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BRIEF REPORT

The War between the Brain and the Body Caused by Stress

Hasret Balcioglu [1*]

[1] Expert at Microbiology and Immunology, Higher Education Planning, Evaluation, Accreditation and Coordination Council, Cyprus

ABSTRACT

This study supports the idea that stress contributes to the autoimmune diseases. It provides examples from different studies and shows some autoimmune diseases caused by the brain and the body. It is thought that stress affects the musculoskeletal, respiratory, cardiovascular, gastrointestinal, endocrine, nervous, and reproductive systems in a negative way. The human body can handle stress in small doses. If the stress lasts for a long-term period or becomes chronic, significant negative effects are expected to occur in the body. The chemical reaction in the body can also change with the impact of stress. It is not confidently concluded that stress causes the autoimmune diseases but the idea can be strongly encouraged according to the conditions found in and interpreted from the literature.

Keywords: stress, autoimmune diseases, immune system, disorders, inflammation

Correspondence:

Hasret Balcioglu

Address: Expert at Microbiology and Immunology, Higher Education Planning, Evaluation, Accreditation and Coordination Council, Cyprus

Email: hasret.balcioglu@kamu.ct.tr

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INTRODUCTION

It is known that the gut, microbiota–brain axis (**Figure 1**) is very important because it has two-way communication between gut bacteria and the brain [1]. This axis also shows the relationship between the enteric (it is a large division of the peripheral nervous system and can influence the behavior the gastro intestines independently) and the central nervous systems. Gut microbiota interacts with central nervous system by regulating brain chemistry. It also makes an impact on the neuro-endocrine systems accompanied by anxiety and stress.

Stress impacts colonic motor activity in a negative way. For example, it can lower the number of Lactobacillus which are very beneficial to the gut microbiata (Lutgendorff et al., 2008). The health of brain can be improved by changing the types of bacteria found in the gut. There are some specific acids and foods which can improve the health of gut and the relationship between the gut-brain axis such as probiotics, omega-3, Q10, fermented foods (yoghurt, ayran, kefir etc.) and other foods containing polyphenol.

It is also known that immune system is a specialized network of cells and organs. The listed body parts/chemicals defend the body from foreign substances, viruses, bacteria and cancer cells:

1. White blood cells,
2. Antibodies,
3. Bone marrow,
4. Immune hormones,
5. The immune complement system,
6. Spleen,
7. The thymus gland,
8. Lymphatic system.

Whenever the autoimmune disorders start in the human body, special signs appear as signals throughout the body [2,3]. The signals can change according to the type of disorder and the tissue it targets. The possible signals are listed below:

1. Inflammation,
2. Muscle aches,
3. Pain in the joints,
4. Fatigue,
5. Malaise,
6. Abdominal pain,
7. Digestive problems,
8. Fever,
9. Rash,
10. Swallowed glands.

