Discover a *smarter approach* to address thyroid health

According to the American Thyroid Association, more than 20 million Americans suffer from thyroid dysfunction and over half are unaware that their thyroid is affected. Even more alarming is the fact that more than half of these cases are due to autoimmunity (where the immune system attacks the thyroid gland).

The most common manifestation of altered thyroid function is referred to as hypothyroidism, where the amount of thyroid hormone produced is decreased. When this condition occurs from an autoimmune condition, it is referred to as Hashimoto's Thyroiditis. If the altered thyroid function causes an increase in thyroid hormone secretion, the condition is referred to as hyperthyroidism. If this occurs due to an autoimmune condition, it is referred to as Grave's disease. The most common underlying mechanism of thyroid dysfunction is autoimmune disease. The purpose of this article will be to discuss how autoimmune disease of the thyroid gland can be addressed as well as some mechanisms that lead to this devastating condition.

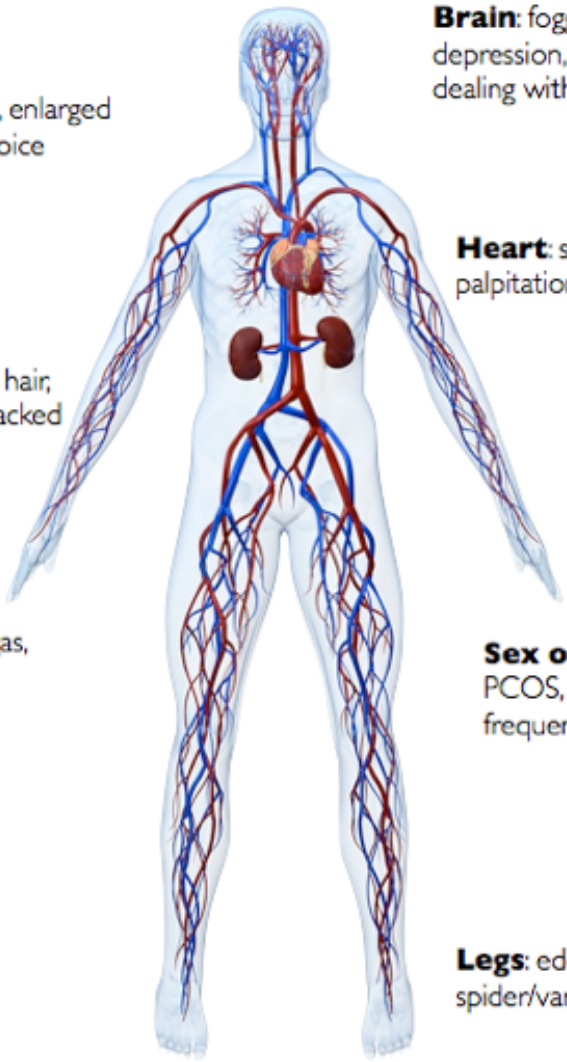
Symptoms of thyroid disease vary based on whether your thyroid is over or under active.

Common Symptoms for Low Thyroid Function:

- Fatigue
- Weight Gain
- Depression
- Constipation
- Cold Intolerance
- Poor Circulation in hands and feet
- Morning Headaches
- Muscle Cramps
- Always feel tired (even after sufficient sleep)
- Dry Skin
- Hair Loss/Brittle hair
- Edema
- Thinning of outer eyebrows
- Weakened Immune System

Common Symptoms for Elevated Thyroid Function:

- Fatigue
- Weight Loss
- Heat Intolerance
- Anxiety or Nervousness
- Mood Swings
- Heart Palpitations
- Insomnia
- Hand Tremors
- Missed or Light Menstrual Cycle
- Goiter
- Night Sweats
- Increased Pulse Rate



Brain: foggy thinking, low motivation, depression, anxiety, fatigue, hard time dealing with stress

Throat: difficulty swallowing, enlarged thyroid gland, hoarseness of voice

Heart: slow heart rate, fast heart rate, palpitations

Hair, skin and nails: dry, lifeless hair, hair loss, brittle nails, dry skin, dry/cracked heels

Wrist: Carpal Tunnel Syndrome

Digestion: constipation, bloating, gas, pain, low stomach acid production, gallstones, liver dysfunction

Sex organs: menstrual issues, PCOS, low libido, infertility, frequent miscarriages.

