STRESS

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Abstract. *A critical approach of stress was done based on literature emphasizing on the main aspects of interest. The stress has been appeared with life being a living attribute. Without stress neither the life nor the evolution would exist. This is the stress, good or worse, always present and necessary.*

Key words: stress, stressor, adaptation, emergency

1.Introduction

The expression *stress* appeared together with the introduction in human medicine of biochemical profile. This happened once with the passage from clinician physicians (that often used classical semiological methods to establish diagnosis) to doctors that use numerous preclinical investigations (offered by modern techniques). Nonspecific reactions of every living individual determine researchers to recompose and study the organism in its complexity. There are studies that are interested of the complex relations and interrelations that make the organism to be a perfect cybernetic system.

2.Materials and Methods

The paper is based on the literature in the field and approached in a critical manner various aspects regarding stress along the time. Analysis, synthesis, comparison were the main methods used in order to set up this paper.

3.Results and Discussions

In 1911, Cannon and De La Paz noticed the increase of adrenalin in the blood of a cat frightened by dog. These changes allow some physiological adjustments as a sudden reaction to the specific danger, such as to run or fight. The authors named this physiological stage *emergency reaction*. In 1935, Cannon highlights the existence of some limits regarding the compensation possibilities (in intensity and time) of the body to critical stress [after 1].

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During 1935-1936, Selye provide a new dimension of this body adaptation phenomenon for changed conditions. The author describe that various excitation determine identical reactions, which was named by the author as general adaptation syndrome [8].

Gradually the study of stress has been provided two directions: investigations regarding physiological response of the stressed organism, and assessments over physiological response. The studies over physiological response focused on adrenal gland reaction, thymic/lymphatic atrophy and acute gastroduodenal ulcer. The physic part has been studied by the way of interpretation of the nervous system to a large variety of environmental events.

The term *stress* entered into biomedical vocabulary relatively fast following its mention by H. Selye (despite the fact of having variable connotations) [8].

The syndrome translated by stereotype response of the organism to various injurious factors was named the *general syndrome of adaptation* (GSA) or *biological syndrome of stress* [8].

Accepting the limits of a classification that might allow the understanding of the complex phenomenon occurring in an organism exposed to stress, there are two main stress factors: (a) stressors that act and generate the reaction of all body (stressors capable to induce GSA) and (b) stressors that act locally and induce local reaction (stressors able to produce *local adaptation syndrome* - LAS). The two factors are interchangeable. In some circumstances and organisms the stressor could trigger GSA, but in some other circumstances the same stressor might determine LSA. The LSA should be considered as a limited reaction of a tissue or organ without involvement of all the body (missing neurohormonal reaction like the GSA). It is considered that LSA might evolve without changing in GSA. In the first stage the body tries to balance using local possibilities. Some local low to moderate intensity reactions or necrosis may occur. These local reactions are often associated with cellular hypertrophy and hyperplasia, and with a local hormonal response produced by *diffuse endocrine system* (DES). DES includes endocrine cells spread in the body having the ability to elaborate polypeptide hormones and biogenic amines. Paracrine phenomenon represents the action of the synthesized hormone on target cell (e.g., serotonin synthesized by DES act on smooth muscle fibers from vascular wall) [6]. Another modality of local action of DES is by distribution of local synthesized hormone to neighboring cells by fine cytoplasm prolongations (direct inoculation in targeted cells) [7].

In this way LSA beneficiate of a complex local response (involving local structures, such as: nervous endings, local vascularization, local cells and DES secretions). It is known that tumor proliferations of DES cells determine over-secretion of active hormone-like products such as: ACTH-like molecules, serotonin, and hormonal polypeptides having neuroendocryne activities.

