**Autoimmune Diseases and Human Health: An updated insight**

Arpan Kundu1, Palas Patra1, Rahul Manna1, Sayan Thakura1, Monalisha Maity1, Krishnnedu Adhikary1\*

1Department of Medical Laboratory Technology, Paramedical College Durgapur, West Bengal 713212, India

\*Corresponding Mail: [krisskrishnendu@gmail.com](mailto:krisskrishnendu@gmail.com)

**Running Title:** Autoimmune diseases and human health

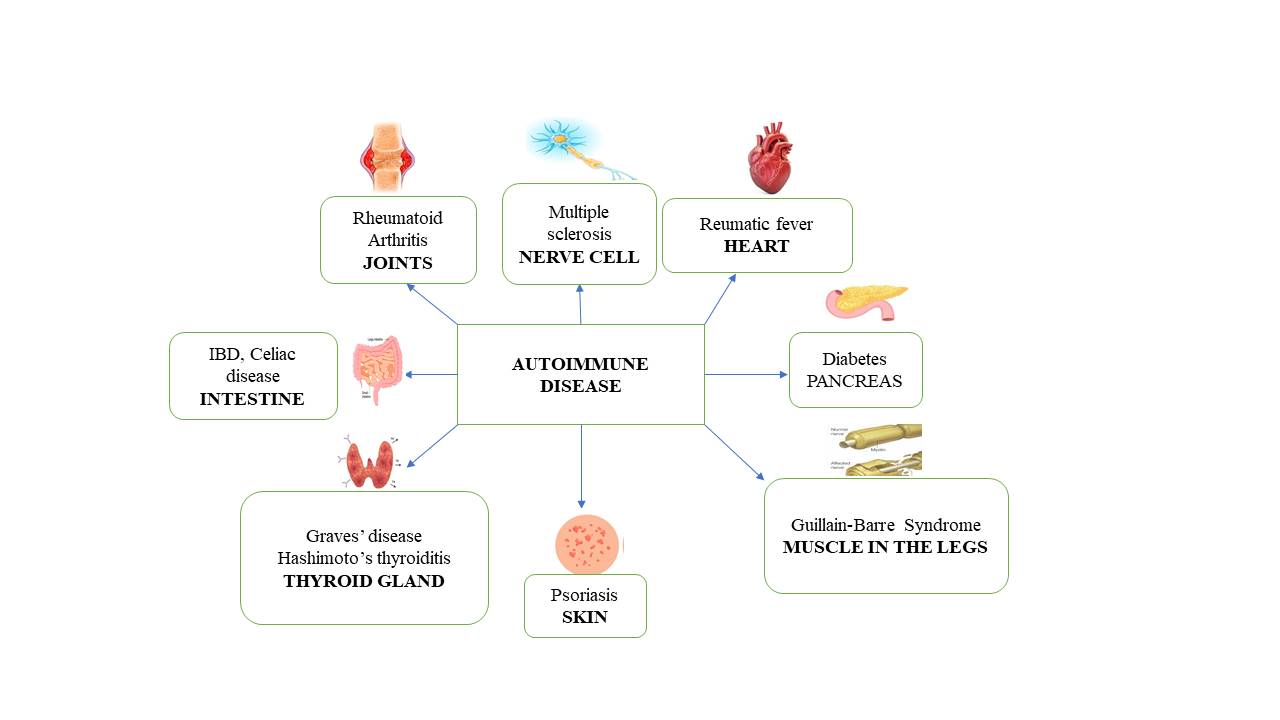
**Abstract**

Autoimmune diseases and disorders are not the same thing. While the underlying aetiology of each illness is different, the immune system dysfunction that underpins both disorders may produce similar symptoms. One key difference is that autoimmune illnesses are characterized by an impairment of the adaptive immune system, while auto inflammatory disorders are characterized by an impairment of the innate immune system. The hallmark of autoimmune/inflammatory diseases is systemic or organ-specific inflammation that causes tissue destruction. The prior categories for autoimmune/inflammatory conditions were auto inflammatory and autoimmune illnesses. Certain disorders, like lupus, which exhibit family aggregation and may suggest a genetic predisposition, are suggested to be the result of a complex interplay between genes and environment. There is evidence linking autoimmune diseases to clinical symptoms. Measuring auto antibodies in patients may help with diagnosis and severity analysis, which might be important for treatment. In this chapter we have focused mainly on the therapeutic interventions of different autoimmune diseases like myasthenia gravis, rheumatoid arthritis, and systemic lupus erythematosus.

**Keywords:** Autoimmune diseases, diabetes, rheumatoid arthritis, lupus erythematous, auto antigen

1. INTRODUCTION

Autoinflammatory illnesses and autoimmune disorders belong to different classes. The immune system failure that underlies both conditions might result in comparable symptoms including weariness, rash, and swelling, but the underlying etiology of each disease is distinct (Scherlinger et al., 2020). One important distinction is that autoinflammatory disorders are characterized by an impairment of the innate immune system, while autoimmune diseases are characterized by an impairment of the adaptive immune system (Leo et al., 2020). The hallmark of autoimmune/inflammatory illness is systemic or organ specific inflammation that causes tissue destruction (Evert et al., 2003). Autoinflammatory and autoimmune disorders were the previous classifications for autoimmune/inflammatory condition (Watad et al., 2017). But it soon become evident that the world is far more complicated than that, with autoimmune and autoinflammatory conditions essentially acting as extremes at either end (Tang et al., 2012). On the other hand, autoimmune disorders were described as being brought on by an immune system that adapts and, as a result, characterized by the presence and pathophysiology involvement of self-antibodies and/or populations of lymphocytes that are reactive to their own substances. (Fig. 1) (Satoh et al., 2016).



**Figure 1:** Different autoimmune diseases and their target organs.

The term "classical" autoimmune illnesses and monogenic autoinflammatory conditions represent opposite ends of a spectrum that represents systemic autoimmune/inflammatory disorders(Croft et al., 2019).

As a result of the constantly expanding list of known autoimmune/inflammatory circumstances, the previously discussed inter-individual fluctuations in phenotypes and results (sometimes even between individuals who have the same assessment and/or within family members), and the recognition that originally separate conditions may move together the inflammation frequency from, for example, a basically auto-inflammatory to an autoimmunity characteristics (this can occur repeatedly in grown-up Still's disease and systematic JIA, for example), the molecular mechanism of autoimmune/inflammatory circumstances is complicated and only partially understood. (Swinkels et al., 2018). Based on current knowledge, autoimmune and inflammatory diseases are caused by either complicated genetic predispositions (more common) or monogenic disease causes (less common). Both types of diseases are influenced by both individual and environmental factors, which can change how the disease manifests itself and/or how specific phenotypes and outcomes are affected. (Wang et al., 2015).

The precise etiology of autoimmune illnesses is yet unknown, but it is most likely complex, incorporating both environmental and genetic factors (Fallah et al., 2014). A complicated interaction between genes and environment is implied in the etiology of some diseases, such as lupus, which show familial aggregation and may indicate a hereditary predisposition(Hainer et al., 2019). However, other cases have been linked to viral triggers or environmental variables.Gene regulatory mechanisms known as epigenetic events regulate chromatin's accessibility to transcriptional regulatory factors, which modifies gene expression without altering the underlying DNA sequence (Meers et al., 2019). Even while all diploid cells have the same genotype, epigenetic processes can be impacted by the environment, are dynamic but also heritable, and ultimately account for considerable diversity between cells and tissues within an organism (Simeonov et al., 2019). Histone protein post-translational modifications, non-coding RNA expression, and DNA methylation are examples of epigenetic processes (West etal., 2018).

2. HISTORICAL BACKGROUND OF AUTOIMMUNE DISEASES

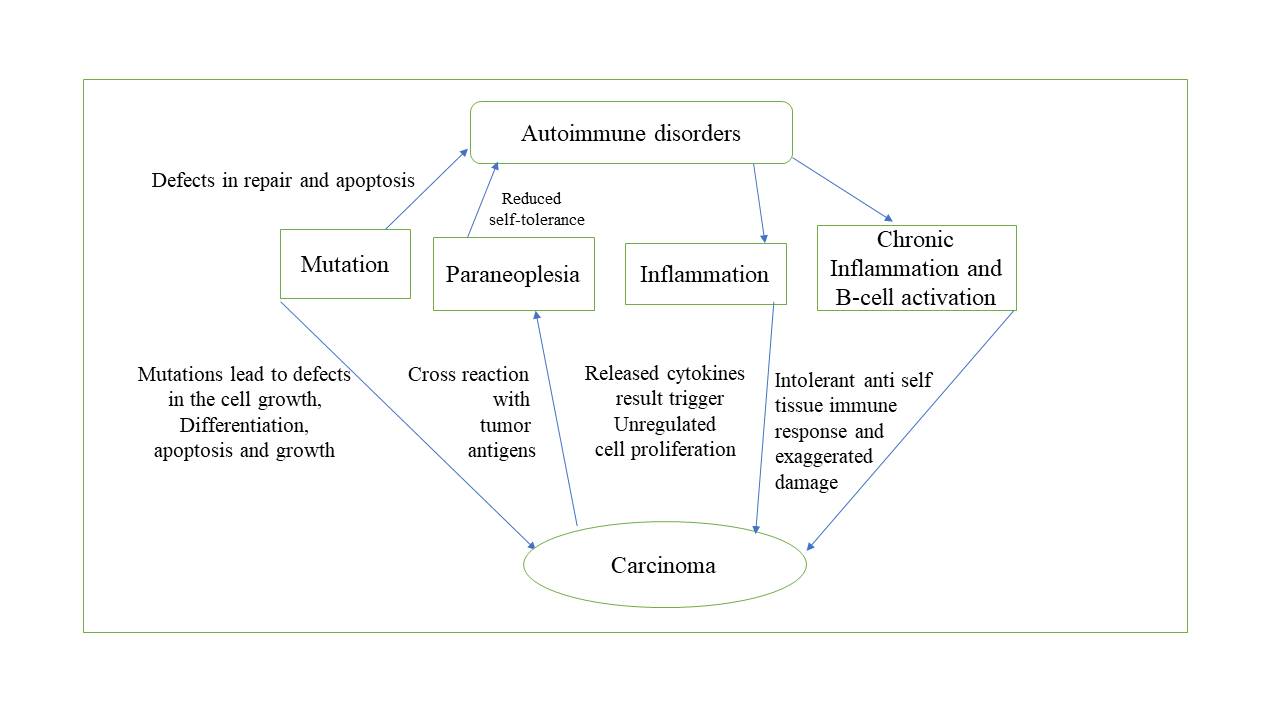
Medical microbiology saw the emergence of immunology as a new specialty. Robert Koch's studies on the origins of infectious diseases—especially tuberculosis—and Louis Pasteur's findings, which validated the germ theory of infectious diseases, raise important questions. Does the host have a strong defence system or is it helpless against dangerous bacteria? (Lo et al., 2020).

Working at Koch's Institute for infectious illnesses in Berlin, Behring and Ehrlich identified antibodies as essential counterparts to bacterial toxins, while Metchnikoff, who had been employed at the Pasteur Laboratory in Paris since 1888, found the essential function of bacterial infection and intracellular kill in host defence. (Conigliaro et al., 2019).

Medical historians regard the mid-twentieth century as the point at which the scientific and medical societies recognized the presence of autoimmune illness (Ling et al., 2019). Several illnesses, including sympathetic ophthalmia andendophthalmitis phacoanaphylactica, were previously identified as autoimmune disorders (Kumagai et al., 2020). During the first part of the century, autoimmune illness was considered biologically improbable (Schreiber et al.,2019). The phrase "horror autotoxicus" was coined by Paul Ehrlich to emphasize how autoimmunity would contradict nature's tendency toward self-harm. (Khan et al.,2020).