Legs: edema and swelling in the legs, spider/varicose veins

The Role of the Thyroid Gland

The thyroid is a butterfly shaped gland that is located in front of your trachea (windpipe) on your neck. It is one of the largest endocrine (hormone secreting) glands in your entire body. The main job of the thyroid is to secrete two key hormones: thyroxine (T4) and triiodothyronine (T3). The main function of these hormones is to increase metabolic activity throughout the body.

The thyroid gland works as a part of a system along with a brain structure called the hypothalamus and another endocrine gland called the pituitary. Collectively, these structures create a negative feedback loop where the secretion of hormones are carefully monitored and controlled by the body.

Key Players in Thyroid Function

When the body requires an increase or decrease in thyroid hormones, it gives a signal to the hypothalamus to either speed up or slow down thyroid hormone production. These signals are completed through the release of hormones.

This is analogous to running a business where your body is the CEO. When your body requires an increase in supply, the CEO first sends a message to your manager to ramp up production. In this case the manager is the hypothalamus and it uses thyrotropin releasing hormone (TRH) to signal the pituitary gland which acts as the supervisor. The pituitary gland accepts this message and relays a message on to the thyroid gland (the employee) via thyroid stimulating hormone (TSH), that more product is needed. This signal tells the thyroid to utilize iodine and stimulate an enzyme known as thyroid peroxidase (TPO) to combine with hydrogen peroxide and create thyroxine (T4) and triiodothyronine (T3).

T4 is the inactive form of thyroid hormone and must rely on peripheral conversion to the active form, which primarily occurs in the liver, kidneys, and gut. Approximately 95% of the hormones made by the thyroid are T4. The remaining 5% is T3 (the active form of thyroid hormone). Only 60% of T4 is converted to T3 and 20% becomes a permanently inactive form known as reverse T3 (rT3). The amount of rT3 you make is increased by chronic stress, inflammation, disease, and trauma.

Once the demand for the supply is met, the hypothalamus is signaled to slow things down. However, this signaling does not always run smoothly and several factors can cause disturbances in communication. In most cases, these factors create a harsh and unfavorable environment for the thyroid, which becomes the ultimate victim.

Testing The Thyroid Gland & Hormones

Most doctors will only measure TSH and use this to dose medications. However, this only addresses one aspect of the supply chain. A comprehensive thyroid blood test is essential to a proper diagnosis and treatment plan. This includes TSH, T4, T3, rT3, and antibody testing (TPO and TGB). By collecting these objective measures of thyroid function, the exact area of dysfunction can be targeted more effectively. Antibody testing is essential to rule out Hashimoto's and Grave's Disease. A thyroid ultrasound is also highly recommended to determine the presence of thyroid nodules, cysts, or tumors.

While the goal of thyroid treatment is to optimize thyroid hormone balance, we must not ignore the autoimmune aspect of the condition. Having one autoimmune condition greatly increases your chances of having another. The correct diagnosis and intervention is critical to prevent further progression of (dormant) autoimmunity. The remainder of this article will discuss the role of autoimmunity in thyroid health.

Autoimmune Disease

Autoimmune disease can manifest several ways. There are currently over 100 known autoimmune diseases, thyroid autoimmunity being one of the most common. A normal functioning immune system is designed to fight off foreign invaders such as bacteria and viruses, however prolonged exposure can lead to overactivity. This overactivity leads to the immune system attacking one's own healthy tissues. In the case of the thyroid, the most common autoimmune disease is called Hashimoto's Thyroiditis. In essence, the thyroid is simply the victim of this process. Sufferers of thyroid disease know how difficult day-to-day function is when the thyroid is under-active and one's quality of life can be dramatically affected.

Your immune system uses small protein molecules known as cytokines to signal cells in the presence of invaders and other molecules that enter your system. One of the most powerful protein molecules is referred to as NF-kB. When NF-kB is signaled, it produces inflammatory cytokines and creates a powerful cascade to destroy the intruder. Unfortunately, the regulation of NF-kB can become overactive and ultimately result in a perpetual cycle of destruction. This overreaction is similar to using a SWAT team to give out a parking ticket. Your body does have protective mechanisms in place to minimize the collateral damage of these inflammatory cytokines. These include natural barriers like your gut lining and the use of antioxidants such as glutathione – the most important of all antioxidants in your body. Glutathione is made by the liver and is typically deficient in those with autoimmune diseases, compromising another layer of defense.