Over the action of minimal stressors (that have a local action and effect) it is generated the "awareness" of local structures. This is retained in the "tissular memory" that will generate an overreaction to subsequent exposure to stress.
Individual peculiarities have a high impact on the reaction induced by stressor. In similar conditions, the stressor in some people leads to homeostasis equilibration but in some others might determine exhaustion or even shock.
It is hardly accepted how various stressors (cold, heat, transport, pain, joy etc.) might induce identical biological reactions and to generate nonspecific body response. It was proved that nonspecific reactions are common to various stressors. Nonspecific reaction is the first response of the body to stressor. This might be followed by specific reactions. Nonspecific response represents the key-point of all reaction system that receipt and respond immediately. It tries and almost always succeeds to reestablish the homeostasis (using nonspecific reactions that are established without using some specialized structures). If the response (of nonspecific adaptation) is not enough to re-establish homeostasis than other systems might be affected in order to provide an appropriated response. The key-point of the homeostasis equilibrium (by its neuro- and hormonal-regulation) has the property to request selectively the most specialized system capable to react.
Nonspecific response of the body to stressor should be understood as a protection and defense phenomenon of the vital body functions (respiration, cardiac, digestive, nervous activities). The nonspecific reaction runs freely during background vital functions of the body.
The time-evolution of the living beings and their preserving and perpetuation reactions have been selected and improved over time (in order to maintain and perpetuate the life).
Excessive demands determine the involvement of the tools that provide a specific response. Also, some vital functions might be disturbed or deviated. The balance of body functions can't exceed the innate limits. Deviations of the physiologic records will be always framed in order to allow the maintenance of body functions. The homeostasis is cybernetically regulated and interdependent with all vital body functions in order to survive. Excessive demands induce responses that excess the control leading to the loss of vital functions.
The possibility to assess the body stress (i.e. the certain diagnosis of the adaptation effort during stress) was controversial. The research tried to establish some criteria and to offer methods and efficient tools.
The main criteria used to appreciate the activation degree of adrenal glands [5] are the following: (1) *direct criteria* – plasmatic proportion of ACTH (radioimmunological method); the plasmatic proportion of glucocorticoids (colorimetric, fluorometric and isotopic methods); (2) *indirect criteria* – glycemia, eosinopenia, adrenal glands weight, adrenal cholesterol decline, gastric ulcer.

Indirect criteria rely on hyperglycemia and sanguine changes (leucocytosis with neutrophilia, relative lymphocytopenia and eosinopenia), or variation of the white cells in the milk of lactating cows. The used morphological criteria could be mentioned: the increasement of adrenal glands weight and hypertrophy of the *zona fasciculata*, diminishment of the content of cholesterol and ascorbic acid in adrenal glands. Except the already mentioned aspects there could be mentioned the thymic involution, and diminishment of the Bursa of Fabricius in young animals, diminishment of lymphoid organs (spleen, lymph nodes), and some histological changes of the hypophysis and thyroid.

The first reaction of an animal to stress is by adopting fight or run attitude (i.e. the emergency reaction described by Cannon). The animal may try to counter the potential or imminent danger. When the fight or run response is unsuccessful, the brain initiate the nonspecific response to stress represented by the general syndrome of adaptation.

There were attempts trying to classify the stressors. A suggestive enumeration of stressors includes physical, biological and emotional, ecological, ethological and technological factors.

Dantzer and Mormede (1979) describe three categories of stressors: interactions with other animals (social stress), human-animal interactions (animal manipulation) and interactions between animal and physical environment. As any other classification this do not includes the interference that might occur between these categories that could aggravate the pathological state [5].

The intensive method of animals' growth has been created some stressors. It seems that both animals and humans are not prepared to support without any consequences the passage from biological to technical rhythm (i.e. from natural to artificial environment). Knowing the environment of modern breeders, some authors attract attention over the moral aspect (that is often neglected) and can't justify the attitude of humans over animals [5].

Simultaneous or successive action of some stressors causes pathogenic effects in avalanche. In such situation the stressors determine *over-sensitivity* in the body. There have been observed situations of *over-resistance* that might appear during or immediately after alarm reaction, which manifest during the action of another injurious factor. Body over-sensitivity or over-resistance following exposure to a new stressor proved to be determined by releasement of pituitary and adrenal hormones. Over-sensitivity or over-resistance is related with the exposure period and intensity of the stressor, and with individual peculiarities (age, genetic base, susceptibility of the specie etc).

There are some viruses that remain for a long period into the cell without expressing their presence. Over the action of some factors these viruses become pathogenic. The loss of cell-virus balance could be due to some stressors that trigger a local syndrome of adaptation in the cell. During the non-specific reaction

(by local syndrome of adaptation) the cell elaborates metabolites that change the virus status from latent to pathogen. Limited knowledge is known concerning the response of various cell types to stress. This interpretation open new research perspectives; this could elucidate some aspects about the macro-organism – pathogenic agent interrelation. Data convergence proves the necessity to complete physiopathological and etiopathogenic concept of diseases.