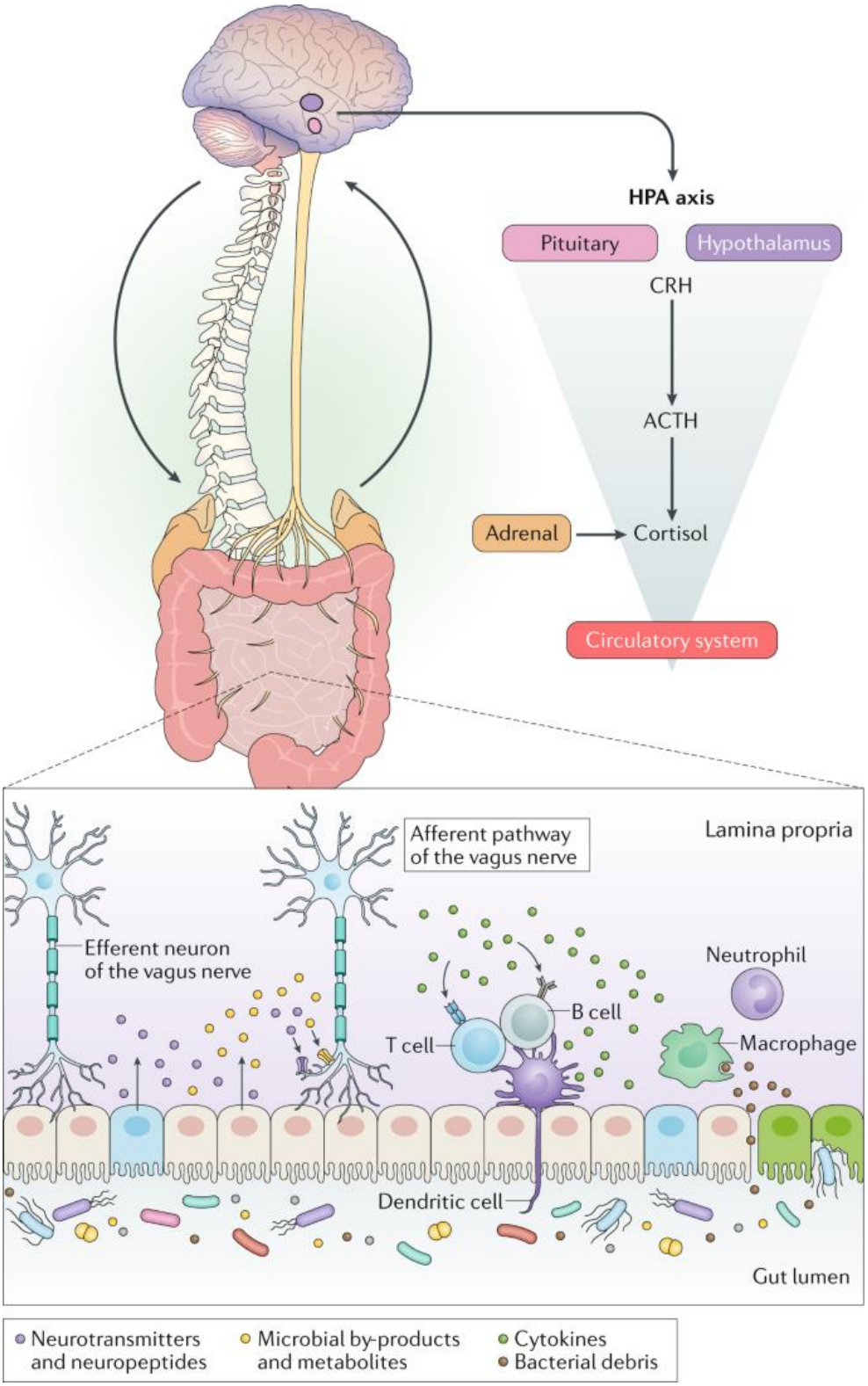

Figure 1. The gut, microbiota–brain axis [4]

For example, in America, 50 million people are affected by autoimmune diseases and it is noticed that nearly 80 percent of them are women. Doctors cannot surely explain why autoimmune diseases occur. Whenever the statistics are discussed, it has been understood that women are more affected than men. The suggested (not proven) reason under this is the higher levels of hormones during some time of women' life [5,6]. Doctors aren't sure why autoimmune disease happens and/or why women are affected more than men. One theory is that higher levels of hormones in women (whenever they are pregnant, they have periods etc.) could make women more open to autoimmune diseases [7]. Women also have more stress than men during their lives, e.g., whenever they raise child while working.

However, [8] notes that this idea has not yet been proven. It is mentioned that there are many factors that affect autoimmunity in genetic and environmental way. Researchers cannot explain why women develop these diseases more than men do in a clear and detailed way.

Whenever this relationship is disturbed especially with the effect of stress [9,10] (this theory is accepted by the author as well), a war starts between the brain and body causing autoimmune diseases. Autoimmune disease is a condition in which the body's immune system regards its own healthy tissues as foreign organisms. As a result, the immune system of the body attacks the healthy organisms and at the end it causes inflammation. The inflammation can affect many parts of the body in a negative way. It can damage the organs, joints and the arteries. If the inflammation cannot be considered properly, it can lead to some of the chronic diseases such as obesity, diabetes, heart disease, blood vessel disease, cancer and Alzheimer's disease.

It is known that stress affects the musculoskeletal, respiratory, cardiovascular, gastrointestinal, endocrine, nervous, and reproductive systems. The human body can handle stress in small doses, but when the stress lasts for a long period of time, it becomes chronic. As a result, significant negative effects are expected to occur in the body. The chemical reaction in the body can also change.