The most widely accepted theory in understanding autoimmune disease is referred to as the "triad theory". There are three components that are said to initiate an autoimmune process. The first is genetics. A number of individuals that develop thyroid disease have a genetic predisposition. Secondly, there is an autoimmune trigger of some sort. This can include dietary triggers, hormonal imbalances, pathogenic organisms, chemicals, medications or stressful events. Lastly, a person will have a compromised gut barrier leading to intestinal hyper-permeability (also known as Leaky Gut Syndrome). Let's take a closer look.

Factors That Affect Thyroid Autoimmunity

1. Genetics

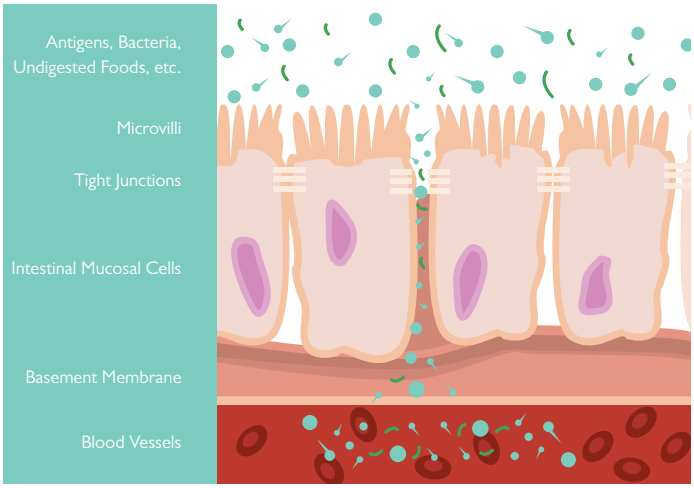
The exact mechanism that causes a normal immune system to lead to an autoimmune condition still remains unknown, however specific contributing factors have been identified. According to research, individuals with a genetic predisposition are more likely to have Hashimoto's thyroiditis or an autoimmune condition. In these individuals, autoimmunity can be triggered by environmental triggers such as high stress, hormonal imbalance, viruses, bacteria, heavy metals, and methylation issues. There are over a dozen factors that can contribute to thyroid disease.

It is important to remember that just having a gene for an autoimmune disease does not guarantee that you will develop the respective condition. Gene regulation is widely influenced by your environment. This field of study is known as "epigenetics". As mentioned in the triad theory of autoimmune disease, Other factors also contribute to the expression of a gene.

2. Intestinal Hyper-permeability (Leaky Gut Syndrome)

Another key contributor that can trigger Hashimoto's disease and other autoimmune diseases is intestinal hyper-permeability better known as "leaky gut syndrome". Your gastrointestinal tract is a natural barrier and is selectively permeable to molecules the body needs. The lining of the gastrointestinal tract is razor thin and is made up of a single layers of cells that are held together by tight junctions.

In a healthy digestive tract, these tight junctions hold together like a zipper. With prolonged inflammation, the tight junctions become damaged and start looking like a picket fence compromising this barrier and granting foreign molecules open access to the rest of the body. These molecules can be bacteria, toxins, and undigested food particles. Once these particles make their way into the body, the immune system has no choice but to deem them as foreign and label them to be attacked. This creates an inflammatory cascade that not only creates more permeability but also systemic inflammation.



It is important to remember that this does not happen overnight and can be caused by years of inflammation and provocation. As the GI tract gets damaged, the cells become unable to fully digest food. This can lead to food sensitivities, malnutrition, bacterial/yeast overgrowth, and an immune system constantly on the attack. Research suggests that a leaky gut may be the primary vehicle for the onset of autoimmune disease. This vicious cycle can be difficult to unwind unless strategic dietary and nutritional strategies are employed.

What causes leaky gut?

Several factors have been found to contribute to a leaky gut.

1. A diet high in processed foods, sugars, dairy, gluten, and alcohol
2. Certain medications: antibiotics, corticosteroids, antacids
3. Pathogenic organisms: parasites, yeast, overgrowth of bad bacteria (dysbiosis)
4. High stress lifestyle

How to heal leaky gut

The way to fix your gut is multifaceted and typically focuses on reverse engineering the process that caused the leaky gut in the first place. The initial

priorities include “stopping the fire from getting bigger”. This includes removing the fuel for the fire by testing for food sensitivities and getting rid of any pathogenic gut infections.