As to Fässler et al. (2019), the immune system's capacity for self-harm was initially demonstrated by the identification of allergies and anaphylaxis. Understanding the etiology of autoimmunity was hampered by a significant stumbling block: how the immune system discriminates between foreign and self, a mechanism that was finally identified as immunological tolerance(Fig. 2) (Finkel et al., 2021).Investigators of sympathetic ophthalmia and endophthalmitis phacoanaphylactica were positioned to disprove horror autotoxicus, but there was insufficient convincing experimental and clinical data to do so (Zhou et al., 2020). In the 1950s, autoimmune illness gained widespread recognition following seminal investigations of chronic thyroiditis and a succession of clinical laboratory advances(Rendeiro et al., 2020).

The difficulties experienced by ophthalmology scientists provide insights into how medical concepts develop (Hajishengalis et al., 2019). We examine how ocular immunology had a role in developing the notion of autoimmune illness and why it took time to gain popularity (Chua et al., 2020).

**Figure 2:**background of autoimmune diseases. Cross reaction, mutation and intolerant are the main hallmarks.

As stated by Paul R. Ehrlich in 1901, an immune response that targets the "self" may cause harmful antibodies to be produced in the person (Schulte-Schrepping et al., 2020). The renowned "horror autotoxicus" he described showed that the body needed a defense mechanism to protect itself against the dangers of self-antibodies (van der Made et al., 2020).

Paul Ehrlich (1900) is regarded as one of the pioneers of contemporary immunology. He developed the side-chain hypothesis, which postulated that pathogens engage with cells' side chain receptors (Combes et al., 2021). His notion of an expanding antibody molecule with many binding sites for complement and antigen activation was the first one proposed (Shin et al., 2019). The concept of clonal selection was created in 1957 by Frank Burnet and David Talmage, after Astrid Fagraeus' 1948 identification of plasma B cells as primarily involved in antibody production (Defendi et al., 2020).

In the 1940s, fluid substances that attach to the radioactive antigenic and immunoglobulin G were discovered, leading to the creation of two types of antagonists (ANAs and RF).. There is evidence linking autoimmune diseases to clinical symptoms. Measuring autoantibodies in patients can help with diagnosis and severity analysis of the disease, which could be important for treatment. (Bekkeringet al., 2018). Pauling's instructive theory from 1940, which held that the antigen serves as an illustration for the antibodies, was challenged by this argument, which stated that cells create just one antibodies component that determines the antibody before they encounter an antigen. (van der Meer et al., 2016). Donath and Landsteiner were the first to identify an autoimmune disorder called Donath-Landsteiner haemolytic anaemia (Wrap et al., 2020). A blood component (antibody) that binds and lyses self-red blood cells was found in a patient whosuffered paroxysmal cold haemoglobinuria after being exposed to cold in the arms or legs (Hoey et al., 2019). August Wassermann observed in Berlin that syphilis patients' sera reacted with extracts of both sick and normal tissues, allowing autoantibodies to be identified (Lung et al., 2019).

3. CLASSIFICATION OF AUTOIMMUNE DISEASES

Numerous factors can be used to categorize autoimmune disorders. The site of the autoimmune attack is one of them, this criterion is used to differentiate between systemic and organ-specific autoimmune disorders (Bettacchioly et al., 2021). This artificial classification structure serves a practical purpose in helping patients and primary care providers find the right expert (Table 1) (Abu-Rumeileh et al., 2020).

**Table 1:**Autoimmune diseases with target organ and auto stimulate antigens.

|  |  |  |
| --- | --- | --- |
| Disease | Target Organ | Known auto antigens |
| Thyroiditis (autoimmune) | Thyroid | Thyroglobulin  Thyroperoxidase |
| Grave’s disease | Thyroid | Thyroid-stimulating hormone receptor |
| Type 1 diabetes | Pancreatic Beta cells | Insulin, GAD, IA-2 |
| Addison’s disease | Adrenal | 21OH hydroxylase |
| Gastritis | Stomach | 17OH hydroxylase |
| Celiac disease | Small bowel | H+/K+ ATPase  Intrinsic Factor |
| Vitiligo | Melanocytes | Transglutaminase |
| Multiple sclerosis | Brain, spinal cord | Tyrosin  Tyrosinase-related protein-2 |
| Pemphigus | Skin | Myelin basic protein  Proteolipid protein |
| Hepatitis (autoimmune) | Liver | Hepatocyte antigens  Cytochrome; p450-1 A2 |
| Myasthenia gravis | Muscle | Acethylcholine receptor |
| Primary biliary cirrhosis | Liver bile ducts | 2-Oxoacid dehydrogenase complexes |

3.1. Systemic Specific

When autoantigens are present in nearly every kind of cell in the body, such as DNA-protein complexes, the condition isreferred to as systemic autoimmune disease(EASL et al., 2017).Consequently, a wide variety of organs and tissues are affected by the pathological damage.Rheumatoid arthritis, systemic lupus erythematosus, scleroderma, and dermatomyositis are examples of common systemic autoimmune illnesses (Nydegger et al., 2016).

3.2. Organ Specific

Immune system attacks that target a single organ or tissue preferentially are known as organ- specific autoimmune disorders.The skin in individuals with vitiligo, the beta cells of the endocrinefew examples.

### 3.3. Graves' disease

### Graves' disease is characterized by the development of self-antibodies targeting thyroid stimulating hormone (TSH) receptors (TRAb). Anxiety, irritability, a rapid heartbeat, and weight loss are examples of stimulatory effects that can result from excessive thyroid hormone production as well as release caused by the attachment of TRAb self-antibodies to the TSH receptor. (Arulraj et al., 2021).

### 3.4. Inflammatory bowel disease

### Crohn's disease and ulcerative colitis are two illness that fall under the umbrella term of inflammatory bowl disease (IBD), which is defined by persistent inflammation of the digestive tract (Annett et al.,2020).

### 3.5. Multiple sclerosis

### Multiple sclerosis (MS) is a form of neurodegenerative illness that destroys myelin, the coating that protects the fibers of nerves in the brain and spinal cord. It causes the immune system to target myelin cells. (Soltani et al., 2019).

### 3.6. Rheumatoid arthritis

### The main target of rheumatoid arthritis (RA) is the joint, where it causes chronic inflammation that leads to discomfort and damage to the joints (Levine et al., 2018). It frequently has symmetry, so if one hand or knee has it, the other one also does.

### 3.7. Systemic lupus erythematosus

### An autoimmune disease called lupus, also known as systemic lupus erythematosus, affects the kidneys, liver, skin, joints, and neurological system, among other organs. (Stojan et al., 2016). A generalized lack of immunological tolerance is one of its defining features.

### 3.8. Type 1 diabetes

### The illness known as type 1 diabetes is brought on by the immune system attacking the pancreatic beta cells that produce insulin, which raises blood sugar level (Lu et al., 2019). Among the symptoms include more thirst, more frequent urination, or unexplained weight loss..

### 3.9. Coeliac disease

### Coeliac illness is an immunological response to gluten, a protein present in wheat, barley, and rye. When gluten is consumed, the small intestine may have an immune response that results in damage to the villi that line the gut and facilitate food absorption. (Zhang et al., 2017). Gluten consumption can raise the risk of gastrointestinal cancer due to its passage through the gastrointestinal system, which includes the esophagus, stomach, small and large intestine, rectum, and anus (Alpert et al., 2019).

### 3.10. Psoriasis and Psoriatic arthritis:

### Rapid cell development that causes scaling on the skin's surface is a hallmark of the skin condition psoriasis.There is a lot of inflammation and redness around the scales. (Mamoshina et al., 2019). Some people with psorias is may develop psoriatic arthritis, which causes joint discomfort, stiffness, and oedema.

### 3.11. Sjögren's syndrome

### Sjögren syndrome, also known as SjS or SS, is an ongoing condition of autoimmune origin that primarily affects the salivary and lacrimal glands in the body. It also often has significant effects on other organ systems, including the kidneys, neurological system, and lungs..

### 3.12. Undifferentiated Connective Tissue Disease

### When a person does not fit the diagnostic criteria for any particular connective tissue disease, but still displays signs of the disease, such as blood test results and physical characteristics, this condition is known as undifferentiated connective tissue diseases. (Rockwood et al., 2011). Over time, 30–40% of people get a specific connective tissue condition.

### 3.13. Multiple Sclerosis (MS)

### MS is an autoimmune illness that damages the insulating coverings of nerve cells in the brain and spine.Damage to the nervous system can impair signal transmission and cause physical, mental, and psychiatric symptoms.Symptoms may include double vision, visual loss, eye discomfort, muscular weakness, and loss of sensation/coordination (Lehallier et al., 2019).The reason is unknown;

### however, it is likely due to immune system damage or myelin-producing cell failure,there is currently no recognized cure for multiple sclerosis.Current therapies include disease-modifying drugs to reduce inflammation and the symptoms that accompany acute flares, as well as to prevent future episodes.Physical and occupational therapy, as well as patient-centered symptom management, can improve functional capacity.

### 

### Figure 3:Pathophysiology and different factors of autoimmune diseases.

4. MYASTHENIA GRAVIS

Myasthenia gravis is a fast and voluntary controllable muscle weakening and weariness.Antibodies that create a breakdown in nerve-muscle communication are the cause of the disorder. One of the most prevalent conditions affecting neuromuscular transmission is myasthenia gravis. It is one of the autoimmune illnesses that is now most understood and defined. Due to an immunological response to the postsynaptic membrane of the neuromuscular junction, it is characterised by cyclical weakness and tiredness affecting a variety of ocular muscles, bulbar functions, limb, and respiratory muscles (Cohen Tervaert et al., 2018). Myasthenia gravis is diagnosed usinga combination of clinical and serological testing. With the help of the available treatment options, the illness can be successfully managed and even completely remitted.

5.1. Epidemiology

Myasthenia Gravis (MG), a chronic, uncommon autoimmune illness, the body's immune system targets neuromuscular junction components, impairing nerve to muscle signal transmission(Imbach et al., 1981). The symptoms of myasthenia gravis include weakness and exhaustion in the voluntary skeletal muscles, especially the jaw, eyes, neck, face, and limbs.

5.2 Incidence

In 55 investigations conducted throughout 1950 and 2007, the frequency rate of MG varied from 1.7 to 21.3, resulting in an entire pooled occurrence ratio for 5.3 per 1,000,000 persons annually. 29 additional research conducted between 2007 and 2019 discovered that the annual incidence rate of MG varied between 0.15 through 61.33 per 1,000,000 people. (Sultan et al., 1984). 2021 study estimates that for every 1,000,000 persons, there are between 4.1 to thirty instances of MG annually.

5.3 Prevalence

Over the past 50 years, there has been an increase in the reported prevalence of MG, which varies by area. The prevalence rates in the world vary from 150 to 200 cases per million individuals.

* 1. Pathophysiology

The most well-understood autoimmune condition is myasthenia gravis (MG), and research on the condition has contributed to a fundamental understanding of the mechanics behind neuromuscular transmission. Antibodies directed against the acetylcholine receptor (AChR) are the cause of myopathy (MG). These antibodies lead to a reduction in the safety factor for efficient synaptic transmission by compromising the end-plate potential (Tian et al., 2021). It is evident that complement activation is necessary for the postsynaptic surface to be destroyed by AChR antibodies.Patients with MG who do not have antibodies against the AChR have been identified to have an antigenic target that is specific to muscle kinase. T-cells are necessary for the formation of autoantibodies in MG, yet it is unclear how tolerance breaks down. There is an intriguing variation in the participation of muscle groups in MG, with the extraocular muscles being particularly involved. This article examines the processes underlying the autoimmune process of myasthenia gravis (MG), normal neuromuscular transmission, and the varying susceptibilities of the ocular muscles to MG.