Stress causes physical, psychological and/or emotional tensions in the body. During this condition, the adrenal gland releases adrenaline. As a following situation, adrenaline causes rapid pulse, breathing and/or high blood pressure. It's shown that continuous stress could convert the healthy body to the body with chronic disease or autoimmune disease (**Figure 2**) [11]. [12] has made an observational study in 2020 by showing the relationship

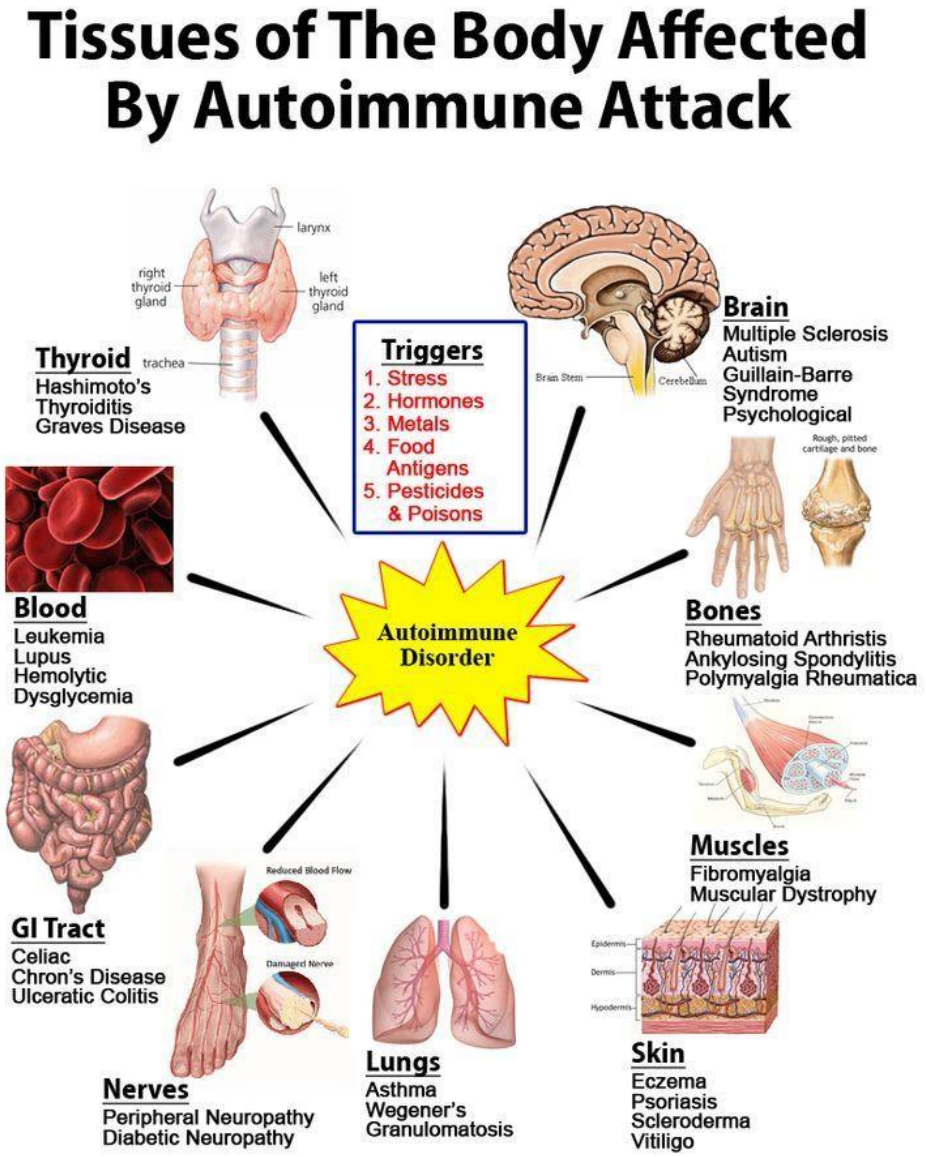

Figure 2. Autoimmune attack on the body tissues [13]

between stress and autoimmune diseases. For this study, 100,000 people with stress-caused disorders have been selected. One year later, the study has made a comparison to see whether they can be affected by the autoimmune disease or not with a similar approach made to their siblings and one million people who don't have any stress-caused disorders. [12] has indicated that people diagnosed with a stress-related disorder have a more tendency to develop autoimmune diseases, multiple autoimmune diseases and autoimmune diseases in younger ages.

It is known that there are generally two categorized autoimmune diseases: 1. Autoimmune Brain Diseases and 2. Autoimmune Body Diseases. These two categories will be explored in the next two sections.