Once the initial fire is tamed, you can incorporate a healthy anti-inflammatory diet full of clean sources of fat, moderate protein and low carbohydrates. You can further assist the healing process by implementing specific supplements depending on your case and finally reinoculating the gut with healthy bacteria to rebalance your intestinal flora.

3. Stress

Stress is rampant in our society and most people underestimate how stressed they really are. One of the biggest problems with stress is that many causes of stress are not considered stressful by traditional definitions. Most individuals will perceive a situation as stressful either physically (such as bodily injury) or emotionally (such as the loss of a loved one). However, the chemical component of stress is often ignored. Our food, water and air supply are contaminated with chemical stressors that are harmful on a daily basis. We are further exposed to cellphone and radio signals that produce harmful electromagnetic field radiation. On our commutes to work we are exposed to exhaust fumes and in our homes, we are exposed to chemical cleaning agents and off-gassing from newly painted rooms and furniture.

No matter the specific cause of the stress, the result is the same: the body reacts to stress by releasing hormones such as catecholamines and cortisol. While these are a natural part of our stress response, chronic exposure to stress leads to pathological outcomes. Cortisol is responsible for thinning the lining of the gut and can lead to leaky gut. Stress can also activate our immune system to be persistently active, leading to overactivity.

One clinical sign we carefully monitor is if an individual has lost the ability to handle environmental stressors such as exhaust fumes, the perfume section in a store, gas stations, or cleaning supplies. This acts as a huge red flag indicating this individual may also be losing tolerance to their own tissues.

Stress reduction is paramount in recovering from thyroid disease or any other autoimmune condition. This can be done through exercise, meditation, deep breathing, yoga, and simply doing things you love. Furthermore, addressing blood sugar regulation issues and hormonal imbalances, the body can decrease its overall stress and focus on the repair process.

If left unaddressed, your thyroid can become the victim of the autoimmune attack. If your thyroid is tagged by the immune system, the prognosis depends on a few factors:

- The amount of antibodies present (TPO, TGB)
- The forcefulness of the attack
- The amount of tissue destroyed
- The amount of exposure to a particular trigger
- The antibody’s accessibility to the tissue

Your Thyroid Plan

In order to regain thyroid health and recover from the associated debilitating symptoms, a multileveled approach is necessary. It is important to remember that conventional thyroid treatment involving synthetic thyroid hormones may be a necessity when you are first diagnosed but the underlying root cause must be addressed as well to prevent the collateral fallout.

The first step is to extinguish the systemic inflammation present in autoimmune conditions. Research has shown several herbal agents can be used to dampen inflammation such as curcumin (the active ingredient in turmeric) and resveratrol. The consumption of essential fats, vitamin D supplementation and supporting glutathione levels is also integral to success.

Exercise is another step one can use to decrease inflammation. However, there is a fine line between anti-inflammatory exercise and catabolic overtraining. In order to better deal with stress, yoga and meditation can be great tools.

Undergoing functional testing can help navigate the rough waters of autoimmunity and provide specific actionable steps to restore health. Getting tested for leaky gut, food sensitivities, gut infections, hormonal and blood sugar imbalances, vitamin and mineral deficiencies, and adrenal health can help paint the full picture of why an individual does not feel optimal.

Once the specific root causes have been addressed, rebuilding a healthy immune system can be carried out. Approximately 80% of our immune system resides in our gut and healing the gut is similar to laying the foundation for a new building. If the gut is not functioning optimally, the first storm of stress may be enough to crack our foundation and knock us over.

As you can see, the thyroid is ultimately a victim of systemic inflammation and a conglomerate of imbalances, infections and deficiencies. Even though your lab work may tell you that your thyroid is "normal", functional medicine can provide real answers to why you don't feel well and what you can do to address it. Your practitioner must be aware of current research regarding thyroid disease and must be willing to address more than the standard of care including dietary and lifestyle modifications.

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References

1.Zhang J, Lazar M. The mechanism of action of thyroid hormones. Ann Rev Physiol 2000;62:439-466.

2.Brucker-Davis F. Effects of environmental synthetic chemicals on thyroid function. Thyroid 1998;8:827-56.

