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Biomedical Sciences

Tears shedding may be adapted to heal physical and psychological hurting in man

M Irfan[1]*, H Nawaz[2], M Inam[3]

Abstract

Introduction

In addition to human many other animal species shed tears. Theories suggest that tears serve as a pain response, sympathies gainer and nonverbal communicator as pheromones, stress and toxin releaser and way of expression of sudden intense emotions. However, these theories remained partially acceptable and the question is still alive that why do we shed tears on mental or physical injuries? Basal tears for lubrication of eyes, nostril damping and eye protection are acceptable, but shedding emotional tears seems to be a mere wastage of useful proteins, lipids and electrolytes.

The Hypothesis

We gave hypotheses about the usefulness of the tear shedding adaptation in man, where tears shedding are to heal the physical injury as they contain antimicrobial, tissue healers and analgesic products and the components of tears must be reflected in high concentration in nervous system and somatic systems on psychological hurting; therefore tear may act as mental healer.

Evaluation of Hypothesis

To assess antimicrobial activity, the diameters of zones of inhibition by human emotional tears applied on bacterial cultures and a broad spectrum antibiotic (positive control) will be measured and compared. Skin wounds of equal thickness and deepness will be created on the back of animals. Microscopic morphological characteristics of wound healing will be compared in wounds treated with tears (experimental) and sterile saline (control) groups. Moreover, pain will be assessed and compared in control and experimental animals. Protein analysis will be done in tears and cerebrospinal fluid and comparison will be done between quantities of tears specific protein in tears and cerebrospinal fluid. Tears being antimicrobial, tissue healer and analgesic may have some usefulness and tear shedding may be a useful adaptation in man.

Conclusion

Basal tears are for lubrication of the eyes, nostril damping and eye protection are acceptable, but shedding emotional tears seems to be a mere wastage of useful proteins, lipids and electrolytes. Moreover, tears contain antimicrobial and tissue healing agents. Therefore, tears shedding may be adapted to heal physical as well as psychological injuries.

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Introduction

The tear film serves to lubricate, nourishes the corneal epithelium and provides the regulatory factors, such as hormones, growth factors, cytokines and reciprocal receptors for maintaining and repairing the epithelium[1–3]. Epidermal growth factor (EGF) and interleukin 6 (IL6) present in tears help in corneal epithelial cell migration, proliferation and differentiation[4,5].

In addition to human many other animal species are reported to shed tears. A number of theories have been proposed about the evolution and usefulness of crying and tear shedding. Theories suggest that tears serve as a pain response, sympathies gainer, nonverbal communicator as pheromones, stress and toxin releaser and way of expression of sudden intense emotions[6–9]. It is suggested that the process of weeping reduces breathing rate to shed the stress along with tears[10]. According to Darwin, function of tears is to lubricate the surface of the eye, and keep the nostrils damp to moisten the inhaled air and increase power of smelling. Tears also serve to wash out particles of dust or other minute objects which may get into the eyes[11]. However, these theories remained partially acceptable and the question still remains: Why do we shed tears on getting mental or physical injuries?

Human tear composition

Tear is composed of three main layers, that is, an outer lipid layer, a mucin layer and a soluble protein layer[12]. Lipids provide a microbial barrier, prevent evaporation and lubrication. Some functional lipids such as sterols are also found[13]. Mucins stabilise tear film, and also plays a major lubrication function[14–16]. The aqueous layer of the tear film comprises electrolytes (sodium, potassium, magnesium, calcium, chloride, bicarbonate and phosphate ions), protein enzymes and metabolites, such as peptide growth factors, vitamins, antimicrobials, cytokines, immunoglobulins and hormones[17–19]. Electrolytes are responsible for maintaining osmolality, pH and epithelial integrity. More than 60 proteins have been isolated from human tears predominantly lysozyme, lactoferrin,

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lipocalin, serum albumin, immunoglobulin, ceruloplasmin, transferrin, monomeric IgA and growth factors (Epidermal growth factor-EGF, hepatocyte growth factor-HGF, transforming growth factor beta-TGF β)[20–25]. Immunoglobulin found in tears is found to be more effective than the systemically produced antibodies[26–29]. Lactoferrin and lysozyme are known to inhibit bacterial multiplication[29,30].

The Hypothesis

Basal tears for the lubrication of eyes, nostril damping and eye protection are acceptable, but shedding emotional tears seems to be a mere wastage of such important proteins and electrolytes. Therefore, we set up hypotheses about the usefulness of the tears shedding adaptation in man.

Hypothesis 1

Tears help to heal the physical injury as they contain antimicrobial, tissue healer and analgesic products (Figure 1).

Hypothesis 2

The components of tears must be reflected in high concentration in the nervous system and somatic systems on psychological hurting, therefore tears may act as a mental healer.

Evaluation of Hypothesis

Testing of hypothesis 1

Tear collection

Tears will be collected, with the permission of medical personals, from injured humans visiting the emergency department of hospitals with no general or eyes infections and other diseases. Prior consent will be obtained from all subjects and the nature of all procedures will be explained to them. The collectors will be highly trained in tear collection techniques. Tear samples will be collected using flame-polished borosilicate glass micropipettes avoiding reflex by ocular surface contact.

Evaluation of antimicrobial activity

Bacterial strains isolated from the human wounds will be cultured into nine Petri plates by using specific media. Human tears will be applied on bacterial culture in three plates serving as experimental units, and in three plates only a broad spectrum antibiotic will be applied to use them as positive control. However, the remaining three plates serving as negative control will be left without any treatment. The tears and antibiotics will be applied through paper discs. The diameter of inhibition zone will be measured in millimetre and compared by using student's t-test.