Classification and congenital myasthenic syndromes in dogs and cats

One can either inherit or acquire myasthenia, a syndrome marked by reduced neuromuscular transmission. A group of genetic diseases with an early onset that impair the neuromuscular junction, also called the NMJ, of skeletal muscle are collectively known as congenital myasthenic syndromes (CMSs). These illnesses vary in therapy. Autoantibodies against the NMJ cause myasthenia gravis (MG), an acquired autoimmune disease. Regarding treatment and result, it is critical to recognise both illnesses as diseases. Reviewing the literature on MG and CMSs in pets such as cats and dogs, and then making recommendations for a classification system upon a comparison with existing human classifications for MG and CMSs in pets of all kinds(Signore et al., 2018). First, myasthenia gravis can present as acute fulminating, localized, or widespread in nature. The basis for subclassification is either the underlying cause of autoimmune disease or seronegativity. The mechanism of autoimmune disease is related to the administration of thiourylene medicine to cats or the existence or absence of a thymoma. Congenital myasthenic disorders are classified according to the affected NMJ component, the involved mutant gene, the affected protein, and the biological cause of the neurological transmission failure. Intending to facilitate identification of the disease categories for both illnesses by presenting this classification of MG and CMSs as well as direct care, improve prognosis, and offer a foundation for more research on these disorders.

Causes

In order to communicate with your muscles, your nerves release chemicals known as neurotransmitters that attach to receptor sites on your muscle cells. This process is known as the nerve-muscle junction. When you have myasthenia gravis, your immune system makes antibodies that block or harm a lot of the acetylcholine (as-uh-teel-KOH-leen) receptors that are located in your muscles. Less accessible receptor locations mean fewer nerve impulses reach your muscles. This leads to weakness. Antibodies can also block a protein called MuSK (muscle-specific receptor tyrosine kinase; TIE-roh-seen KIE-nays). This protein helps to create the nerve-muscle junction (Ding et al., 2021). Antibodies designed to neutralize this protein may cause myasthenia gravis. Antibodies targeting lipoprotein-related polypeptide 4 (LRP4) may make this sickness worse. Through research studies, more antibodies have been found, and this number is likely to rise in the future.

Antibodies that block the LRP4, MuSK, or cholinergic do not cause myasthenia gravis to develop in certain people. (Vulto et al., 2017). Seronegative myasthenia gravis, sometimes referred to as antibody-negative myasthenia gravis, is the name given to this kind of the disease. Generally speaking, scientists still think that autoimmunity plays a role in this kind of myasthenia gravis; the antibodies that are responsible have just not been identified yet.

Thymus gland

One component of your immune system is the thymus gland. This gland is situated beneath the breastbone in the upper chest. The antibodies that obstruct acetylcholine are thought to be produced by the thymus gland or to have assisted in their production.In healthy adults, the thymus gland is small, but in newborns it is enormous. However, the thymus gland is larger than normal in some adults with myasthenia gravis. Thymomas, or tumours of the thymus gland, are another condition that some myasthenia gravis patients develop. Thymomas, also called malignant, are rarely cancerous. However, thymomas can develop into malignancy.

Among the things that can exacerbate myasthenia gravis are:

• Weary

• Disease or illness.

• Surgery.

• Tension.

• Certain medications, including beta blockers, antibiotics, quinidine gluconate, quinidine sulphate, quinine (Qualaquin), phenytoin (Dilantin), and several anaesthetics.

• Maternity.

• Menstrual cycles.

Symptoms

With usage of the affected muscle, myasthenia gravis induces muscular weakness that worsens. Since most symptoms of muscle weakness go better with rest, they can occur intermittently (Rajewsky et al., 2019). However, the symptoms frequently get worse over time. The worst of the illness usually strikes a few years afterwards it first manifests.

Myasthenia gravis could be your condition, and it could harm any controllable muscles in your body. The frequency of afflicted muscle groups varies.

Muscles within the eye

More than half of cases of myasthenia gravis typically start with ocular symptoms. A few of the signs and symptoms include

• The word for one or both pupils drooping is ptosis.

• Double vision, known as diplopia, happens if one of the eyes is closed and can be either upward or horizontal. It can either improve or disappear.

The facial and throat muscles

Face and throat muscles are involved in the initial symptoms of myasthenia gravis in around 15% of cases. These signs and symptoms may:

* Difficulty in speaking.
* Difficulty in swallowing
* Impact the chewing process, halfway through a meal, the chewing muscles may start to ache. This is particularly valid if you've been consuming tough foods like steak (Weinreichet al., 2020).
* Alter your facial expressions.
* The leg and neck muscles:

In addition, myasthenia gravis may cause weakness in the neck, arms, and legs. A person's gait may be affected by leg weakness. Weak neck muscles make holding up the head difficult.

Diagnosis

Neurological test

Testing could be one way your doctor examines your neurological health

• Adaptations.

• Strength of muscles.

• Tone of muscles.

• Touch and visual senses.

• Sync.

• Equilibrium.

The following tests could be performed to support a myasthenia gravis diagnosis

Test with an ice pack

Your healthcare professional may apply an ice bag to your eyelid if it is drooping. Your healthcare practitioner takes out the bag after two minutes and assesses your drooping eyelid for potential improvement.

Blood examination:

Unusual antibodies that block the receptor sites where nerves instruct your muscles to contract may be detected by a blood test.

Stimulating nerves repeatedly

In this nerve conduction study, the testing muscles' skin is covered with electrodes that the physicians place there. Electricity is applied in tiny pulses across the electrodes (Kohler et al.,2019). These pulses gauge the nerve's ability to communicate with the muscle.The nerve is put through multiple tests during this examination to see whether weariness impairs the nerve's capacity to convey impulses. The test's results aid in the diagnosis of myasthenia gravis.

EMG, or single-fiber electromyography

This test examines the electrical activity going between your brain and your muscle. To test a single muscle fibre, a thin wire electrode must be inserted through your skin and into a muscle.

Visualising

prescribe an MRI or CT scan.

Tests for pulmonary function

These tests determine whether breathing is being affected by your disease.

Treatment

Medications

* Antagonists of cholinesterase

Medication like pyridostigmine (Mestinon, Regonal)enhances the nerve-muscle transmission. While these medications don't cure anything, they can help some people's muscles contract more forcefully and stronger.Intense salivation and perspiration, diarrhoea, nausea, and upset stomach are possible adverse effects.

* Corticosteroids

Prednisolone (Rayos), a corticosteroid, inhibits the immune system and reduces its capacity to create antibodies (Adamson et al., 2019). On the other hand, prolonged use of corticosteroids might have major adverse consequences. These include diabetes, weight gain, deteriorating bones, and an increased risk of some infections.

* Immunosuppressive medicines

It is also possible for your doctor to recommend additional medications that alter your immune system. These medications may consist of mycophenolate mofetil (Cellcept), cyclosporine (Sandimmune, Gengraf, and others), methotrexate (Trexall), azathioprine (Azasan, Imuran), or tacrolimus (Astagraf XL, Prograf, and others). Corticosteroids and these medications, which have a months-long half-life, may be combined.Immunosuppressant side effects can include increased infection risk as well as liver or renal damage (Terwiel et al., 2019).

Intravenous treatment

The following treatments are typically administered briefly to address symptoms that worsen out of the blue or prior to surgery or other treatments

* Plasmapheresis (plaz-muh-fuh-REE-sis)

This technique involves a dialysis-like filtering process. Your blood is run through a machine that eliminates the antibodies preventing messages from reaching your muscles from your nerve terminals. Nevertheless, the benefits of this surgery typically wear off within a few weeks (Llanos et al., 2019). Finding veins for therapy can become difficult after multiple surgeries.

Plasmapheresis carries some risks, such as bleeding, cramping in the muscles, irregular heartbeat, and blood pressure decline. An allergic reaction to the liquids used to replace the plasma occurs in certain individuals.

* Intravenous immunoglobulin (IVIg)

Your body receives normal antibodies from this therapy, which modifies the reaction of your immune system. Benefits can last three to six weeks and are typically noticeable in less than a week. Chills, headaches, vertigo, and fluid retention are among the moderate side effects that are occasionally experienced.

* Antibody that is monoclonal

Myasthenia gravis patients are administered eculizumab (Soliris) and rituximab (Rituxan) intravenously. These drugs are typically utilised in cases where no other therapy is effective. They may cause major adverse consequences.

Operation

There are some myasthenia gravis sufferers who have thymus gland tumours. A thymectomy—the removal of the thymus gland—is required if you have a tumour known as a thymoma.Eliminating the thymus gland may help alleviate symptoms even in the absence of a tumour. It may take years for this operation to start showing results, though.

There are two types of thymectomy procedures: minimally invasive and open. To access the chest and remove the thymus gland, an open surgical procedure involves the physician splitting the sternum, the middle portion of the breastbone.Tiny incisions are used in minimally invasive surgery to remove the thymus gland.

6. RHEUMATOID ARTHRITIS

The term" Arthritis" means joint inflammation, joints are places where two bones meet. There are various types of arthritis present, Rheumatoid arthritis is one of them. Rheumatoid arthritis is a disease which causes irreversible joint damage and disability (Starshinova et al., 2018). Generally diagnosis is done by combination of both clinical and laboratory features. Patient's suffering from polyarthritis ofjoints of the hands and feet generally faces problems like early morning stiffness and sometimes constitutional symptoms.Proteins prepared by our immune system can attack healthy tissue in our body, those are known as rheumatoid factors. Elevated levels of rheumatoid factor in blood are common in autoimmune diseases such as rheumatoid arthritis and Sjogren syndrome. Normal range of Rheumatoid factor level is 0-20 units per mililiter of blood.

Risk factor

Factors influencing high risk of rheumatoid arthritis

1. Gender

Women are mostly affected to Rheumatoid arthritis as compared to men.

1. Age

Generally, occurs in middle age.

1. Smoking

Smoking cigarettes increase high risk of rheumatoid arthritis,if one havea genetic disposition for the development of the disease.

1. Overweight

People with excess obesity may face high risk of developing rheumatoid arthritis.

Pathophysiology

* Antigen presentation to T cells.
* T and B cell Multiplicity in the synovial lining angiogenesis.
* Build up of neutrophils in synovial fluid.
* Initial formation of Pannus ( a sheet of granulation tissue containing inflammation, known as the Pannus, proliferates from the synovial membrane and invades the joint
* Erosion of subchondral bone.
* Invasion of cartilage by Pannus proliferation of chondrocytes.
* Ligament laxity.
* Reduced range of motion, contractures, joint instability and systemic problems.

Complications

* Rheumatoid arthritis including medications increases the risk of osteoporosis (weakening of bones that increases the risk of fracture).
* Arthritis nodules - Usually, the elbows and other pressure areas are where these rigid masses of tissue form. However, the body's nodules can form anywhere, including the heart and lungs.
* Many medications used to treat rheumatoid arthritis can decrease the immune system, which raises the risk of pathogens. Get immunized to protect yourself from illnesses including influenza, shingles, pneumonia, and COVID-19.
* Carpal tunnel syndrome - The nerve that supplies the majority of our hand and fingers may be compressed if rheumatoid arthritis affect our wrists.
* Lung condition - Breathlessness that worsens over time is a possible consequence of lung tissue inflammation and scaring in rheumatoid arthritis patients.
* Thyroid cancer - Rheumatoid arthritis is linked to an increased risk of lymphomas, a family of blood cancers that start in the lymphatic system.

Indications and Manifestations

* Symptoms and indicators of rheumatoid arthritis can include:
* heated, swollen, and delicate joints
* stiffness in the joints, which usually grows worse after sitting still and in the morning
* Fatigue, fever, and loss of appetite
* Early-stage rheumatoid arthritis usually affects smaller joints first, notably those that connect your fingers and toes to your foot. Early-stage rheumatoid arthritis usually affects smaller joints first, notably those that connect your fingers and toes to your foot.Usually, the identical joint on each side of your body give you trouble.
* About 40% of people with rheumatoid arthritis also have non-joint indications and symptoms. Areas that could be impacted include:
* Seeing
* Respiratory
* Skin
* Coronary
* Glandular glands
* Nervous tissue
* The bone marrow
* Blood vessels

Rheumatoid arthritis symptoms and indicators can vary greatly in severity and occasionally come and go. Relative remissions, or periods when the illness's pain and swelling are reduced or eliminated, alternate with flare-ups, or periods of increased disease activity.Over time, rheumatoid arthritis may cause joints to shift and swell.

