Anatomical and Immunohistochemical Variations Regarding the Epidermal Stem Cell among Different Traumatic Fingers of Hands in Iraqi Male Workers

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Abstract

Background: The role of stem cell during the whole life of human constricted into two stages. First stage occurred during prenatal life when stem cell take part in formation of organ in process called embryogenesis. Second stage occurred in postnatal life when these cells contribute in regeneration of damaged or old tissue as repairing or substituting cell in adults.

Patient and Method: 150 male volunteers who work in different industries with traumatic finger of the right or left hand (33 right thumb,25 right middle finger ,22 right little finger,28 left thumb,26 left middle fingers 16 left little finger) were taken on from the Department of surgery, Baghdad Hospital, Baghdad; Iraq from February 2019 to October 2019.

Results: Anatomical results showing that The grip was affected only in case of traumatic thumb. Vimentin rich-stem cells were highly positive in the proximal epidermal areas of traumatic fingers more than the stem cells in the distal areas of the same fingers.

Conclusion: there is a little hope in the near future that the injured or even amputated finger or any part of the body could be replaced by new one made by culturing stem cells in laboratories.

Keyword:- *Anatomical immunohistochemical ,epidermal stem cell, traumatic.*

Introduction

The hands of the human and some apes had significant manual functions in nearly most of human daily manual works. Hand injury without doubt will affect the life style of manual workers as well as affect the social life too. So study of anatomy and histology of the hand will gave the scientists the clue to solve many problems that occurred during hand injury. Any part of the hand which include bone or muscle or nerve will cause tremendous hand dysfunction, therefore the main goal of hand treatment was restoring the main hand functions depend on the knowledge of hand anatomy which represented by griping function [(1).]

In present day, plastic surgeons repair and reconstruct many tissue damage and defect. Technological improvements in plastic surgery department increase the rate of success in repair fingers injuries. Despite the availability of many high centers of hand surgery, permanent hand dysfunction could occurred till now [(2).]

Tissue transplantation being the second choice for limb injures but this part of management need immunosuppressive therapy because there was a chance of tissue rejection [(3,4).]

Another solution for compensate tissue loss was the Cosmetic prostheses in this case, patient couldn't use all

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of his skills in daily manual wok [5]. Therefore, to solve this dilemma, researchers suggest regenerative methods by aid of tissue engineering [6,7,8].

Tissue engineering now consider as a hopeful field that in future can generate and construct limbs, fingers in the clinical laboratories [9].

Salamanders as a good example of urodeles had wondrous ability to substitute any injured or even amputated part in their bodies. Human as example of mammals had no this ability except in prenatal life [10].

In postnatal life, this ability will be limited for some organs like liver or skin [11,12,13].

Ability of substitution of body parts depend on regeneration of stem cells. This kind of cell had major function in keep the biological balance in human body in addition to developing of the body during life [14,15].

The role of stem cell during the whole life of human constricted into two stages. First stage occurred during prenatal life when stem cell take part in formation of organ in process called embryogenesis. Second stage occurred in postnatal life when these cells contribute in regeneration of damaged or old tissue as repairing or substituting cell in adults [16].

Patients and Methods

150 male volunteers who work in different industries with traumatic finger of the right or left hand (33 right thumb,25 right middle finger ,22 right little finger,28 left thumb,26 left middle fingers 16 left little finger) were taken on from the Department of surgery, Baghdad Hospital, Baghdad; Iraq from February 2019 to October 2019. Their age and jobs were recorded. Age of the male volunteers rounded between 20 to 38.

They didn't complain from any dermatological or systemic diseases. Skin specimens was obtained under local anesthesia by making superficial surgical excision of an epidermal graft from distal and proximal areas (proximal area which was near the traumatic area of finger and the distal which was far from traumatic area of the finger), fixed in 40% formalin and as soon as possible embedded in paraffin section. Histochemical staining were performed in the laboratory of department of anatomy in the medical college of Baghdad university on skin samples.

After immersion of all samples throughout the night in a fixative with 3.5% paraformaldehyde in saline solution. Samples dehydrated in ethanol toward xylene successions then embedding was made as a paraffin wax.

Staining by aid of a streptavidin -biotin technique. Sections with thickness about 2 to 5 mm sliced and putted on positive charged - slides. At last all of the sections were stained for vimentin and putted in autoclave for 13 min.

Treatment of sections with 6% H2O2 mixed with methanol for 12 minutes . Again incubation was done all over the night at degree of about 50 C with diluted anti-vimentin antibody (Bio Connect ,USA).