Evaluation of tissue healing activity

Ten animal models of same age and weight (rabbits or laboratory rats) will be used in this experiment. Six skin wounds of equal thickness and deepness will be created on the back of each animal. Three wounds, serving as an experimental unit, on each animal will be treated topically with tears and the remaining three, serving as control will be treated with sterile saline. Wounds will be assessed by wound measurements and collection of samples at specific time intervals post-treatment to evaluate the healing process. Gross morphological characteristics reflecting wound healing will be compared in experimental and control groups.

Evaluation of analgesic effects

Ten animal models of same age and weight (rabbits or laboratory rats) will be used in this experiment. Skin wounds of equal thickness and deepness will be created on the back of animals. Wounds of five animals,

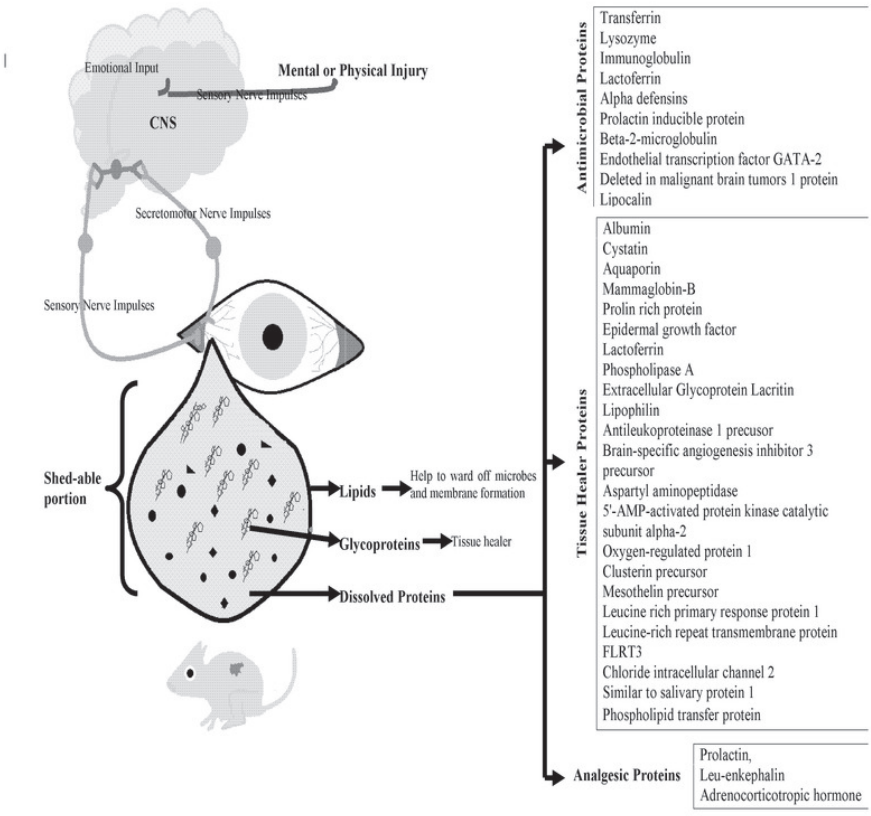

Figure 1: Application of tears in tissue healing[31–33].

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serving as an experimental unit, will be treated topically with tears and wounds on the remaining five animals, serving as a control will be treated topically with sterile saline. Pain will be assessed and compared in control and experimental animals at specific time intervals post-treatment to evaluate the healing process.

Testing of hypothesis 2

People mourning on the death of their relatives in the emergency department of hospitals will be approached. Tears of these participants will be collected by using the method stated in 'Tear collection' section. Cerebrospinal fluid of these participants will be aspirated by a lumbar puncture.

Evaluation

Protein analysis will be done in tears, blood and saliva by using standard protocol to find out quantities of tears-specific proteins and correlate with their tears.

Implication of hypotheses

Tears being antimicrobial, tissue healer and analgesic may have some usefulness in them and tear shedding may be a useful adaptation in man.

Discussion

The human tear is composed of lipids, mucin and soluble proteins. A number of electrolytes, functional lipids and proteins have been isolated from the human tears. These proteins and lipids include antimicrobial and tissue healers[12-20]. It is believed that tears shedding are a pain response, sympathies gainer, nonverbal communicator as pheromones, stress and toxin releaser and way of expression of sudden intense emotions[6–10]. Moreover, function of tears is to lubricate the surface of the eye, and keep the nostrils damp to moisten the inhaled air and increase power of smelling. Tears also serve to wash out particles of dust or other minute objects which may get into the eyes[11]. However, these theories are acceptable for basal tears, but shedding emotional tears seems to be a mere wastage of useful proteins and electrolytes and the question still remains: Why do we shed tears on getting mental or physical injuries?

Conclusion

Basal tears are for lubrication of the eyes, nostril damping and eye protection are acceptable, but shedding emotional tears seems to be a mere wastage of useful proteins, lipids and electrolytes. Moreover, tears contain antimicrobial and tissue healing agents. Therefore, tears shedding may be adapted to heal physical as well as psychological injuries.

Abbreviation list

EGF, epidermal growth factor;
HGF, hepatocyte growth factor;
IL6, interleukin 6;
TGF β, transforming growth factor beta.

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