3.General Information About Thyroid, 2015. American Thyroid Association: http://www.thyroid.org/media-main/about-hypothyroidism/.

4.Medical Guidelines For Clinical Practice For The Evaluation and Treatment of Hyperthyroidism and Hypothyroidism, 2006. American Academy of Clinical Endocrinologists: https://www.aace.com/files/hypo_hyper.pdf

5.Bailleres. Autoimmunity and hypothyroidism. Clin Endocrin Metab. 1988;2(3):591-617

6.Streider T, Prummel M, Tijssen J, Endert E, Wiersinga, W. Risk factors for and prevalence of thyroid disorders in a cross-sectional study among healthy female relatives of patients with autoimmune thyroid disease. Clin Endocrinol 2003;59(3):396-401.

7.Surks M, Sievert R. Drugs and thyroid function. NEJM 1995;333(25):1688.

8.McLachlan SM, Rapoport B. Why measure thyroglobulin antibodies rather than thyroid peroxidase autoantibodies. Thyroid 2004;14(7):510-520.

9.Holick MF. Sunlight and vitamin D for bone health and prevention of autoimmune diseases, cancers, and cardiovascular disease. Am J Clin Nutr 2004;80:1678-1688.

10.Fasano, A. Study of a potentially fatal food-triggered disease has uncovered a process that may contribute to many autoimmune disorders. Scientific American; 2009:32-39.

11.Ruland J. Return to homeostasis: downregulation of NF-kB responses. Nat Immmunol. 2011 Jun 19;12(8):709-14

12.Yan J Greer JM. NF-kB, a potential therapeutic target for the treatment of multiple sclerosis. CNS Neurol Disord Drug Targets. 2008 Dec; 7(6): 536-57.

13.Zhao Y, Krishnamurthy B. Mollah ZU, Kay TW, Thomas HE. NF-kB in type 1 diabetes. Inflamm Allergy Drug Targets. 2011 Jun; 10(3):208-17.

14.Tewthanom K Janwityanuchit S, Totemchockchyakarn K, Panamvana D. Correlation of lipid peroxidation and glutathione levels with severity of systemic lupus erythematosus: a pilot study from single center. J Pharm Pharm Sci. 2008; 11(3): 30-4.

15.Vaarala O. Gut and the induction of immune tolerance in type 1 diabetes. Diabetes Metab Res Rev. 1999 Sep-Oct; 15(5); 353-61.

16.Fasano A, Shea-Donohue T. Mechanisms of disease: the role of intestinal barrier function in the pathogenesis of gastrointestinal autoimmune diseases. Nat Clin Pract Gastroenterol Hepatol. 2005 Sep; 2(9): 416-22.

17.Karper WB. Intestinal permeability, modderate exercise, and older adult health. Holist Nurs Pract. 2011 Jan-Feb; 25(1): 45-8.

18.Terjung B, Spengler U. Atypical p-ANCA in PSC and AIH: a hint toward a "leaky gut"? Clin Rev Allergy Immunol. 2009 Feb; 36(1): 40-51.

19.Hollander D. Intestinal permeability, leaky gut, and intestinal disorders. Curr Gastroenterol Rep. 1999 Oct; 1(5): 410-6.

20.Tsigos C, Chrousos GP. Hypothalamic-pituitary-adrenal axis, neuroendocrine factors and stress. J Psychosom Res 2002;53(4):865-871.

21.Strakis CA, Chrousos GP. Neuroendocrinology and pathophysiology of the stress system. Ann NY Acad Sci Vol. 771, pp 1-18, 1995.

22.Burkholder KM, Thompson KL, Einstein ME, Applegate TJ, Patterson JA. Influence of stressors on normal intestinal microbiota, intestinal morphology, and susceptibility to Salmonella enteritidis colonization in broilers. Poult Sci 2008;87(9):1734-1741.

23.Guhad FA. Salivary IgA as a marker of social stress in rats. Neurosci Lett 1996;216(2):137-140.

24.Patil, AD. Link between hypothyroidism and small intestinal bacterial overgrowth. Indian J Endocrinol Metab 2014;18(3):307-309.

25.Lauritano EC, et al. Association between hypothyroidism and small intestinal bacterial overgrowth. J Clin Endcrinol Metab 2007;92(11):4180-4184.