The diseases could be classified (depending of the stressor intervention) as follow: diseases produced by the stress; diseases conditioned by stress or stressors; diseases where the stress intervenes as aggravating factor; diseases that are not influenced by the stress.

The understanding of the stress implies a wide view, a modern biological concept adequate for actual knowledge. The stress should be understood as a biological concept, as a property of living, in which some actions over the body trigger a reaction.

The biological concept is a group of interconnected elements that interact. All living systems are open and permanently have exchanges with the environment (e.g., substances, energy and information). The open system has a permanent dynamic balance. The life could be also considered a continuous alternation around an equilibrium point [4]. The most complex cybernetic adjustment is represented by living organism. It has some large possibilities to create regulation boundaries using the feed-back mechanism, thus preserving life. The cybernetic has unimaginable development in our days but the science seems to forget the source of this science that is the body physiology. The literature feels the scarcity of papers studying biological adjustments of the body.

The nervous system has the role to decode information in order to integrate the organism in the environment and to select impulses related with physiological state of the body. The stress belongs to the daily experience of the organism, enriching it with some new reactions to future stimuli. The incapacity of the body to establish informational exchanges and to react is defined as death. By its genetic code each body possess an informational model (some specific structural and functional schemes) which has accounted and codified the experience of previous generations. The life cannot exist without a permanent stimulation but when stressors overwhelm (by number and intensity) the reaction possibilities of the body than the disease is likely to occur.

The stress become pathological when overwhelms the response capacity of the body determining some diseases (i.e. inducing some new connections in the body). The body reacts to some over-demands as such, implying initially the relation functions, nervous system, and endocrine system; afterwards involve the rest of the organs and systems.

The central nervous system (under the stressor actions) has two types of biological adjustments: the mechanism of *run and fight*, conservative hyperemotional

reaction, which modify all the energetic potential to *escape* the aggressor; the shock mechanism, a vegetative effort to maintain the threatened homeostasis, mobilizing the potential to re-equilibrate damaged internal functions during aggression. Both mechanisms are compensatory (having a common mechanism) implying catecholamines. Glucocorticoids are the fight hormones and mineralocorticoids are considered restoration hormones [3].

Intensive breeding realized few for animals, always the main target having an economical background. The intensive breeding has been interested by the prevention of infectious diseases. There was a sudden passage to intensive breeding without having adapted animals. If animals raised in large spaces having many possibilities (i.e., opportunity to move and access to the sun in small groups, always in the same shelter, long economical life, a kind caretaker), would be transferred to restrictive spaces (i.e., having a limited possibility of movement, large and permanently changed groups, with successive passages through new technologized spaces - feeding, watering, and an intense economical life) represents permanent technological stressors. These industrial conditions generate stress, the nonspecific injurious factors having a huge involvement in the pathogenesis of several diseases. The animals are raised industrially without having enough knowledge about them. A number of shortcomings (due to ignorance) have been noticed only when animals were merged in large units. The studies involving pathological behavior came to the attention of the researchers when occurred in intensive breeding.

There should be also mentioned that some stressors can trigger all pathogenic diseases. The establishment of pathogenic diseases etiopathogenesis should be clarified. It was confirmed (and still happening) what C. Bernard affirmed: *the microorganism is nothing, the ground is everything*. In various diseases (including cancer) easily they pass over the *ground* where diseases develop. In humans due to memory, stressful mental states can be relived inducing events and reactions similar with the primary stress. Perhaps we deny easily the existence of similar states in animals.

Mechanic D. (sociology physician) and Holmes T. (psychiatrist) realized a hierarchy of the stress as follow: death of a loved person – 100; divorce – 73; prison – 63; accident or disease – 53; retirement – 43; change of the working place – 36; marital hostility – 35; change of professional responsibilities – 29; change of the life style – 26; change of the working schedule – 20; change of the alimentary custom – 15; change of the life environment – 13.

Conclusions

The stress has been appeared with life being a living attribute. Without stress neither the life nor the evolution would exist. This is the stress, good or worse, always present and necessary.

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