REVIEW

JKMS

http://dx.doi.org/10.3346/jkms.2014.29.S3.S167 • J Korean Med Sci 2014; 29: S167-169

Stem Cell and Research in Plastic Surgery

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Received: 12 June 2014
Accepted: 21 July 2014

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Funding: This work was supported by a grant from the National Research Foundation, Ministry of Education, Science, and Technology, Korea (NRF-2012R1A1A2021731).

Regenerative medicine using stem cells has progressed significantly over the last decade. Plastic surgeons historically have used tissues of human being to restore various defect sites and utilized a single cell lines for the tissue regeneration. The cell sources (autologous or allogeneic), cell types (embryonic stem cell or adult stem cell), and source of tissues (bone marrow, muscle, adipose, cartilage, or blood) are very important for stem cell-based tissue coverage. Embryonic stem cells are pluripotent precursors obtained from the inner cell mass of the blastocyst and reported to be used for preventing muscle atrophy after peripheral nerve injury. Multipotent adult stem cells are easily accessed for plastic surgeons during many routine procedures. This article briefly review the current state of overall stem cell research and clinical applications in the plastic surgical field.

Keywords: Stem Cell; Plastic Surgery; Research

INTRODUCTION

The major advantage of stem cell therapy is avoiding potentially harmful surgical procedures and resulting donor-site morbidity. In particular, it can reduce the surgical risk for elderly patients. The skin grafting or flap surgery can be a great loading due to poor general status or for patients. Indications are traumatic skin defect, severe burn, scar, skin ulcer, sore, diabetic foot, etc (1). Stem cell therapy can provide effective treatment modality for the treatment of bony and soft tissue defects like traumatic skin defect and severe burn, non-healing wounds complicated by ischemia like diabetic foor and sore. It also becomes very attractive tool for skin rejuvenation, scar improvement and augmentation of breast. The unwearying rearch work using various stem cells is still ongoing by many plastic surgeons.

STEM CELLS ACCELERATES WOUND HEALING

The art and science of wound healing is complex process involving various interactions among cells, cytokines and extracellular matrices. During the last few decades, various wound healing technologies using stem cells have been developed and some are used in the clinical field. When it comes to the wound healing activities, both bone marrow stem cells (BSCs) and fibroblasts has shown superior healing results by high collagen and growth factor production (2). The angiogenic properties of adipose stem cells (ASCs) could be beneficial in the case of critical limb ischemic wounds. ASCs secrete numerous cytokines increasing macrophage recruitment, fibroblast chemotaxis, enhance collagen production, granulation tissue formation and improve vascularization (3).

STEM CELLS REDUCE SCAR

The mammalian skin does not regenerate spontaneously, the ultimate outcome of mammalian wound healing is scar formation. Scar is characterized morphologically as disorganized collagen deposition. Recently, various scar minimizing technologies have been developed (4). Direct applying a therapeutic number of cells into a target wound is possible, which lead to improved wound healing. The inflammation period in wound healing process is closely associated with the extent of scar formation. ASCs could be a potential therapeutic tool for excessive scarring because they have anti-inflammatory and immunosuppressive effect (5). This method can make more complete and favorable regeneration process that resembles scarless wound healing. In the near future, this ASC-based therapy might be a new therapeutic option for the wound management to enable complete healing without any visible scar formation.

STEM CELLS AND TISSUE ENGINEERING

There have been a lot of integrating clinical research between biologic technology, tissue engineering and plastic surgery (6). Plastic surgeons can get stem cell sources from various tissue in human body. The circulating stem cells, hematopoietic stem

pISSN 1011-8934
eISSN 1598-6357

cells, are potentially unlimited pool of cells, harvested by minimally invasive procedure and has milti-differentiation potentials (7, 8). Mesenchymal stem cells (MSCs) derived from bone marrow and adipose tissue are another useful source. Autologous mesenchymal stem cells with scaffold system have shown improved wound healing. ASCs can be harvested easily from various human body using a lot of liposuction technique. Administration of adequate number of stem cells to the defect may trigger local regeneration and healing process (9). Finding appropriate scaffold for applying this cell-based strategy could be challenge. Scaffold can do functional role as promoting cell adhesion, proliferation, differentiation and preventing the migration of implanted cells (10).

STEM CELLS INCRESE FAT GRAFT SURVIVAL

Aging process involves a number of different degenerative pathways, specially a soft tissue volume loss. Owing to the aged population, a desire to regain youthful looks, minimal-invasive surgery options, the demand for cosmetic procedures has been increasing (11). Fat graft technique is one of the most common anti-aging procedures in plastic surgery. It can help restore defect and augment the soft tissue. Using autologous tissue, there have been no specific side effects caused by immune responses have been reported. However, simply grafted fat can be absorbed anytime, and the absorption level is very difficult to anticipate (12). The survival rate of aspirated fat can be increased using cell-assisted lipotransfer (CAL). CAL is a technique that combines concentrated ASCs with aspirated fat to make ASC-rich fat grafts (13). This approach allows for marked survival rate improvements implanted fat and decrease in adverse effects of fibrosis and cyst formation (14). BSCs can make systemic contribution to fat graft survival by new blood vessel sprouting. The bone marrow–derived mesenchymal stem cells (BSC) and circulating progenitor cells, up-regulates vasculogenic growth factor production, and increase the number of new blood vessels formed in the grafted fat leading to improvement of graft survival (15).

STEM CELLS PREVENT ALLOTRANPLANTATION REJECTION

Composite tissue allotransplantation (CTA) could be an ideal solution for the replacement of certain tissue defects after trauma, tumor ablation, congenital anomaly repairs, etc. Recently, several great advances have been made in this field and CTA has gained much popularity as a viable alternative reconstructive option. However, CTA has harmful adverse effects of immunosuppressive agents (16, 17). Stem cells can contribute to establish life-long tolerance after transplantation avoiding immunosuppressant systemic toxicity. Bone marrow transplantation (BMT) combined with immunosuppressive agent protocols have proven to prolong organ transplant survival (18). Bone marrow contains multipotent progenitor cells that can differentiate into various mesenchymal cell types. These cells have been characterized as marrow stromal cells, marrow progenitor cells, or bone marrow mesenchymal stem cells (MSCs). These stem cells can modulate the antiinflammatory cytokine expression and T-cell subsets (19). MSC or ASC infusion in combination with transient immunosuppression can induce immune tolerance, prolong allograft survival and facilitated long-term graft acceptance. (20, 21).

FUTURE PERSPECTIVES

During the last decade, patient's own stem cells has been tested and effectively utilized in the plastic surgical field. Overall, clinical advances using various stem cells suggest a promising future for opening a new cell therapeutic strategy in plastic surgery (22). To make stem cell therapy more established standard treatment, a larger number of upcoming clinical study is necessary. Further research about determining the fate of transplanted cells and numbering of cells required for definitive clinical effects should be followed. The adverse effects of cell transplantation, possibility of tumor growth and long-term results of these cells should also be validated. Good manufacturing practice (GMP) facilities are mandatory for safe collection, testing and cryopreservation of customer's cells (23).

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