Diagnose

The most frequent systemic inflammatory arthritis to be diagnosed is rheumatoid arthritis. The most common groups afflicted are women, smokers, and anyone with a family history of the condition. Having at least one joint with noticeable swelling that cannot be attributed to another illness is a requirement for diagnosis. The more minor joints impacted, the higher the chance ofbeing diagnosed with rheumatoid arthritis. Rheumatoid factor or anti-citrullinated protein antibody, as well as an increased C-reactive protein level or erythrocyte sedimentation rate, all point to a diagnosis of rheumatoid arthritis in an inflammatory arthritis patient. Renal and hepatic function tests, as well as a complete blood count with differential, should be part of the first laboratory evaluation. Testing for tuberculosis, hepatitis B, and hepatitis C is recommended for patients receiving biologic drugs. Early treatment with disease-modifying antirheumatic medications is possible with an earlier diagnosis of rheumatoid arthritis.

Treatment

To manage the disease, drug combinations are frequently employed. The first-line treatment for rheumatoid arthritis is usually methotrexate. Tumour necrosis factor inhibitors, for example, are considered biologic medicines and can be combined for dual therapy. Reduction of joint discomfort and swelling, avoidance of radiographic damage and apparent deformity, and maintenance of job and personal activities are the objectives of treatment (Starshinova et al.,2020). For patients with significant joint deterioration whose symptoms are not well controlled with medicine, joint replacement is indicated.

1. SYSTEMIC LUPUS ERYTHEMATOSUS

Systemic lupus erythematosus (SLE), another name for lupus, is a chronic (long-term) inflammatory illness that can affect nearly every area of the body, with the skin,joints, kidneys, heart, lungs, bones, blood, and brain being the most commonly affected. An individual with systemic lupus erythematosus has an autoimmune illness, which means that their own immune system targets and damages their own healthy cells and tissues. No two persons with lupus have the same exact form of the disease because it can affect any organ system. Nonetheless, the majority of individuals suffering from lupus or systemic lupus erythematosus (SLE) report experiencing remissions or times when their symptoms appear tobe minimal or nonexistent, and flare-ups or relapses, which are marked by increased inflammation (Table 2).

**Table 2:**Various antigens their nature, prevalence and association with systemic lupus erythematosus

|  |  |  |  |
| --- | --- | --- | --- |
| Antigen | Nature | Prevalence in SLE | Association |
| Hep-2 cell nuclei | ANA | > 95% | Numerous autoimmune diseases |
| dsDNA | Native, double-stranded DNA | 40%-60% | High specificity for lupus, titers correlate with disease activity |
| Histones |  | 50%-70% | Drug-induced lupus |
| Sm | Small nuclear RNAs complexed with protein | 20% - 30% | High specificity for lupus |
| Nuclear RNP (U1 RNP) | Small nuclear RNAs complexes with protein | 30% -40% |  |
| SS-A (Ro) | Protein associated with RNA | 30% -50% | ndrome, subacute cutaneous lupus, neonatal lupus with heart block, SLE with interstitial pneumonia |
| SS-B(La) | Protein bound to small RNA | 10% -15% | ndrome |
| Ku | DNA binding proteins | 10% -39% | MCTD, scleroderma, primary pulmonary hypertension |
| Ki | Nuclear protein | 8%- 31% | Arthritis, pericarditis, and pulmonary hypertension in patients with SLE |
| PCNA/cyclin | Cell cycle protein | 3% |  |
| Hsp90 | Heat shock protein | 50% | Polymyositis |
| p ribosomal protein, rRNP | Ribosomal phosphoprotein | 10% | Neuropsychiatric SLE |
| ssDNA | Single-stranded DNA | 70% |  |
| β2-glycoprotein1 | Anionic proteins, cardiolipin | 25% | Lupus anticoagulant, arterial and venous thromboses, neurologic disease |

A systemic lupus genetic predisposition may be associated with several risk factors, such as the -DR3 haplotype, HLA-B8 haplotype, ultraviolet ( UV ) rays from sunlight, viral infection, particularly Epstein-Barr virus infection, hormones, toxins, and tobacco smoking.

The prevalence of mild along with more severe SLE is increased in smokers. Smoking also decreases the effectiveness of other therapies, such as antimalarial drugs.

Types of Systemic lupus erythematosus

1. Systemic lupus erythematosus -The most prevalent type of lupus is systemic lupus erythematosus (SLE)
2. Cutaneous lupuserythematosus (CLE)

Skin-specific lupus or cutaneous lupus erythematosus (CLE) (which includes discoid lupus erythematosus (DLE) and subacute cutaneous lupus erythematosus (SCLE) Skin lupus erythematosus (CLE) can manifest either systemically involved or not.

III) Drug-induced lupus erythematosus (DILE)

A condition similar to lupus that is brought on by some pharmaceutical medications. Characteristics of drug-induced lupus erythematosus (DILE) set it apart from typical (idiopathic) SLE. For instance, DILE appears concurrently with drug exposure and disappears after treatment is finished.

IV) Neonatal lupus erythematosus

A rare disorder known as neonatal lupus erythematosus affects newborns of lupus-affected women. Neonatal lupus refers to lupus that affects infants born to women who have the disease. Anti-Sjögren's syndrome-related antigen A (also known as anti-Ro; SSA/Ro) or anti-Sjögren's syndrome-related antigen B (also known as anti-La; SB/La) antibodies from the mother pass through the placenta and cause neonatal lupus, which is characterised by congenital heart block, photosensitivity rash, cytopenia, and abnormalities of the liver (Nydegger et al., 1974).

V) Child-onset lupus or juvenile-onset systemic lupus

Juvenile-onset systemic lupus erythematosus (JSLE) or child-onset lupus erythematosus. SLE, often known as "child-onset lupus" or "juvenile-onset systemic lupus," can also affect children. It has been separated into a distinct class because of the clinical distinctions between usual adult-onset SLE and child-onset SLE.

## Complications of Lupus:

Acute atherosclerosis, or arterial blockage, brought on by lupus disease, especially when it's active, can cause cardiac events, kidney failure, and strokes in young women.Therefore, it is imperative that lupus patients exercise and reduce other heart disease risk factors, such as smoking, high blood pressure, and high cholesterol, in addition to managing their condition.One of the most prevalent and dangerous symptoms of lupus is inflammation of the kidneys. Dialysis and renal failure may result if it remains undiagnosed. By obtaining treatment as soon as kidney disease manifests, you can contribute to preventing these dangerous consequences. Among these indicators are:

* Elevated blood pressure
* Swollen hands and feet
* Swollenness surrounding your eyes
* Urinating more frequently at night, having bleeding with foam in the urine, or experiencing discomfort or difficulty urinating are examples of changes in urination.)

Many parts of your body, including your: can become inflamed as a result of systemic lupus erythematosus (SLE).

Renal system

Kidney failure is one of the main causes of death for lupus patients, and the disease can cause severe kidney damage (lupus nephritis).

**Brain and central nervous system:** The central nervous system and the brain. Lupus can cause brain damage that manifests as headaches, vertigo, altered behaviour, visual issues, strokes, or seizures. Many lupus sufferers struggle with memory loss and may find it difficult to articulate their ideas.

**Blood and blood vessels**

vascular and blood flow, Anaemia, or low red blood cell count, and a higher risk of bleeding or blood clotting are among the blood issues that can result from lupus. Vasculitis, or inflammation of the blood vessels, is another effect it may have.

Lungs

Breathing difficulties may result from an inflammation of the lining of the chest cavity, which is more likely in people with lupus. Pneumonia and lung bleeding are also potential outcomes.

Heart

Inflammation of the heart muscle (myocarditis), arteries (arteritis), or cardiac membranes (pericarditis) can all be brought on by lupus. There is also a significant rise in the risk of heart attacks and cardiovascular disease.

## Lupus Causes

Your immune system defends your body against infections and cancer when it is in good health. Your body's immune system targets healthy tissue when you have lupus, an autoimmune illness. Your genetic makeup and environmental factors most likely have a combined role in your development of lupus. But neither the aetiology nor the factors influencing the disease's variable manifestation are understood. Physicians are aware that a variety of elements are necessary, such as the "correct" genetic composition, exposure to the environment, and features unique to each organ. In addition, lupus patients may have trouble getting rid of ageing and damaged cells from their bodies, which constantly stimulates the immune system and causes an aberrant reaction.

It seems that exposure to environmental triggers for lupus can cause the disease to flare up in persons who have a hereditary propensity for it. In most cases, however, the cause of lupus remains unknown. Among the possible triggers are:

* Sunlight: Exposure to the sun may bring on lupus skin lesions or trigger an internal response in susceptible people.
* Infections: Having an infection can initiate lupus or cause a relapse in some people.
* Medications: Lupus can be triggered by certain types of blood pressure medications, anti-seizure medications and antibiotics. People who have drug-induced lupus usually get better
* when they stop taking the medication. Rarely, symptoms may persist even after the drug is stopped.

## Lupus Signs and Symptoms

## Many times, lupus patients experience non-lupus-specific symptoms. Fever, exhaustion, weight loss, blood clots, and patchy or hairline-related hair loss are a few of them. In addition, they could experience impaired circulation in their fingers and toes, heartburn, and stomach ache. Miscarriages can happen to pregnant women.Nonetheless, skin symptoms are present in about 90% of patients with systemic lupus erythematosus. The following are the most typical places where systemic lupus erythematosus skin lesions occur:

* Face, in particular the nose and cheeks
* Photosensitivity—an heightened sensitivity to sunlight—resulting in sun-exposed skin on the limbs, supports the palms, the upper portion of the chest, and upper back.
* The nails and fingers
* The nose or mouth

• The Scalp

One of the defining cutaneous characteristics of systemic lupus erythematosus is a butterfly rash, often known as malar blush. After being exposed to the sun, redness around the cheekbones and nose bridge may arise weeks before other symptoms do. A rash may appear on skin that has been photo-distributed, or has been subjected to the sun, particularly the backs of hands and fingers. The arms and trunk may also be affected by this rash, which takes the form of red, scaly areas.Tiny, painless ulcers can appear in the mouth, particularly on the roof of the mouth, or more frequently in the nose.Hair loss is a possible symptom of lupus that affects the scalp skin. Patchiness or thinning throughout the scalp, particularly at the temples, are possible

Prevention of Lupus

Nobody is aware of a preventative measure for systemic lupus erythematosus (SLE) because its cause is unclear. By minimising sun exposure (wearing hats, long sleeves, and sunscreen), getting enough sleep, and taking prescribed medicine, flares of lupus may be lessened. Taking calcium and vitamin D supplements can lower your risk of osteoporosis.

## Lupus Diagnosis

No one test can diagnose lupus. The combination of blood and urine tests, signs and symptoms, and physical examination findings leads to the diagnosis. Unusual blood tests, including:

* Low blood vessel counts, including anemia, low white blood cell counts, and low platelets.
* A positive result for antinuclear antibodies (ANA): Specific abnormal antibodies as well as like anti-double-strand DNA (also called anti-dsDNA), anti-Smith (sometimes called anti-Sm), or antiphospholipid immunoglobulins are present in almost all lupus patients and have the capacity to set off the body's own self-attackIf, based on your symptoms, your doctor suspects you have lupus, they will order many tests for blood to confirm the diagnosis. The ANA blood screening test is the most significant. A negative ANA indicates the absence of lupus. If your ANA test results are positive, you may have lupus and require more testing. Antibodies specific to the diagnosis of lupus, such as anti-dsDNA and anti-Sm, are part of these blood tests.Antiphospholipid antibodies indicate an increased risk for specific problems, such as blood clots or miscarriage. Physicians may also assess blood levels of specific complement proteins, which are components of the immune system, in order to help identify and monitor the disease (Bogdanos et al., 2017).

