated. Multiple second-degree superficial burns were present over the face, neck, chest and anterior aspect of abdomen, bilateral arms, bilateral thighs and second-degree deep burns involving frontoparietal region of scalp at the vertex (Fig. 1). CT skull showed small ill-defined hypodense area with loss of grey white differentiation noted in the left frontal region suggestive of left frontal infarct. He was resuscitated with the standard WHO burn protocol. Serum electrolytes, urea and creatinine, urine analysis, and electrocardiogram were normal, urine myoglobin negative. Patient was asymptomatic with no seizures, syncope, focal neurological deficits. He was managed conservatively with prophylactic antiepileptic Phenytoin. The patient was extubated after three days of intensive care. According to the manual muscle test, both upper and lower extremities were normal. Sensory function was intact, muscle stretch reflexes were normoactive, no pathological reflexes were identified, and all the other cranial nerve and cerebellar functions were normal. Debridement of scalp wound was done after demarcation of necrotic patch. Non-viable necrotic tissue was debrided without damaging the normal tissues in both horizontal and vertical planes with dermabrader (Fig. 2). After debridement, regenerative therapies like biological human amniotic membrane, collagen scaffold dressing, Low level laser therapy, Negative pressure wound therapy was done to enhance granulation over the scalp bone and wound bed preparation was done (Fig. 3). Once the wound bed showed healthy granulation, perforator based type 4 keystone flap was done.

Fig. 1: Scalp electrical burn wound at presentation

Fig. 2: Post dermabrasion assisted debridement till the appearance of bleeding points

Fig. 3: Well granulated electrical burn scalp wound

The bone marrow was aspirated from the iliac crest (Fig. 4) and the Autologous Bone Marrow Aspirate cells was injected into the edges of the flap (Fig. 5) followed by flap was inserted into the edges of the defect. (Fig. 6)

RESULTS

There was good take of type 4 perforator based keystone flap and no necrosis of the edges of the flap

present. No complications were noted. Postoperative day 7, there was no necrosis in the flap (Fig. 7). The Autologous Bone Marrow Aspiration Therapy was helpful in preventing flap necrosis and good flap take.

Fig. 4: Autologous bone marrow aspirationfrom iliac crest

Fig. 5: Administration of Autologous Bone Marrow Aspiration Therapy (ABMAT) to the edges of the flap