AUTOIMMUNE BRAIN DISEASES

Autoimmune brain diseases are defined as the attacks of the body's immune system to the healthy cells and tissues in the brain or spinal cord. These attacks result in inflammation by causing inflammation impaired functioning (loss of vision, language; weakness of arms or legs; abnormal movements), neurological disorders (decline in performance and more) or psychiatric symptoms such as depression, hallucinations, paranoid, obsession etc.

There are different kinds of autoimmune brain diseases. Some of them are listed below with brief explanations:

1. Autoimmune encephalitis: This disease occurs when the body's immune system attacks healthy brain cells and causes inflammation throughout the brain. As a conclusion, people have various neurologic and/or psychiatric symptoms.
2. Autoimmune-related epilepsy: Autoimmune-related epilepsy is caused by the immune system of the body whenever it attacks to the brain cells and causes seizures throughout the body as a neurological disorder.
3. Central nervous system vasculitis: Central nervous system vasculitis is defined as an inflammation of the small arteries and veins in the brain and/or spinal cord.
4. Cerebral lupus: Cerebral lupus shows itself with the symptoms of headaches, dizziness, vision problems, behavior changes, memory problems, seizures and/or strokes.
5. Hashimoto's encephalopathy: Hashimoto's encephalopathy is characterized by encephalopathy and thyroid autoimmunity.
6. Neuromyelitis optica (Devic's disease): Neuromyelitis optica is a disease condition where the immune system damages the spinal cord and the optic nerves.
7. Neurosarcoidosis: Neurosarcoidosis is a disease that occurs by the inflammation and abnormal cell deposits in any part of the brain, spinal cord or peripheral nerves. It mainly occurs in the cranial and facial nerves, the hypothalamus and the pituitary gland.
8. Neuro-Behcet's disease: Neuro-Behçet disease is a multisystem inflammatory disorder. It can be diagnosed by oral lesions, genital lesions, uveitis and neurological deficits.
9. Optic Neuritis: Optic Neuritis is an acute inflammatory disorder of the optic nerve. It occurs with eye pain in young adults and sudden monocular visual loss. This disease is mostly seen in women.

AUTOIMMUNE BODY DISEASES

Autoimmune body diseases are defined as the attacks of the body's immune system to the healthy cells and tissues with the order of brain. As a result, these brain-ordered attacks can cause:

1. Hashimoto's Disease: Hashimoto's disease occurs whenever immune system attacks the thyroid with the order of the brain. This destruction is important because the thyroid gland coordinates many body's functions including the production of hormones.
2. Addison's disease: Addison's disease is caused because the immune system attacks the outer portion of the adrenal glands (the cortex). It is a significant condition because it is known that cortisol and aldosterone are produced in the cortex.
3. Graves' disease: Graves' disease is an immune system disorder that causes hyperthyroidism.
4. Autoimmune premature ovarian failure (APOF): APOF is defined as the inflammatory permeation of the liquid from the developing follicles, anti-ovarian antibodies' production, atrophy, and sparing of first class follicles (1–3). Autoantibodies sometimes react with common antigens in steroid-producing ovarian cells and adrenal gland whenever the body is diagnosed with APOF.
5. Type 1 diabetes: Type 1 diabetes occurs whenever the pancreas can't make insulin because of the attack of the immune system. This attack destroys the cells that produce insulin.
6. Systemic lupus erythematosus (SLE): SLE is an autoimmune disease where the immune system attacks its own tissues. This attack causes widespread inflammation and damages in the tissue found in the affected organs.
7. Pernicious anemia: Pernicious anemia is an autoimmune disease where the absorption of B12 is prevented.
8. Rheumatoid arthritis: Rheumatoid arthritis is an autoimmune and inflammatory disease where the

immune system mainly attacks the joints (usually many joints at once).

9. Eczema: Eczema is the condition where immune response causes itchy skin patches.
10. Wegener granulomatosis (WG): WG occurs whenever there is pauci-immune vasculitis in small- and medium-sized blood vessels
11. Muscular dystrophy: Muscular dystrophy occurs whenever the immune system attacks the muscle and the tissue.

CONCLUSION

This study summarizes some of the autoimmune diseases and explains the impact of stress on the immune system. It is not confidently said that stress causes the autoimmune diseases but this case can be strongly suggested according to the conditions and examples mentioned throughout the manuscript. It can also be said that stress can indirectly cause the autoimmune diseases. For example, whenever the people are under stress, they smoke more and as a conclusion smoking can cause lung-related diseases. As a result of smoking and the drugs taken, the autoimmune diseases can develop.

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