## Lupus Treatment

## The lupus is a long-term illness. Remission induction is the goal of treatment. The kind and severity of your symptoms will determine how you are treated. A thorough discussion of the advantages and hazards with your doctor is necessary to decide what medications to use and whether your symptoms and signs should be addressed. It’s possible that you and your doctor will need to adjust your medicine or dosage as your symptoms come on and off. The following drugs are most frequently used to treat lupus:

NSAIDs, ornonsteroidal anti-inflammatory medications

For the treatment of lupus-related pain, edoema, and fever, over-the-counter NSAIDs like ibuprofen (Advil, Motrin IB, and others) and naproxen sodium (Aleve) may be utilised. Prescriptions are available for stronger NSAIDs. Stomach bleeding, kidney issues, and an elevated risk of heart problems are among the side effects of NSAIDs. Prior to using any over-the-counter (OTC) medication for your lupus, always get your doctor's approval.

Immunosuppressive medicines

In severe lupus patients, immune-suppressive medications may be beneficial. Trexall, mycophenolate mofetil (CellCept), and azathioprine (Imuran, Azasan) are a few examples. The severe kidney ailment linked to the disease known as lupus nephritis has recently been treated with mycophenolate mofetil. An increased risk of infection, liver damage, lower fertility, and an increased risk of cancer are possible side effects.

Combination therapy

To manage lupus and avoid tissue damage, medical professionals may mix and match a few different drugs. Every therapy has advantages and disadvantages. The majority of immune-suppressive drugs have potential negative effects and need to be closely watched. Some side effects of these drugs include an increased risk of infections, diarrhea, nausea, and vomiting, loss of hair, hypertension, and osteoporosis (weak bones). When a medication has negative effects or the disease enters a remission, rheumatologists may decide to discontinue it altogether or reduce the dosage. Because of this, it's critical to have thorough and regular physical examinations as well as laboratory testing to monitor your symptoms and adjust your care as necessary.

Steroids

Prednisone and other corticosteroids help reduce lupus-related inflammation. Steroids at high dosages, including methylprednisolone (A-Methapred, Medrol), are frequently used to treat severe renal and brain diseases. Weight gain, bruising easily, osteoporosis (thinning bones), high blood pressure, diabetes, and an elevated risk of infection are some of the side effects. Larger dosages and longer treatment regimens carry a larger risk of adverse effects (Song etal., 2020).

8. CONCLUSION

Symptoms of inflammation have been linked to autoimmune diseases, and autoantibody counts in patients may help with diagnosis and severity assessments of the condition, which may be important for treatment. Myasthenia gravis is the most well-understood autoimmune disease; studies on the disease have advanced our knowledge of the basic principles underlying neuromuscular transmission. Rheumatoid arthritis and several medications used to treat it may decrease the immune system, which raises the risk of infections. Methotrexate is often the first line of therapy for rheumatoid arthritis. Biologic medications, such as tumour necrosis factor inhibitors, may be used in combination for dual treatment. The -DR3 haplotype and other genetic predispositions to systemic lupus are associated with risk factors such as sunlight exposure, UV radiation from HLA-B8, viral infection (particularly Epstein-Barr virus hormones), pollutants, and cigarette smoking. Over-the-counter NSAIDs, such as ibuprofen (Advil, Motrin IB, and others) and naproxen sodium (Aleve), may be used to treat fever, edoema, and pain associated with lupus. Extended treatment plans and larger dosages are associated with an increased risk of side effects.

**REFERENCES**

1. Scherlinger M., Mertz P, Arnaud L.Worldwide trends in all-cause mortality of auto-immune systemic diseases between 2001 and 2014. *Autoimmune. Rev.*2020;19(8) [[PubMed](https://pubmed.ncbi.nlm.nih.gov/32234406)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Autoimmun.+Rev.&title=doi:+arj:+worldwide+trends+in+all-cause+mortality+of+auto-immune+systemic+diseases+between+2001+and+2014&author=M.+Scherlinger&author=P.+Mertz&author=L.+Arnaud&volume=19&issue=8&publication_year=2020&)]

2. Leo A., Leung P.S.C., Hirschfield G.M., Gershwin E.M. The pathogenesis of primary biliary cholangitis: a comprehensive review. *Semin. Liver Dis.*2020;40(1):34–48. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31537031)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Semin.+Liver+Dis.&title=The+pathogenesis+of+primary+biliary+cholangitis:+a+comprehensive+review&author=A.+Lleo&author=P.S.C.+Leung&author=G.M.+Hirschfield&author=E.M.+Gershwin&volume=40&issue=1&publication_year=2020&pages=34-48&pmid=31537031&)]

3. Evert J., Lawler E., Bogan H., Perl’s T. Morbidity profiles of centenarians: survivors, delayers, and escapers. *J Gerontol A BiolSci Med Sci.*2003;58(3):232–237. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/12634289)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=J+Gerontol+A+Biol+Sci+Med+Sci&title=Morbidity+profiles+of+centenarians:+survivors,+delayers,+and+escapers&author=J.+Evert&author=E.+Lawler&author=H.+Bogan&author=T.+Perls&volume=58&issue=3&publication_year=2003&pages=232-237&pmid=12634289&)]

4. Watad A., Bragazzi N.L., Shoenfeld Y. Autoimmunity in the elderly: insights from basic science and clinics - a mini-review. *Gerontology.*2017;63(6):515–523. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/28768257)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Gerontology&title=Autoimmunity+in+the+elderly:+insights+from+basic+science+and+clinics+-+a+mini-review&author=A.+Watad&author=N.L.+Bragazzi&author=Y.+Shoenfeld&volume=63&issue=6&publication_year=2017&pages=515-523&pmid=28768257&)]

5. Tang D., Kang R.…Lotze M.T. PAMPs and DAMPs: signals that spur autophagy and immunity. *Immunol. Rev.*2012;249(1) [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3662247/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/22889221)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Immunol.+Rev.&title=PAMPs+and+DAMPs:+signals+that+spur+autophagy+and+immunity&author=D.+Tang&author=R.+Kang&author=M.T.+Lotze&volume=249&issue=1&publication_year=2012&)]

6. Satoh T., Akira S. Toll-like receptor signalling and its inducible proteins. *Microbiol.Spectr.*2016;4(6) [[PubMed](https://pubmed.ncbi.nlm.nih.gov/28084212)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Microbiol.+Spectr.&title=Toll-like+receptor+signaling+and+its+inducible+proteins&author=T.+Satoh&author=S.+Akira&volume=4&issue=6&publication_year=2016&)]

7. Croft A.P., Campos J., Buckley C.D. Distinct fibroblast subsets drive inflammation and damage arthritis. *Nature.*2019;570(7760):246–251. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6690841/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31142839)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Nature&title=Distinct+fibroblast+subsets+drive+inflammation+and+damage+arthritis&author=A.P.+Croft&author=J.+Campos&author=C.D.+Buckley&volume=570&issue=7760&publication_year=2019&pages=246-251&pmid=31142839&)]

8. Swinkels M., Zhang J.H., Clark S.J. C-reactive protein and pentraxin-3 binding of factor H-like protein 1 differs from complement factor H: implications for retinal inflammation. *Sci. Rep.*2018;8(1) [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5786067/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/29374201)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Sci.+Rep.&title=C-reactive+protein+and+pentraxin-3+binding+of+factor+H-like+protein+1+differs+from+complement+factor+H:+implications+for+retinal+inflammation&author=M.+Swinkels&author=J.H.+Zhang&author=S.J.+Clark&volume=8&issue=1&publication_year=2018&)]

9. Wang S.S., Vajdic C.M., Smedby K.E. Associations of non-Hodgkin Lymphoma (NHL) risk with autoimmune conditions according to putative NHL loci. *Am. J. Epidemiol.*2015;181(6):406–421. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4402340/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/25713336)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Am.+J.+Epidemiol.&title=Associations+of+non-Hodgkin+Lymphoma+(NHL)+risk+with+autoimmune+conditions+according+to+putative+NHL+loci&author=S.S.+Wang&author=C.M.+Vajdic&author=K.E.+Smedby&volume=181&issue=6&publication_year=2015&pages=406-421&pmid=25713336&)]

10. Fallah M., Liu X.… K. H: autoimmune diseases associated with non-Hodkin lymphoma: a nationwide cohort study. *Ann. Oncol.*2014;25(10):2025–2030. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/25081899)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Ann.+Oncol.&title=K.+H:+autoimmune+diseases+associated+wih+non-Hodkin+lymphome:+a+nationwide+cohort+study&author=M.+Fallah&author=X.+Liu&volume=25&issue=10&publication_year=2014&pages=2025-2030&pmid=25081899&)]

11. Hainer S.J. TG. F: high-resolution chromatin profiling using CUT&RUN. *CurrProtocMol Biol.*2019;126(1) [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6422702/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/30688406)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Curr+Protoc+Mol+Biol&title=TG.+F:+high-resolution+chromatin+profiling+using+CUT&RUN&author=S.J.+Hainer&volume=126&issue=1&publication_year=2019&)]

12. Meers M.P., Bryson T.D., Henikoff J.G., Henikoff S. Improved CUT&RUN chromatin profiling tools. *Elife.*2019 [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6598765/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31232687)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Elife&title=Improved+CUT&RUN+chromatin+profiling+tools&author=M.P.+Meers&author=T.D.+Bryson&author=J.G.+Henikoff&author=S.+Henikoff&publication_year=2019&)]

13. Simeonov D.R. A. M: CRISPR-based tools in immunity. *Annu. Rev. Immunol.*2019;37:571–597. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/30698999)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Annu.+Rev.+Immunol.&title=A.+M:+CRISPR-based+tools+in+immunity&author=D.R.+Simeonov&volume=37&publication_year=2019&pages=571-597&pmid=30698999&)]

14. West E.E., Kolev M., Kemper C. Complement and the regulation of T cell responses. *Annu. Rev. Immunol.*2018;36:309–338. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7478175/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/29677470)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Annu.+Rev.+Immunol.&title=Complement+and+the+regulation+of+T+cell+responses&author=E.E.+West&author=M.+Kolev&author=C.+Kemper&volume=36&publication_year=2018&pages=309-338&pmid=29677470&)]

15. Lo M.W., Kemper C., Woodruff T.M. COVID-19: complement, coagulation, and collateral damage. *J. Immunol.*2020;205(6):1488–1495. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7484432/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/32699160)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=J.+Immunol.&title=COVID-19:+complement,+coagulation,+and+collateral+damage&author=M.W.+Lo&author=C.+Kemper&author=T.M.+Woodruff&volume=205&issue=6&publication_year=2020&pages=1488-1495&pmid=32699160&)]

16. Conigliaro P., Triggianese P.…Chimenti M.S. Complement, infection, and autoimmunity. *Curr.Opin.Rheumatol.*2019;31(5):532–541. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31192812)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Curr.+Opin.+Rheumatol.&title=Complement,+infection,+and+autoimmunity&author=P.+Conigliaro&author=P.+Triggianese&author=M.S.+Chimenti&volume=31&issue=5&publication_year=2019&pages=532-541&pmid=31192812&)]

17. Ling M., Murali M. Analysis of the complement system in the clinical immunology laboratory. *Clin. Lab. Med.*2019;39(4) [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31668271)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Clin.+Lab.+Med.&title=Analysis+of+the+complement+system+in+the+clinical+immunology+laboratory&author=M.+Ling&author=M.+Murali&volume=39&issue=4&publication_year=2019&)]