26.Sidneva LN, Adamskaia EI. The relationship between changes in the concentration of catecholamines in the hypothalamus and the level of thyroid hormone in the body. Probl Endokrinol (Mosk) 1975;21(6):84-88.

27.Lammers KM, Lu R, Brownley J, Lu B, Gerard C, Thomas K, Rallabhandi P, Shea-Donohue T, Tamiz A, Alkan S, Netzel-Arnett S, Antalis T, Vogel SN, Fasano A. Gliadin induces an increase in intestinal permeability and zonulin release by binding to the chemokine receptor CXCR3. Gastroeneterology. 2008; 35(1):194-204.

28.Bock G. Prietl B. Mader JK, Holler E, Wolf M, Pilz S, Graninger WB, Obermayer-Pietsch BM, Pieber TR. The effect of vitamin D supplementation on peripheral regulatory T cells and B cell function in healthy humans: a randomized controlled trial. Diabetes Metab Res Rev. 2011 Nov; 27(8): 942-5.

29.Kleijwegt FS, Laban S, Duinkerken G, Joosten AM, Koeleman BP, Nikolc T. Roep BO. Transfer of regulatory properties from tolerogenic to proinflammatory dendritic cells via induced autoreactive regulatory T cells. J Immunol. 2011 Dec 15; 187(12):6357-64.

30.Yan Z, Garg SK, Banerjee R. Regulatory T cells interfere with glutathione metabolism in dendritic cells and T cells. J Biol Chem. 2010 Dec 31; 285(53):41525-32.

31.Waite JC, Skokos D. Th17 response and inflammatory autoimmune diseases. Int J Inflam. 2012; 2012:819467.