The positive cell mean that vimentin protein was appear in the cell as brown color and , the negative cell means that the stem cell had no vimentin which appear blue in color. The vimentin protein found in cytoskeleton of stem cell cytoplasm, so the cytoplasm appear as brown [17]

Estimation with light microscope at X10,X20,X40 and X100 was done in optimal conditions . Recording of percentage scores were based on the amount of positive signals tacked by the protein .Counting of cell depend score categories: Score(1)=1-25% , Score(2)=26-50%, Score(3)>50% [18].

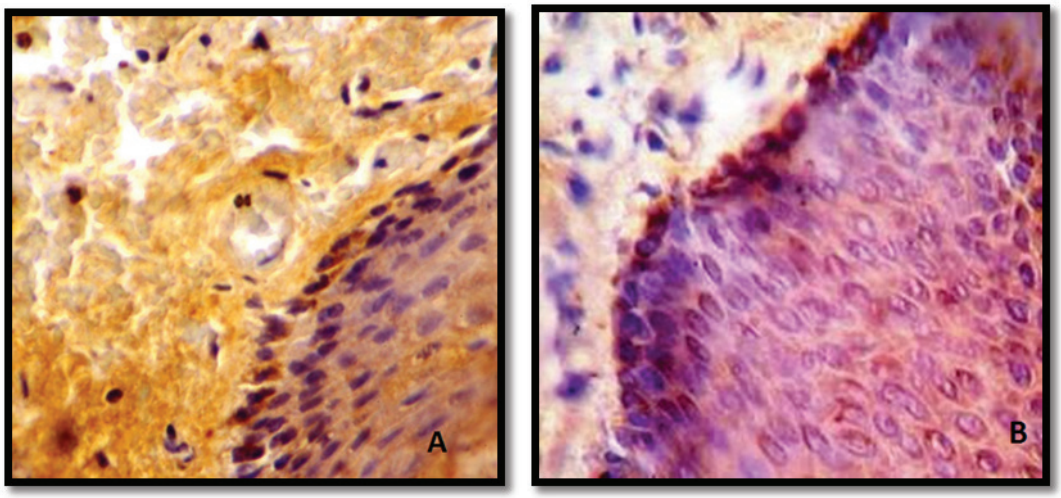
Result

Anatomical results showing that The grip was affected only in case of traumatic thumb which represent the highest percentage among cases while other fingers not showing any affect even if they were injured all regardless which type of finger was injured .

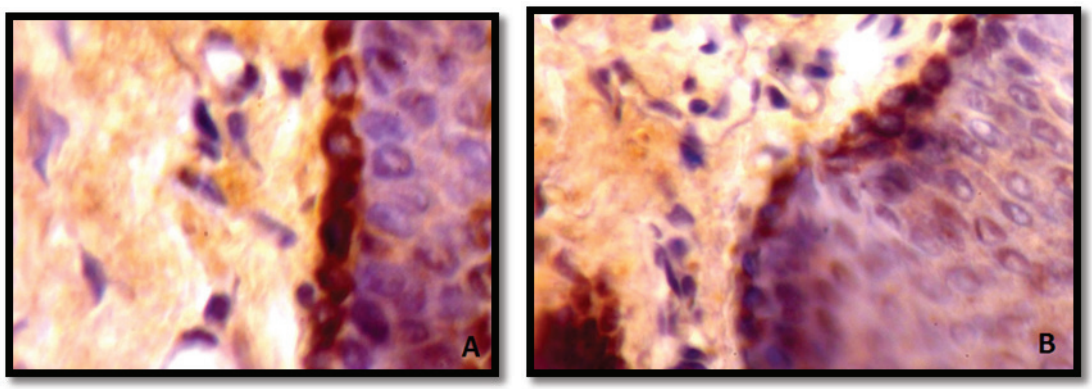
Histochemical results showing that vimentin, the cytoskeleton marker of skin stem cells was detected in this study in order to recognized the stem cell which contained this protein . As appeared during the laboratory work ,vimentin staining was clear in the basal layer as showed in table (1) and figures (1,2and 3). Vimentin rich-stem cells were highly positive in the proximal epidermal areas of traumatic fingers more than the stem cells in the distal areas of the same fingers .Proximal and distal was decided according to the site of injury. Vimentin-histochemical stain clearly showing cytoskeleton staining. No differences were appeared regarding the side of limb(right or left) , age and the type of fingers between the samples of volunteers.

Table(1): Number of stem cell in different type of fingers injury.