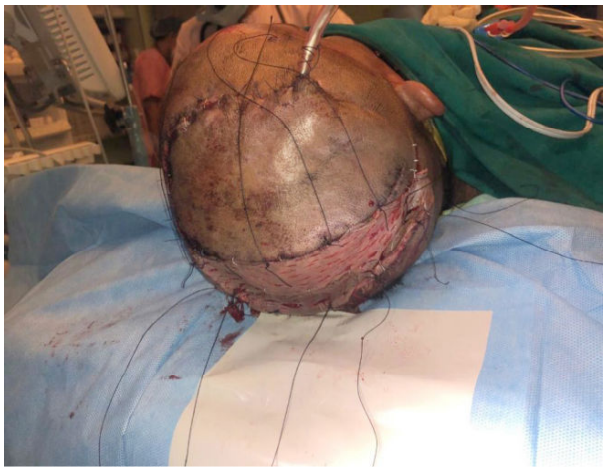

Fig. 6: Keystone perforator flap POD 1

Fig. 7: POD 7 Keystone perforator flap

DISCUSSION

Flaps are important in covering defects caused by trauma, tumour excision, lower limb vascular ulcer, or diabetes mellitus.[3] One of the most frequent postoperative consequences for flaps is distal flap necrosis, which increases morbidity, necessitates a longer hospital stay, and necessitates additional surgery. Insufficient blood perfusion, venous return abnormality, and ischemia reperfusion damage are the main causes of flap necrosis. To avoid necrosis of flaps, local neovascularization must be enhanced and the blood supply to ischemic tissues must be increased.[4] In skin flaps, angiogenesis is a complex process that requires the cooperation of several cells and cytokines. Inhibiting apoptosis, reducing oxidative stress, and using vasodilators are a few recent prevention methods for flap necrosis. Because of their extraordinary capacity for self-renewal and cell differentiation, stem cells play a crucial role in preventing ischemia damage to tissue. Thus, flap necrosis may be avoided by the application of cell therapy.[5,6] One of the most current therapeutic approaches for the treatment of wounds is autologous bone marrow aspiration therapy. Re-epithelization, angiogenesis, and immunomodulation are all impacted by it. Autologous Bone Marrow Aspiration Therapy (ABMAT) is the mechanical or enzymatic processing of aspirated bone marrow to produce a diverse mixture of adipose derived stem cells, macrophages, different blood types, fibroblasts, smooth muscle cells, and vascular endothelial progenitors.[7] The use of autologous bone marrow aspiration therapy in regenerative cell therapy for wound healing, skeletal regeneration, cardiovascular and peripheral vascular disorders, and tissue engineering has

been shown in numerous clinical trials to be both safe and effective. Postmastectomy breast reconstruction, cosmetic breast augmentation, facial remodelling, scar and deformity correction, and lipoatrophy treatment are common operations where autologous bone marrow aspirate cells have been employed.[10] Large defect covering with flaps is a crucial surgical procedure, and flap necrosis is a frequent postoperative consequence. Flap failure is frequently brought on by tissue ischemia brought on by inadequate blood flow.[8] Because stem cells can self-renew and differentiate into multiple cell types, there is a chance for early angiogenesis of the skin flap. 6 Human derived stem cells employed in clinical and preclinical trials have recently been found to be safe and effective. While cell based therapy is quickly becoming a common component of wound care, it is rarely utilised in isolation. These cells can be taken out of adipose tissue or bone marrow. Autologous bone marrow derived stem cell utilisation in clinical settings is growing quickly. They are utilised in the treatment of chronic wounds, osteoarthritis, inflammatory bowel disease, aesthetic surgery, myocardial infarction, and bone regeneration. Clearly surviving after transplantation, possessing pluripotency, anti-apoptotic, anti-inflammatory, and pro-angiogenic properties are autologous bone marrow aspirate cells. These cells can differentiate into endothelial cells and release endogenic growth factors, both of which promote greater neovascularization.[9]

This case report aims to present clinical evidence for the efficacy of autologous bone marrow aspiration therapy, a type of stem cell therapy, in avoiding flap necrosis. These cells participate in all three phases of wound healing and have an effect on flap necrosis prevention. Reduces mast cell and myofibroblast levels during the initial stage of wound healing (the inflammatory stage) through immunosuppressive and anti-inflammatory effects, which reduces the active scar formation.[10] The differentiation of adipose derived stem cells and various growth factors present in autologous bone marrow aspirate cells aids in enhanced angiogenesis during the proliferative phase of wound healing. In the maturation phase, chemokines such (TGF: transforming growth factor) beta 3 and matrix metalloproteinases[8] promote collagen remodelling while suppressing excessive collagen synthesis. Growth factors such as platelet derived growth factor (PDGF), insulin like growth factor (IGF), keratinocyte growth factor (KGF), basic fibroblast growth factor (b FGF), and vascular endothelial growth factor [VEGF] are present, which speeds up angiogenesis and enhances flap microcirculation.[12] The main causes of flap necrosis are inadequate perfusion, venous return abnormality, and ischemia reperfusion damage. Flaps are kept from necrotizing by improving local neovascularization and enhancing blood flow to ischemic tissues. In skin flaps, angiogenesis is a complex process that requires the cooperation of several cells and cytokines. Flap necrosis is avoided by using autologous bone marrow aspirate cells because of their capacity to generate endothelial growth factors and trigger angiogenesis.

CONCLUSION

Stem cell based therapy in the form of Autologous Bone Marrow Aspitaion Therapy is effective in preventing flap necrosis. It is hypothesised to do so by promoting early angiogenesis by upregulating VEGF and ultimately improving the survival rate of skin flap. Patient compliance is also improved in addition to reduced morbidity.

Conflicts of interest: None

Authors' contributions: All authors made contributions to the research, is putatively expected to be useful article.

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