32.Vojdani A, Lambert J. The Rold of Th17 in Neuroimmune

Disorders: Target for CAM Therapy. Part II. Evid Based Complement Alternat Med. 2009 Jul 21.
33.Culotta E, Koshland DE Jr. NO news is good news. Science. 1992; 258:1862-5.
34.Gius D, Botero A, Shah S, Curry HA. Intracellular oxidation/reduction status in the regulation of transcription factors NFkB and AP-1. Toxicol Lett. 1999; 106:93-106.
35.Turner JR. Molecular basis of epithelial barrier regulation: from basic mechanisms to clinical application. Am J Pathol. 2006 Dec; 169(6): 1901-9.
36.Nusrat A. turner JR, Madara JL. Molecular physiology and pathophysiology of tight junctions. IV. Regulation of tight junctions by extracellular stimuli: nutrient, cytokines, and immune cells. Am J Physiol Gastrointest Liver Physiol. 2000 Nov; 279(5):G851-7.
37.Cuvelier C, Barbatis C, Mielants H, De Vos M, Roels H, Veys E. Histopathology of intestinal inflammation related to reactive arthritis. Gut. 1987 Apr; 28(4):394-401.
38.Rakoff-Nahoum S, Paglino J, Eslami-Varzaneh F, Edberg S, Medzhitov R. Recognition of commencal microflora by tolllike receptors is required for intestinal homeostasis. Cell. 2004 Jul 23; 118(2):229-41.
39.Cario E, Gerken G, Podolsky DK. Toll-like receptor 2 enhances ZO-1 associated intestinal epithlial barrier integrity via protein kinase C. Gastroenterology. 2004 Jul; 127(1):224-38.
40.Lee J, Mo JH, Katakura K, Alkaly I, rucker AN, Liu YT Lee HK, Shen C, Cojocaru G, Shenouda S, Kagnoff M, Eckmann L, Ben-Neriah Y, Raz E. Maintenance of colonic homeostasis by distinctive apical TLR9 signalling in intestinal epithelial cells. Nat Cell Biol. 2006 Dec; 8(12): 1327-36.
41.van Ampting MT, Schonewille AJ, Vink C, Brummer RJ, van der Meer R, Bovee-Oudenhoven IM. Intestinal barrier function in response to abundant or depleted mucosal glutathione in Salmonella-infected rats. BMC Physiol. 2009 Apr 17; 9:6.
42.Machowska A, Brzozowski T, Sliwowski Z, Pawlik M, Konturek PC, Pajdo R, Szlachcic A, Drozdowicz D. Schwarz M. Stachura J, Kontruk SJ, Palik WW. Gastric secretion, proinflammatory cytokines and epidermal growth factor (EGF) in the delayed healing of lingual and gastric ulcerations by testosterone. Inflammaopharmacology. 2008 Feb; 16(1):40-7.
43.Money SR, Cheron RG, Jaffe BM, Zinner MJ. The effects of thyroid hormones on the formation of stress ulcers in the rat. J Surg Res. 1986 Feb; 40(2):176-80.
44.Braniste V. Leveque M, Buisson_Brenac C, Bueno L, Fioramonti J, Houdeau E. Oestradiol decreases colonic permeability through oestrogen receptor beta-mediated up-regulation of occludin and junctional adhesion molecule-A in epithelial cells. J Physiol. 2009 Jul; 587(Pt 13):3317-28.
45.Gareau MG, Silva MA, Perdue MH. Pathophysiological mechanisms of stress-induced intestinal damage. Curr Mol Med. 2008 Jun; 8(4): 274-81.
46.Korenaga K, Micci MA, Tagliatatela G, Pasricha PJ. Suppression on nNOS expression in rat enteric neurones by the receptor for advanced glycation end-products. Neurogastroenterol Motil. 2006 May; 18(5): 392-400.
47.Purohit V, Bode JC, Bode C Brenner DA, Choudhry MA, Hamilton F, Kang YJ, Keshavarzian A, Rao R, Sartor RB, Swanson C, Turner JR. Alcohol, intestinal bacterial growth, intestinal permeability to endotoxin, and medical consequences: summary of a symposium. Alcohol. 2008 Aug; 42(5):349-61.
48.Bansal V, Costantini T, Ryu SY, Peterson C, Loomis W, Putnam J, Elicieri B, Baird A, Coimbra R. Stimulating the central nervous system to prevent intestinal dysfunction after traumatic brain injury. J Trauma. 2010 May; 68(5):1059-64.
49.Shindler KS, Ventrua E, Dutt M, Elliott P, Fitzgerald DC, Rostami A. Oral resveratrol reduces neuronal damage in a model of multiple sclerosis. J Neuroopthalmol. 2010 Dec;30(4): 328-39.
50.Petro TM. Regulatory role of resveratrol on Th17 in autoimmune disease. Int Immunopharmacol. 2011 Mar; 11(3): 310-8. Epub 2010 Aug 12.
51.Anekonda TS, Adamus G. Resveratrol prevents antibodyinduced apoptotic death of retinal cells through upregulation of Sirt1 and Ku70. BMC Res Notes. 2008 Dec 1; 1: 22.
52.Yoshida Y, Shioi T, Izumi T. Resveratrol ameliorates experimental autoimmmune myocarditis. Circ J. 2007 Mar; 71(3):397-404.
53.Mito S, Watanabe K, Harima M, Thandavarayan RA, Veeraveedu PT, Sukumaran V, Suzuki K, Kodama M, Aizawa Y. Curcumin ameliorates cardiac inflammation in rats with autoimmune myocarditis. Biol Pharm Bull. 2011; 34(7): 974-9.
54.Xie L, Li XK, Takahar S. Curcumin has bright prospects for the treatment of multiple sclerosis. Int Immunopharmacol. 2011 Mar; 11(3): 323-30. Epub 2010 Sep 8.
55.Kurien BT, D'Souza A, Scofield RH. Heat-solubilized curry spice curcumin inhibits antibody-antigen interaction in in vitro studies: a possible therapy to alleviate autoimmune disorders. Mol Nutr Food Res. 2010 Aug; 54(8): 1202-9.
56.Simopoulos, AP. Omega-3 fatty acids in health and disease and in growth and development. Am J Clin Nutr 1991;54(3):438-463.
57.Xuzhe G, Komai-Koma M, Leung BP, Howe HS, McSharry C, McInnes IB, Xu D. Resveratrol modulates murine collageninduced arthritis by inhibiting Th17 and B-cell function. Ann Rheum Dis. 2012 Jan; 71(1): 129-35.
58.Petro TM. Regulatory role of resvertatrol on Th17 in autoimmune disease. Int Immunopharmacol. 2011 Mar; 11(3): 310-8. Epub 2010 Aug 12.
59.Hewison M. Vitamin D and immune function: an overview. Proc Nutr Soc. 2012 Feb; 71(1): 50-61. Epub 2011 Aug 1