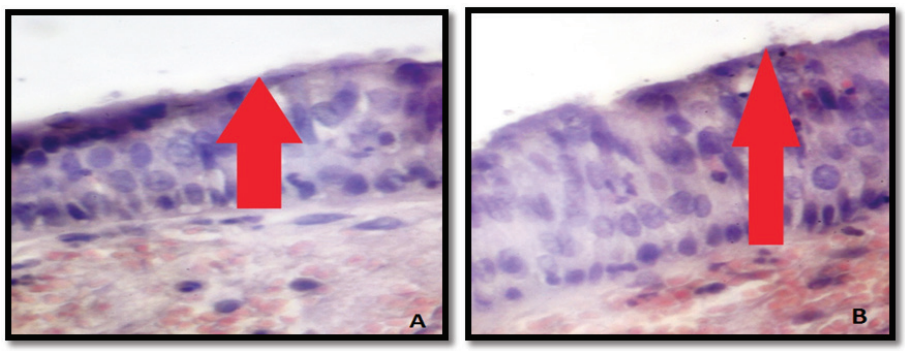
Type of finger	Number of stem cell				Total
	Proximal	%	Distal	%	
Thumb (Rt. &Lt.)	48	79%	13	21%	61
Middle finger(Rt. &Lt.)	41	80%	10	20%	51
Little finger(Rt. &Lt.)	29	76%	9	23%	38
Total	118	79%	32	21%	150



Figure(1): Epidermal layer of injured middle finger in proximal (A) and distal (B) areas X20.



Figure(2): Epidermal layer of injured thumb showing basal stem cell in proximal (A) and distal (B) areas. X100.



Figure(3): Epidermal layer of injured thumb showing the thickness of epidermal layer in proximal (A) and distal (B) areas. X40.

Discussion

In the hand of the human, thumb is consider as the most significant part. Significances of thumb came from its important role in a grip.

First anatomist called Napier in 1956 was interested in understanding the mechanism of grips. Napier was tried to understand the biomechanical anatomy of the hand in order to increase his knowledge more about compensation of hand injuries. This anatomist divided the grips into two types, precision and power grip. Power grip done by using the fingers, thumb as well as the palm together like grip the hammer. The precision grip done by using only the distal parts of thumb and fingers like writing with a pen [19].

Clearly, there was no doubt that the thumb had the major role in control the function of griping in both types. Therefore, any kind of trauma to the thumb which may complicated or not or sometimes leading to amputation of thumb will lead to dysfunction of this vital and significant part of the hand [20,21]

Traumatic injuries to the hand increased with increasing the age with frequency ranged from 2nd to fifth decade. Controversially, some epidemiologists conveyed that most of the trauma occurred during the early decades of life (2nd to 4th decades)who works manually in factories [22].

Other epidemiologists believed that the higher risk was founded in the late decades(6th to 8th decades) [23].

All of these decades from 2nd to 8th were workers while, in non-worker people also observed high risk of hand trauma among children and aging people[24] .

In worker group, 60% of them worked in industries or farms [25]. Boyle et al , Onuba and and Stanbury et al agree with this percentage [26,27,28] .

In non-worker group most of causes of trauma were by car or motor vehicle accident (24%) [29, 24].

Many trials in the last decades try to minimize or even terminate the dysfunction or paralysis of fingers especially the thumb that result from trauma to the hand or any part of the body. This was done by made many public programs all over the world for education of the people who works in farms or factories by making them aware about the most precautions that help them to be save during the time of work [25].

The usual period of epidermal turnover was nearly (311 hour more or less)depend on optimal conditions. Mitosis of cells usually happened by stem cells located in the most basal part of epithelial layer of skin. Usually in most of cases the stem cells had a growth rate which might consider as slow rate , in addition to their capacity to made different type of cells (differentiation processes) [30,31,32].

The aim of existing such type of stem cell was to make balance between the lost and newly formed cells as a compensatory mechanisms to maintain the layers of skin within usual manner in case of injury to tissues. So, it's very important for the scientists to look for the good conditions and optimal mechanisms that may help in developing or even accelerate the proliferation and differentiation of his kind of cells after creating a simple and good manner to isolate these cells in laboratories[33].

Franssen et al, suggested different type of markers that may be useful in detecting the stem cell in their tissues.one of these markers was the vimentin [34].

In spite of the huge and tremendous development in different branches that have to do with detection and isolation of stem cells ,working in such branches carry many and unexpected difficulties [35]

Unfortunately, regeneration in case of amputated finger was restricted only in distal part rather than proximal and some experiment done on mice showing that complete regeneration not happen if the percentage of remaining proximal tissue was less than 60% after amputation [36].

Many studies demonstrate that regeneration came after period of healing injury by aid of epidermal stem cells [37].

The motivation of fibroblastic and neural cells in remaining parts also had significant role in regeneration of smooth muscle, blood vessel and nerves [38].

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