18. Kumagai S., Togashi Y.… H. N: the PD-1 expression balance between effector and regulatory T cells predicts the clinical efficacy of PD-1 blockade therapies. *N*at. Immunol.2020;21(11) [[PubMed](https://pubmed.ncbi.nlm.nih.gov/32868929)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Nat.+Immunol.&title=H.+N:+the+PD-1+expression+balance+between+effector+and+regulatory+T+cells+predicts+the+clinical+efficacy+of+PD-1+blockade+therapies&author=S.+Kumagai&author=Y.+Togashi&volume=21&issue=11&publication_year=2020&)]

19. Schreiber K.H., Apelo Si Arriola.… DW. L, .NCJd: a novel rapamycinanalog is highly selective for mTORC1 in vivo. *Nat. Commun.*2019;10(1) [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6642166/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31324799)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Nat.+Commun.&title=DW.+L,+.+NCJd:+a+novel+rapamycin+analog+is+highly+selective+for+mTORC1+in+vivo&author=K.H.+Schreiber&author=Arriola+Apelo+Si&volume=10&issue=1&publication_year=2019&)]

20. Khan S., Gerber D.E. Autoimmunity, checkpoint inhibitor therapy and immune-related adverse events: a review. *Semin. Canc. Biol.*2020;64:93–101. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6980444/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31330185)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Semin.+Canc.+Biol.&title=Autoimmunity,+checkpoint+inhibitor+therapy+and+immune-related+adverse+events:+a+review&author=S.+Khan&author=D.E.+Gerber&volume=64&publication_year=2020&pages=93-101&)]

21. Fässler M., Diem S.…Flatz L. Antibodies as biomarker candidates for response and survival to checkpoint inhibitors in melanoma patients. *J Immunother Cancer.*2019;7(1) [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6383238/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/30786924)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=J+Immunother+Cancer&title=Antibodies+as+biomarker+candidates+for+response+and+survival+to+checkpoint+inhibitors+in+melanoma+patients&author=M.+F%C3%A4ssler&author=S.+Diem&author=L.+Flatz&volume=7&issue=1&publication_year=2019&)]

22. Finkel P., Xia W., Jefferies W.A. Beyond unconventional: what do we really know about group 2 innate lymphoid cells? *J. Immunol.*2021;206(7):1409–1417. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33753565)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=J.+Immunol.&title=Beyond+unconventional:+what+do+we+really+know+about+group+2+innate+lymphoid+cells?&author=P.+Finkel&author=W.+Xia&author=W.A.+Jefferies&volume=206&issue=7&publication_year=2021&pages=1409-1417&pmid=33753565&)]

23. Zhou L., Huntington K.…El-Deiry W.S. Natural Killer cell activation, reduced ACE2, TMPRSS2, cytokines G-CSF, M-CSF and SARS-CoV-2-S pseudovirus infectivity by MEK inhibitor treatment of human cells. *bioRxiv.*2020, aug 3 [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=bioRxiv&title=Natural+Killer+cell+activation,+reduced+ACE2,+TMPRSS2,+cytokines+G-CSF,+M-CSF+and+SARS-CoV-2-S+pseudovirus+infectivity+by+MEK+inhibitor+treatment+of+human+cells&author=L.+Zhou&author=K.+Huntington&author=W.S.+El-Deiry&publication_year=2020,+aug+3&)]

24. Rendeiro A.F., Casano J.…Inghirami G. Profiling of immune dysfunction in COVID-19 patients allows early prediction of disease progression. *Life Science Alliance.*2020 [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7768198/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33361110)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Life+Science+Alliance&title=Profiling+of+immune+dysfunction+in+COVID-19+patients+allows+early+prediction+of+disease+progression&author=A.F.+Rendeiro&author=J.+Casano&author=G.+Inghirami&publication_year=2020&)]

25. Hajishengalis G., Xiaofei L.…Chavakis T. Trained innate immunity and its implications for mucosal immunityand inflammation. *Adv. Exp. Med. Biol.*2019;1197:11–26. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6986364/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31732931)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Adv.+Exp.+Med.+Biol.&title=Trained+innate+immunity+and+its+implications+for+mucosal+immunityand+inflammation&author=G.+Hajishengalis&author=L.+Xiaofei&author=T.+Chavakis&volume=1197&publication_year=2019&pages=11-26&pmid=31732931&)]

26. Chua B.A., Van Der Werf I., Jamieson C., Signer R.A. Post-transcriptional regulation of homeostatic, stressed, and malignant stem cells. *Cell Stem Cell.*2020;26(2) [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7158223/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/32032524)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Cell+Stem+Cell&title=Post-transcriptional+regulation+of+homeostatic,+stressed,+and+malignant+stem+cells&author=B.A.+Chua&author=I.+Van+Der+Werf&author=C.+Jamieson&author=R.A.+Signer&volume=26&issue=2&publication_year=2020&)]

27. Schulte-Schrepping J., Reusch N.… (DeCOI). SLDC-OI: severe COVID-19 is marked by a dysregulated myeloid cell compartment. *Cell.*2020;182(6):1419–1440. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7405822/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/32810438)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Cell&title=(DeCOI).+SLDC-OI:+severe+COVID-19+is+marked+by+a+dysregulated+myeloid+cell+compartment&author=J.+Schulte-Schrepping&author=N.+Reusch&volume=182&issue=6&publication_year=2020&pages=1419-1440&pmid=32810438&)]

28. van der Made C.I., Hoischen A.…Ikeno Y. Primary immunodeficiencies in cytosolic pattern-recognition receptor pathways: toward host-directed treatment strategies. *Immunol. Rev.*2020;297(1):247–272. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/32640080)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Immunol.+Rev.&title=Primary+immunodeficiencies+in+cytosolic+pattern-recognition+receptor+pathways:+toward+host-directed+treatment+strategies&author=C.I.+van+der+Made&author=A.+Hoischen&author=Y.+Ikeno&volume=297&issue=1&publication_year=2020&pages=247-272&pmid=32640080&)]

29. Combes A.J., Courau T.…Krummel M.F. Global absence and targeting of protective immune states in severe COVID-19. *Nature.*2021;591:124–130. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8567458/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33494096)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Nature&title=Global+absence+and+targeting+of+protective+immune+states+in+severe+COVID-19&author=A.J.+Combes&author=T.+Courau&author=M.F.+Krummel&volume=591&publication_year=2021&pages=124-130&pmid=33494096&)]

30. Shin J.I., Lee K.H.… Kronbichler A**: inflammasomes and autoimmune and rheumatic diseases: a comprehensive review.** *J Autoimmmun.*2019;103 [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31326231)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=J+Autoimmmun&title=Kronbichler+A:+inflammasomes+and+autoimmune+and+rheumatic+diseases:+a+comprehensive+review&author=J.I.+Shin&author=K.H.+Lee&volume=103&publication_year=2019&)]

31. Defendi F., Thielens N.M.…Dumestre-Pérard C. The immunopathology of complement proteins and innate immunity in autoimmune disease. *Clin. Rev. Allergy Immunol.*2020;58:229–251. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31834594)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Clin.+Rev.+Allergy+Immunol.&title=The+immunopathology+of+complement+proteins+and+innate+immunity+in+autoimmune+disease&author=F.+Defendi&author=N.M.+Thielens&author=C.+Dumestre-P%C3%A9rard&volume=58&publication_year=2020&pages=229-251&pmid=31834594&)]

32. Bekkering S., Arts R.J.W.…Netea M.G. Metabolic induction of trained immunity through the mevalonate pathway. *Cell.*2018;(1–2):135–146. J.W. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/29328908)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Cell&title=Metabolic+induction+of+trained+immunity+through+the+mevalonate+pathway&author=S.+Bekkering&author=R.J.W.+Arts&author=M.G.+Netea&issue=1%E2%80%932&publication_year=2018&pages=135-146&pmid=29328908&)]

33. van der Meer J.W., Simon A. doi: ro: the challenge of autoinflammatory syndromes: with an emphasis on hyper-IgD syndrome. *Rheumatology.*2016:ii23–ii29. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/27856657)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Rheumatology&title=doi:+ro:+the+challenge+of+autoinflammatory+syndromes:+with+an+emphasis+on+hyper-IgD+syndrome&author=J.W.+van+der+Meer&author=A.+Simon&publication_year=2016&pages=ii23-ii29&pmid=27856657&)]

34. Wrap D., De Vlieger D., McLellan J.S. Structural basis for potent neutralization of beta coronaviruses by single-domain camelid antibodies. *Cell.*2020;181(5) [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7199733/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/32375025)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Cell&title=Structural+basis+for+potent+neutralization+of+betacoronaviruses+by+single-domain+camelid+antibodies&author=D.+Wrapp&author=D.+De+Vlieger&author=J.S.+McLellan&volume=181&issue=5&publication_year=2020&)]

35. Hoey R.J., Eom H., Horn J.R. Structure and development of single domain antibodies as modules for therapeutics and diagnostics. *Exp. Biol. Med.*2019;244(17):1568–1576. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6920669/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31594404)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Exp.+Biol.+Med.&title=Structure+and+development+of+single+domain+antibodies+as+modules+for+therapeutics+and+diagnostics&author=R.J.+Hoey&author=H.+Eom&author=J.R.+Horn&volume=244&issue=17&publication_year=2019&pages=1568-1576&)]

36. EASL European Association for the Study of the Liver. Clinical Practice Guidelines: the diagnosis and management of patients with primary biliary cholangitis. *Hepatol.*2017;67(1):145–172. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/28427765)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=JHepatol&title=European+Association+for+the+Study+of+the+Liver.+Clinical+Practice+Guidelines:+the+diagnosis+and+management+of+patients+with+primary+biliary+cholangitis&volume=67&issue=1&publication_year=2017&pages=145-172&pmid=28427765&)]

37. Lung T., Sakem B.…Nydegger U. The complement system in liver diseases: evidence-based approach and therapeutic options. *J Trans Autoimmun.*2019 [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7388403/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/32743505)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=J+Transl+Autoimmun&title=The+complement+system+in+liver+diseases:+evidence-based+approach+and+therapeutic+options&author=T.+Lung&author=B.+Sakem&author=U.+Nydegger&publication_year=2019&)]

38. Nydegger U., Lung T. T. B: inflammation thread runs across medical laboratory specialities. *Mediat.Inflamm.*2016;2016:4121837. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4963559/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/27493451)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Mediat.+Inflamm.&title=T.+B:+inflammation+thread+runs+across+medical+laboratory+specialities&author=U.+Nydegger&author=T.+Lung&volume=2016&publication_year=2016&pages=4121837&)]

39. Song S., De S., Barners B. Inhibition of IRF5 hyperactivation protects from lupus onset and severity. *J. Clin. Invest.*2020;130(12):6700–6717. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7685739/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/32897883)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=J.+Clin.+Invest.&title=Inhibition+of+IRF5+hyperactivation+protects+from+lupus+onset+and+severity&author=S.+Song&author=S.+De&author=B.+Barners&volume=130&issue=12&publication_year=2020&pages=6700-6717&pmid=32897883&)]

40. Bettacchioly E, Legaffric C, ., Renaudineau Y: An elevated polyclonal free light chain level reflects a strong interferon signature in patients with systemic autoimmune diseases. J Trans Autoimmun 2021, 4(100090). [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8010703/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33817614)].

