

A New Aspect of Application of Allogeneic Biomaterials: Prevention of Scarring in Limb Replantation

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RK Ibragimov and SA Muslimov*

Bashkir State Medical University, Ufa, Russian Federation, Russia

Opinion

It is known that allogeneic decellularized biomaterials after implantation promote tissue restoration after various injuries. But there is another aspect of the use of allogeneic biomaterials - prevention of scarring after limb replantation, based on stimulation of macrophages, increased expression of TNF- α and inhibition of fibrosis development.

At the present, restorative and reconstructive surgery cannot be imagined without the use of various biomaterials. Biomaterials not only improve surgical outcomes but also significantly expand the spectrum of applicable procedures. As early as the second half of the 20th century when they sought to transplant viable tissues, methods for reducing the immune response of the recipient were proposed by preserving tissues in various solutions, deep freezing or lyophilization [1,2]. It was subsequently established that tissues were not viable when using the above methods. However, that fact did not have a significant impact on the surgical outcomes since the transplanted tissue was subjected to gradual lysis and replacement by the newly formed tissue. Seifert KE [3], who substantiated the transplantation of tissues deprived of cells as the main immunogen components, put an end to the discussion that unfolded on this issue. The concept of using cell-free biomaterials as biological scaffolds for constructing the new tissue has emerged.

At the beginning of the 21st century, a strategy of regenerative medicine was formed that involved the use of biomaterials in two aspects: as scaffolds for the formation of a new tissue in vitro for its further implantation into the tissue defect [4,5]. Currently, the use of cell-loaded biomaterials has not yet gone beyond the experimental stage and more than 80 types of acellular materials are approved for clinical practice of restorative surgery in various countries.

The results of the experimental research showed that the application of the dispersed form of allogeneic biomaterial from connective tissue prevents the development of fibrosis and scarring [6]. As is known, any injury as well as surgical incision causes a reaction in the form of inflammation [7]. The outcome of such inflammation is a pronounced fibrosis to varying degrees with scar formation. This also includes the cicatricial-adhesive process, the severity of which significantly affects the result of the surgical procedure, especially during the replantation of the traumatically severed limb. Fibrosis as a universal phenomenon completes such processes as ischemia, infarction, cirrhosis etc. It has been established that the cause of fibrosis is an uncontrolled synthesis of collagen by fibroblasts. The main factor stimulating fibroblast proliferation and collagen synthesis is transforming growth factor- β 1 (TGF- β 1). It was found that tumor necrosis factor- α (TNF- α) suppresses TGF- β 1 expression [8]. As is known, when a tissue defect is filled with allogeneic biomaterial, the

***Corresponding author:** SA Muslimov, Bashkir State Medical University, Ufa, Russian Federation, Russia

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latter is gradually subjected to lysis by matrix metalloproteinases secreted by macrophages and at this point there is a substantial increase in TNF- α expression which appears to result in a relative reduction of TGF- β 1 expression. This relationship between the specified factors is maintained until the complete resorption of the implanted biomaterial particles. It should be noted that such a development of events is observed only with the implantation of allogeneic biomaterial and is not revealed in case of the xenogeneic biomaterial implantation [6]. It is shown that the described pattern of tissue reaction to the introduced allogeneic biomaterial opens broad prospects for treating various diseases in the pathogenesis of which fibrosis and scarring play an important role (hepatic cirrhosis, post-infarction myocardial remodeling etc.). One of the pressing problems in modern surgery is the cicatricial adhesive process after replantation of the traumatically dismembered limb. Experimental studies have shown that after microsurgical replantation, pronounced fibrosis is observed around blood vessels and nerves which clinically manifests itself as blood supply and innervation disorders. The use of the dispersed allogeneic biomaterial applied in powder form to wound surfaces ensures tissue healing after replantation without the formation of rough scars and adhesions [9].

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