41. Annett S., Moore G., Robson T. FK506 binding proteins and inflammation related signalling pathways; basic biology, current status and future prospects for pharmacological intervention. *Pharmacol.Ther.*2020 [[PubMed](https://pubmed.ncbi.nlm.nih.gov/32622856)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Pharmacol.+Ther.&title=FK506+binding+proteins+and+inflammation+related+signalling+pathways;+basic+biology,+current+status+and+future+prospects+for+pharmacological+intervention&author=S.+Annett&author=G.+Moore&author=T.+Robson&publication_year=2020&)]

42. Stojan G., Petri M. Anti-C1q in systemic lupus erythematosus. *Lupus.*2016;25(8):873–877. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7523495/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/27252264)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Lupus&title=Anti-C1q+in+systemic+lupus+erythematosus&author=G.+Stojan&author=M.+Petri&volume=25&issue=8&publication_year=2016&pages=873-877&pmid=27252264&)]

43. Bogdanos D.P., Sakkas L.I. From microbiome to infectome in autoimmunity. *Curr.Opin.Rheumatol.*2017;29(4):369–373. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/28394824)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Curr.+Opin.+Rheumatol.&title=From+microbiome+to+infectome+in+autoimmunity&author=D.P.+Bogdanos&author=L.I.+Sakkas&volume=29&issue=4&publication_year=2017&pages=369-373&pmid=28394824&)]

44. Nydegger U.E., Lambert P.H., Gerber H., Miescher P.A. Circulating immune complexes in the serum in systemic lupus erythematosus and in carriers of hepatitis B antigen. Quantitation by binding to radiolabelled C1q. *J. Clin. Invest.*1974;54:297–309. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC301557/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/4847246)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=J.+Clin.+Invest.&title=Circulating+immune+complexes+in+the+serum+in+systemic+lupus+erythematosus+and+in+carriers+of+hepatitis+B+antigen.+Quantitation+by+binding+to+radiolabeled+C1q&author=U.E.+Nydegger&author=P.H.+Lambert&author=H.+Gerber&author=P.A.+Miescher&volume=54&publication_year=1974&pages=297-309&pmid=4847246&)]

45. Arulraj T., Binder S., Meyer-Hermann M. Rate of immune complex cycling in follicular dendritic cells determines the extent of protecting antigen integrity and availability to germinal centre B cells. *J. Immunol.*2021;206(7):1436–1442. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7980531/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33608455)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=J.+Immunol.&title=Rate+of+immune+complex+cyclingg+in+follicular+dendritic+cells+determines+the+extent+of+protecting+antigen+integrity+and+availability+to+germinal+center+B+cels&author=T.+Arulraj&author=S.+Binder&author=M.+Meyer-Hermann&volume=206&issue=7&publication_year=2021&pages=1436-1442&pmid=33608455&)]

46. Abu-Rumeileh S., Abdelhak A.…Otto M. Guillain-Barré syndrome spectrum associated with COVID-19: an up-to-date systematic review of 73 cases. *J. Neurol.*2020:1–30. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7445716/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/32840686)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=J.+Neurol.&title=Guillain-Barr%C3%A9+syndrome+spectrum+associated+with+COVID-19:+an+up-to-date+systematic+review+of+73+cases&author=S.+Abu-Rumeileh&author=A.+Abdelhak&author=M.+Otto&publication_year=2020&pages=1-30&)]

47. Soltani E.Z., Rahmani F., Rezaei N. Autoimmunity and cytokines in Guillain-Barre syndrome revisited: review of pathomechanisms with an eye on therapeutic options. *Eur. Cytokine Newt.*2019;30(1):1–14. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31074417)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Eur.+Cytokine+Netw.&title=Autoimmunity+and+cytokines+in+Guillain-Barre+syndrome+revisited:+review+of+pathomechanisms+with+an+eye+on+therapeutic+options&author=E.Z.+Soltani&author=F.+Rahmani&author=N.+Rezaei&volume=30&issue=1&publication_year=2019&pages=1-14&pmid=31074417&)]

48. Levine M.E., Lu A.T., Horvath S. doi: a-: an epigenetic biomarker of aging for lifespan and health span. *Aging (Albany NY)*2018;10(4):573–591. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5940111/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/29676998)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Aging+(Albany+NY)&title=doi:+a-:+an+epigenetic+biomarker+of+aging+for+lifespan+and+healthspan&author=M.E.+Levine&author=A.T.+Lu&author=S.+Horvath&volume=10&issue=4&publication_year=2018&pages=573-591&pmid=29676998&)]

49. Lu A.T., Quach A., Wilson J.G., Reiner A.P., Aviv A., Raj K., Hou L., Baccarelli A.A., Li Y., Stewart J.D. DNA methylation GrimAge strongly predicts lifespan and health span. *Aging (Albany NY)*2019;11(2):303–327. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6366976/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/30669119)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Aging+(Albany+NY)&title=DNA+methylation+GrimAge+strongly+predicts+lifespan+and+healthspan&author=A.T.+Lu&author=A.+Quach&author=J.G.+Wilson&author=A.P.+Reiner&author=A.+Aviv&volume=11&issue=2&publication_year=2019&pages=303-327&pmid=30669119&)]

50. Zhang Y., Wilson R.… H. B: DNA methylation signatures in peripheral blood strongly predict all-cause mortality. *Nat. Commun.*2017;17(8) [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5357865/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/28303888)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Nat.+Commun.&title=H.+B:+DNA+methylation+signatures+in+peripheral+blood+strongly+predict+all-cause+mortality&author=Y.+Zhang&author=R.+Wilson&volume=17&issue=8&publication_year=2017&)]

51. Alpert A., YishaiPickman Y., Shen-Orr S.S. A clinically meaningful metric of immune age derived from high-dimensional longitudinal monitoring. *Nat. Med.*2019;25(3):487–495. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6686855/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/30842675)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Nat.+Med.&title=A+clinically+meaningful+metric+of+immune+age+derived+from+high-dimensional+longitudinal+monitoring&author=A.+Alpert&author=Y.+Yishai+Pickman&author=S.S.+Shen-Orr&volume=25&issue=3&publication_year=2019&pages=487-495&pmid=30842675&)]

52. Mamoshina P., Zhavoronkov A. edn. vol. 10.Moskalev A; 2019. Deep integrated biomarkers of aging. (Biomarkers of Human Aging, Healthy Aging and Longevity). [[Google Scholar](https://scholar.google.com/scholar?q=Mamoshina+P.+Zhavoronkov+A.+Deep+integrated+biomarkers+of+aging+edn.+Biomarkers+of+Human+Aging,+Healthy+Aging+and+Longevity+vol.+10+2019+Moskalev+A+)]

53. Rockwood K., Mitnitski A. Frailty defined by deficit accumulation and geriatric medicine defined by frailty. *Clin.Geriatr. Med.*2011;27(1):17–26. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/21093719)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Clin.+Geriatr.+Med.&title=Frailty+defined+by+deficit+accumulation+and+geriatric+medicine+defined+by+frailty&author=K.+Rockwood&author=A.+Mitnitski&volume=27&issue=1&publication_year=2011&pages=17-26&pmid=21093719&)]

54. Lehallier B., Gate D., Schaum N., Nanasi T., Lee S.E., Yousef H., Moran Losada P., Berdnik D., Keller A., Verghese J. Undulating changes in human plasma proteome profiles across the lifespan. *Nat. Med.*2019;25(12):1843–1850. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7062043/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31806903)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Nat.+Med.&title=Undulating+changes+in+human+plasma+proteome+profiles+across+the+lifespan&author=B.+Lehallier&author=D.+Gate&author=N.+Schaum&author=T.+Nanasi&author=S.E.+Lee&volume=25&issue=12&publication_year=2019&pages=1843-1850&pmid=31806903&)]

55. Vučković F., Krištić J.… G. L: association of systemic lupus erythematosus with decreased immunosuppressive potential of the IgGglycome. *Arthritis Rheum.*2015;67(11):2978–2989. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4626261/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/26200652)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Arthritis+Rheum.&title=G.+L:+association+of+systemic+lupus+erythematosus+with+decreased+immunosuppressive+potential+of+the+IgG+glycome&author=F.+Vu%C4%8Dkovi%C4%87&author=J.+Kri%C5%A1ti%C4%87&volume=67&issue=11&publication_year=2015&pages=2978-2989&)]

56. Mueller A.L., McNamara M.S., Sinclair D.A. Why does COVID-19 disproportionately affect older people? *Aging (Albany NY)*2020;12(10):9959–9981. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7288963/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/32470948)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Aging+(Albany+NY)&title=Why+does+COVID-19+disproportionately+affect+older+people?&author=A.L.+Mueller&author=M.S.+McNamara&author=D.A.+Sinclair&volume=12&issue=10&publication_year=2020&pages=9959-9981&pmid=32470948&)]

57. Kohli J., Veenstra I., Demaria M. The struggle of a good friend getting old: cellular senescence in viral responses and therapy. *EMBO Rep.*2021 [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8024996/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33734564)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=EMBO+Rep.&title=The+struggle+of+a+good+friend+getting+old:cellular+senescence+in+viral+responses+and+therapy&author=J.+Kohli&author=I.+Veenstra&author=M.+Demaria&publication_year=2021&)]

58. Challenor S., Tucker D. SARS-CoV-2-induced remission of Hodgkin lymphoma. *Br. J. Haematol.*2021;(3):192. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33386647)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Br.+J.+Haematol.&title=SARS-CoV-2-induced+remission+of+Hodgkin+lymphoma&author=S.+Challenor&author=D.+Tucker&issue=3&publication_year=2021&pages=192&)]

59. VkPh, Annika Kratzel A., Thiel V. Coronavirus biology and replication: implications for SARS-CoV-2. *Nat. Rev. Microbiol.*2021;19(3):155–170. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7592455/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33116300)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Nat.+Rev.+Microbiol.&title=Coronavirus+biology+and+replication:+implications+for+SARS-CoV-2&author=Ph+Vk&author=A.+Annika+Kratzel&author=V.+Thiel&volume=19&issue=3&publication_year=2021&pages=155-170&pmid=33116300&)]

60. Henriksson J., Chen X., Teichmann S.A. Genome-wide CRISPR screens in T helper cells reveal pervasive crosstalk between activation and differentiation. *Cell.*2019;176(4):882–896. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6370901/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/30639098)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Cell&title=Genome-wide+CRISPR+screens+in+T+helper+cells+reveal+pervasive+crosstalk+between+activation+and+differentiation&author=J.+Henriksson&author=X.+Chen&author=S.A.+Teichmann&volume=176&issue=4&publication_year=2019&pages=882-896&pmid=30639098&)]

61. Moreno AM, Aleman F, .., Mali P: Long-lasting analgesia via targeted in situ repression of Nav 1.7 in mice. Sci. Transl. Med. 2021, 13(584). [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8830379/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33692134)]

62. Liu Y., Sawalha A.H., Lu Q. COVID-19 and autoimmune diseases. *Curr.Opin.Rheumatol.*2021;33(2):155–162. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7880581/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33332890)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Curr.+Opin.+Rheumatol.&title=COVID-19+and+autoimmune+diseases&author=Y.+Liu&author=A.H.+Sawalha&author=Q.+Lu&volume=33&issue=2&publication_year=2021&pages=155-162&pmid=33332890&)]

63. Lung T., Kazatchkine M., Risch L., Risch M., Nydegger U. A consideration of convalescent plasma and plasma derivatives in the care of severely- ill patients with COVID 19. *Transfuse. Apher. Sci.*2020;59(5) [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7833822/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/32919880)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Transfus.+Apher.+Sci.&title=A+consideration+of+convalescent+plasma+and+plasmaderivatives+in+the+care+of+severely-+ill+patients+with+COVID+19&author=T.+Lung&author=M.+Kazatchkine&author=L.+Risch&author=M.+Risch&author=U.+Nydegger&volume=59&issue=5&publication_year=2020&)]

64. McMillan P., Dexhiemer T.…Uhal B.D. COVID-19 - a theory of autoimmunity against ACE-2 explained. *Front. Immunol.*2021 [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8021777/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33833750)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Front.+Immunol.&title=COVID-19+-+a+theory+of+autoimmunity+against+ACE-2+explained&author=P.+McMillan&author=T.+Dexhiemer&author=B.D.+Uhal&publication_year=2021&)]

65. Patriquin C., Kuo K.H.M. Eculizumab and beyond: the past, present, and future of complement therapeutics. *Transfuse. Med. Rev.*2019;33(4):254–265. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31703946)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Transfus.+Med.+Rev.&title=Eculizumab+and+beyond:+the+past,+present,+and+future+of+complement+therapeutics&author=C.+Patriquin&author=K.H.M.+Kuo&volume=33&issue=4&publication_year=2019&pages=254-265&)]

66. Hillmen P., Szer J., de la Tour P. Pegcetacoplan versus eculizumab in paroxysmal nocturnal haemoglobinuria. *N. Engl. J. Med.*2021;384:1028–1037. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33730455)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=N.+Engl.+J.+Med.&title=Pegcetacoplan+versus+eculizumab+in+paroxysmal+nocturnal+hemoglobinuria&author=P.+Hillmen&author=J.+Szer&author=P.+de+la+Tour&volume=384&publication_year=2021&pages=1028-1037&pmid=33730455&)]

67. Jayne D.R.W., Merkel P.A.…Bekker M.D. Avoca pan for the treatment of ANCA-associated vasculitis. *N. Engl. J. Med.*2021;384(feb 18):599–609. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33596356)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=N.+Engl.+J.+Med.&title=Avocapan+for+the+treatment+of+ANCA-associated+vasculitis&author=D.R.W.+Jayne&author=P.A.+Merkel&author=M.D.+Bekker&volume=384&issue=feb+18&publication_year=2021&pages=599-609&pmid=33596356&)]

68. Roth A., Barcellini W.…Berentsen S. Sutimlimab in cold agglutinin disease. *N. Engl. J. Med.*2021;384:1323–1334. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33826820)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=N.+Engl.+J.+Med.&title=Sutimlimab+in+cold+agglutinin+disease&author=A.+R%C3%B6th&author=W.+Barcellini&author=S.+Berentsen&volume=384&publication_year=2021&pages=1323-1334&pmid=33826820&)]

69. Berentsen S. How I treat cold agglutinin disease. *Blood.*2021;137(10):1295–1303. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33512410)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Blood&title=How+I+treat+cold+agglutinin+disease&author=S.+Berentsen&volume=137&issue=10&publication_year=2021&pages=1295-1303&pmid=33512410&)]

70. Zelek W., Xie L., Morgan B.P., Harris C.L. Compendium of curreent complement therapeutics. *Ml Immunol.*2019;114:341–352. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31446305)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Ml+Immunol&title=Compendium+of+curreent+complement+therapeutics&author=W.+Zelek&author=L.+Xie&author=B.P.+Morgan&author=C.L.+Harris&volume=114&publication_year=2019&pages=341-352&)]

71. Valenti L., Griffini S., Cugno M. Chromosome 3 cluster rs11385942 variant links complement activation with severe COVID-19. *J. Autoimmun.*2021 al e. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7796659/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33453462)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=J.+Autoimmun.&title=Chromosome+3+cluster+rs11385942+variant+links+complement+activation+with+severe+COVID-19&author=L.+Valenti&author=S.+Griffini&author=M.+Cugno&publication_year=2021&)]

72. Prochaska Z.…Frazer-Abel A. Complement analysis in the era of targeted therapeutics. *Mol. Immunol.*2018;102:84–88. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/29933889)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Mol.+Immunol.&title=Complement+analysis+in+the+era+of+targeted+therapeutics&author=Z.+Prohaszka&author=A.+Frazer-Abel&volume=102&publication_year=2018&pages=84-88&pmid=29933889&)]

73. Flemming A. mRNA vaccine shows promise in autoimmunity. *YNat Rev Immunol.*2021, Jan 12 [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7802056/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33437044)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=YNat+Rev+Immunol&title=mRNA+vaccine+shows+promise+in+autoimmunity&author=A.+Flemming&publication_year=2021,+Jan+12&)]

74. Krienke C., Kolb L.… U. S: a noninflammatory mRNA vaccine for treatment of experimental autoimmune encephalomyelitis. *Science.*2021, Jan 8;(371):145–153. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33414215)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Science&title=U.+S:+a+noninflammatory+mRNA+vaccine+for+treatment+of+experimental+autoimmune+encephalomyelitis&author=C.+Krienke&author=L.+Kolb&issue=371&publication_year=2021,+Jan+8&pages=145-153&pmid=33414215&)]

75. Caso F., Costa L.…Scarpa R. Could SARS-CV-2 trigger autoimmune and/or autoinflammatory mechanisms in genetically predisposed subjects? *Autoimmun. Rev.*2020 [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7271072/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/32220633)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Autoimmun.+Rev.&title=Could+SARS-CV-2+trigger+autoimmune+and/or+autoinflammatory+mechanisms+in+genetically+predisposed+subjects?&author=F.+Caso&author=L.+Costa&author=R.+Scarpa&publication_year=2020&)]

76. Robinson E.K., Covarrubias S., Carpenter S. The how and why of lncRNA function: an innate immune perspective. *Biochim Biopsy’s Acta Gene Regul Mech.*2020;(4):1863. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7185634/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31487549)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Biochim+Biophys+Acta+Gene+Regul+Mech&title=The+how+and+why+of+lncRNA+function:an+innate+immune+perspective&author=E.K.+Robinson&author=S.+Covarrubias&author=S.+Carpenter&issue=4&publication_year=2020&pages=1863&)]

77. Cohen Tervaert J.W. Autoinflammatory/autoimmunity syndrome induced by adjuvants (ASIA; Shoenfeld's syndrome): a new flame. *Autoimmun. Rev.*2018;17(12):1259–1264. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/30316995)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Autoimmun.+Rev.&title=Autoinflammatory/autoimmunity+syndrome+induced+by+adjuvants+(ASIA;+Shoenfeld%27s+syndrome):+a+new+flame&author=J.W.+Cohen+Tervaert&volume=17&issue=12&publication_year=2018&pages=1259-1264&pmid=30316995&)]

78. Imbach P., Barandun S.…Wagner H.P. High-dose intravenous gammaglobulin for idiopathic thrombocytopenic purpura in childhood. *Lancet.*1981;i:1228–1231. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/6112565)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Lancet&title=High-dose+intravenous+gammaglobulin+for+idiopathic+thrombocytopenic+purpra+in+childhood&author=P.+Imbach&author=S.+Barandun&author=H.P.+Wagner&volume=i&publication_year=1981&pages=1228-1231&)]

79. Sultan Y., Kazatchkine M.D., Maisonneuve P., Nydegger U.E. Anti-idiotypic suppression of autoantibodies to factor VIII (antihemophilic factor) by high-dose intravenous gammaglobulin. *Lancet.*1984;8406:765–768. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/6148519)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Lancet&title=Anti-idiotypic+suppression+of+autoantibodies+to+factor+VIII+(antihaemophilic+factor)+by+high-dose+intravenous+gammaglobulin&author=Y.+Sultan&author=M.D.+Kazatchkine&author=P.+Maisonneuve&author=U.E.+Nydegger&volume=8406&publication_year=1984&pages=765-768&)]

80. Tian M., Cheng H.L.…Alt F.W. An in vivo method for diversifying the functions of therapeutic antibodies. *Proc. Natl. Acad. Sci. Unit. States Am.*2021;118(10) [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7958431/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33658386)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Proc.+Natl.+Acad.+Sci.+Unit.+States+Am.&title=An+in+vivo+method+for+diversifying+the+functions+of+therapeutic+antibodies&author=M.+Tian&author=H.L.+Cheng&author=F.W.+Alt&volume=118&issue=10&publication_year=2021&)]

81. Signore A., Erba P.A. Molecular imaging of inflammation/infection: the future of disease management. *Curr.Pharmaceut.Des.*2018;24(7):741–742. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/29773052)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Curr.+Pharmaceut.+Des.&title=Molecular+imaging+of+inflammation/infection:+the+future+of+disease+management&author=A.+Signore&author=P.A.+Erba&volume=24&issue=7&publication_year=2018&pages=741-742&)]

82. Ding X., Zhang B. DeepBAR: a fast and exact method for binding free energy computation. *J. Phys. Chem. Lett.*2021;12:2509–2515. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8030779/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33719449)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=J.+Phys.+Chem.+Lett.&title=DeepBAR:+a+fast+and+exact+method+for+binding+free+energy+computation&author=X.+Ding&author=B.+Zhang&volume=12&publication_year=2021&pages=2509-2515&pmid=33719449&)]

83. Vulto A.G., Jaquez O.A. The process defines the product: what really matters in biosimilar design and production? *Rheumatology.*2017;56:iv14–iv29. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5850795/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/28903544)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Rheumatology&title=The+process+defines+the+product:+what+really+matters+in+biosimilar+design+and+production?&author=A.G.+Vulto&author=O.A.+Jaquez&volume=56&publication_year=2017&pages=iv14-iv29&pmid=28903544&)]

84. Rajewsky K. The advent and rise of monoclonal antibodies. *Nature.*2019:47–49. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31686050)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Nature&title=The+advent+and+rise+of+monoclonal+antibodies&author=K.+Rajewsky&publication_year=2019&pages=47-49&)]

85. Weinreich D.M., Sivapalasingam S., Norton T. Investigators T: REGN-COV2, a neutralizing antibody cocktail. *N. Engl. J. Med.*2020;17dec [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7781102/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/33332778)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=N.+Engl.+J.+Med.&title=Investigators+T:+REGN-COV2,+a+neutralizing+antibody+cocktail&author=D.M.+Weinreich&author=S.+Sivapalasingam&author=T.+Norton&volume=17+dec&publication_year=2020&)]

86. Kohler H., AnastasPashov A., Kieber-Emmons T. The promise of anti-idiotype revisited. *Front. Immunol.*2019 [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6474207/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31031777)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Front.+Immunol.&title=The+promise+of+anti-idiotype+revisited&author=H.+Kohler&author=A.+Anastas+Pashov&author=T.+Kieber-Emmons&publication_year=2019&)]

87. Adamson H., Nicholl A.T.… DC. T: affimers as anti-idiotypic affinity reagents for pharmacokinetic analysis of biotherapeutics. *Biotechniques.*2019:261–269. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31823668)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Biotechniques&title=DC.+T:+affimers+as+anti-idiotypic+affinity+reagents+for+pharmacokinetic+analysis+of+biotherapeutics&author=H.+Adamson&author=A.T.+Nicholl&publication_year=2019&pages=261-269&)]

88. Terwiel M., Grutters J.C., van Morsel C.H.M. Clustering of immune-mediated diseases in sarcoidosis. *Curr.Opin.Plum. Med.*2019;25(5):539–553. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31365389)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Curr.+Opin.+Pulm.+Med.&title=Clustering+of+immune-mediated+diseases+in+sarcoidosis&author=M.+Terwiel&author=J.C.+Grutters&author=C.H.M.+van+Moorsel&volume=25&issue=5&publication_year=2019&pages=539-553&pmid=31365389&)]

89. Llanos O., Hamzeh N. Sarcoidosis. *Med. Clin.*2019;103(3):523–534. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/30955519)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Med.+Clin.&title=Sarcoidosis&author=O.+Llanos&author=N.+Hamzeh&volume=103&issue=3&publication_year=2019&pages=523-534&)]

90. Starshinova A., Zinchenko Y., Yablonskiy P. Specific features of immune complexes in patients with sarcoidosis and pulmonary tuberculosis. *Immunol. Res.*2018;66(6):737–743. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/30552618)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Immunol.+Res.&title=Specific+features+of+immune+complexes+in+patients+with+sarcoidosis+and+pulmonary+tuberculosis&author=A.+Starshinova&author=Y.+Zinchenko&author=P.+Yablonskiy&volume=66&issue=6&publication_year=2018&pages=737-743&pmid=30552618&)].

91. Starshinova A.A., Malkova A.M.…Yablonskiy P.K. Sarcoidosis as an autoimmune disease. *Front. Immunol.*2020:10. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6960207/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/31969879)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Front.+Immunol.&title=Sarcoidosis+as+an+autoimmune+disease&author=A.A.+Starshinova&author=A.M.+Malkova&author=P.K.+Yablonskiy&publication_year=2020&pages=10&pmid=32117219&)].