

Subjective Somatosensory of Ankylosing Spondylitis and its Correlation With Vertigo

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Abstract. Ankylosing spondylitis as a form of arthritis starts to arouse more medical faculties' attention due to its mysterious origins and not yet discovered treatment. This study analyzed ankylosing spondylitis' correlation with vertigo and advanced diagnosis of ankylosing spondylitis. Common complications and symptoms are introduced based on etiology and history of ankylosing spondylitis. Patients' subjective somatosensory of the disease is further examined to study the coupling diseases ankylosing spondylitis brought with its infections. Several authentic cases of ankylosing spondylitis are studied and found possible relations between ankylosing spondylitis and the nervous system, which may lead to vertigo. Different neurological diseases are suspected to be caused by ankylosing spondylitis, thus research is conducted to explore the correlation between ankylosing spondylitis and vertigo. Despite ankylosing spondylitis, the ultimate goal of diagnosing is revealed through the spectrum of advanced radiographs and MRIs. The intention for indicating the diagnosis is to elucidate some early and late possibility of having ankylosing spondylitis on a technology-based level.

Keywords: Ankylosing spondylitis, vertigo, spinal cord, MRI diagnosis.

1. Introduction

Ankylosing spondylitis (AS) is a type of arthritis that affects the spine's development by inducing fusing between body structures. This fusing makes the spine less flexible, resulting in stiff movement accompanied by pain. Patients with ribs affected by ankylosing spondylitis may have difficulty breathing deeply. The word derived from the Greek “ankylos” means curved or rounded; “spondylos” means vertebra and inflammation. The first record of the disease has a very history Ankylosing spondylitis is first distinguished from rheumatoid arthritis by Galen in the 2nd century AD. Skeletal evidence of the disease was thought to be found in the remains of a 5000 years-old Egyptian mummy with evidence of a bamboo spine, but recent research found this not the case [1]. Currently, ankylosing spondylitis is suspected to be triggered by the presence of HLA-B27, but there's no conclusion drawn due to the lack of data and testable populations. Males and females are equally affected but women are more likely to experience inflammation rather than fusion than men. Current treatment for ankylosing spondylitis is still limited, mainly relying on routine biological injections to lower inflammation and long-term rehabilitations like exercises. However, no medication or surgical treatment is found to be able to cure ankylosing spondylitis fully. This study analyzed ankylosing spondylitis' correlation with vertigo and advanced diagnosis of ankylosing spondylitis.

2. Etiology

Researchers suspected that the incidences of ankylosing spondylitis derived from the HLA-B27 gene. Ankylosing spondylitis is a genetic disease that may exist through heritage. For unknown reasons, there is a correlation between ankylosing spondylitis and the HLA-B27 gene [2]. Human leukocyte antigens (HLAS) are proteins made from inherited genes that signal the immune system to distinguish the human body's host cell from foreign cells. HLA-B27 is often detected through blood as the protein is found on the surface of white blood cells. People with a positive (+) result indicate the presence of HLA-B27 in their bodies with greater-than-average risks for having autoimmune disorders.

3. Common Complications and Symptoms

Ankylosing Spondylitis patients exhibit several complex complications and symptoms seemingly unrelated to ankylosing Spondylitis. Patients may develop symptoms not correlated with bone structure or vertebrae, making them hard to derive the causes of ankylosing spondylitis (AS).

3.1. Uveitis

The most common complication is uveitis or inflammation of the eyes. Uveitis causes red-colored eyes, stinging pains around the eyeball, extreme sensitivity toward light, and blurred vision (extreme conditions can lead to loss of peripheral vision) [3]. Patients with uveitis should receive medical support as soon as possible to avoid further deterioration of eye functions. The usual treatment of uveitis is steroid medicine through eyedroppers, capsules, tablets, and injections. Uveitis is often caused by immune system deformity such as ankylosing spondylitis when an overreactive immune response starts in the regions of eye structures, other potential induced sources are eye injuries and infections. Patients must derive the cause of their uveitis correctly [4]. Immediate analysis of blood samples is needed to test the presence of HLA-B27 to eliminate ankylosing spondylitis as one possibility. In diagnosing uveitis, patients' eyeball images are analyzed. Doctors need to distinguish the different regions of eyeballs (Figure 1) to be aware of patients' abnormalities. Intermediate uveitis is common in patients from ages 15 to 40 years. Vitreous cells and cellular aggregates float predominantly in the inferior vitreous, or snowballs. White exudative material over the inferior ora serrata and pars plana, or snowbank, suggests pars planitis (Figure 2). A harsher type of uveitis is Posterior and Panuveitis. The typical symptoms of this uveitis are blurred vision and floaters. Pain and redness are subjective somatosensory indicated by patients. No matter which type of uveitis patients are diagnosed with, it is important to receive treatment as soon as possible to avoid further deterioration and appoint an analysis of blood samples to eliminate the possibility of ankylosing spondylitis.



Figure 1. Anatomy Structure of Eyeball

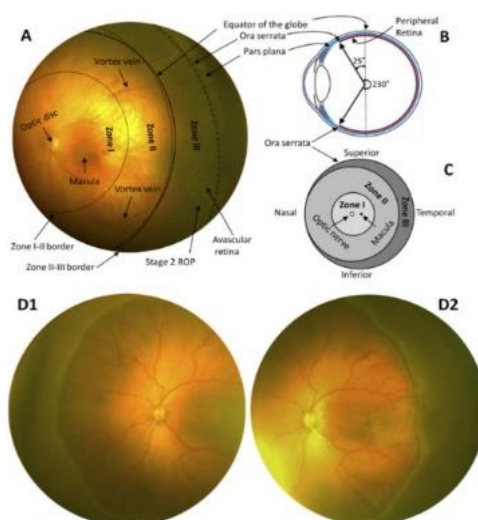


Figure 2. Pars planitis/intermediate uveitis with snowballs

3.2. Inflammation

Inflammation is common among ankylosing spondylitis patients who do not receive immediate treatments or are not being diagnosed. The pain and swelling are not limited to patients' vertebrate regions and can occur in every part of the human body. The gradual development of inflammation leads to simultaneously chronic somatosensation pain in different body parts. Inflammation of joints, or arthritis, is commonly found among ankylosing spondylitis patients, which causes pain during structural motions, body movement, swelling, and warmth of the affected area [1,3]. Inflammation of some crucial structures with movement, like hips, may disturb patients' ability to move, especially when movements require pressure exerted on their backbones, such as standing up and lifting.

3.3. Fatigue

Extreme tiredness and fatigue experienced by patients are due to the inflammations of body structures. Inflamed tissue releases small, protein-based chemicals called cytokines to signal and activate the immune system's response. These pro- and anti-inflammatory cytokines can act on the central nervous system (CNS) and induce behavior alterations [5]. For example, cytokines can inhibit the synthesis of neurotransmitters, such as dopamine or serotonin, by activating enzymes that limit the rate of biosynthesis of neurotransmitters [1]. These alternations led to behavioral changes called sickness behavior, which includes fatigue, reduced activity, and reduced appetite. Sickness behavior is a body's adaptive response to infections by redirecting energy toward fighting inflammations.

4. Ankylosing Spondylitis' Correlation with Vertigo

4.1. Causes of Dizziness and Vertigo

Dizziness may be common among the American population, but its causes are hard to derive because various factors can cause dizziness. The subjective somatosensory of dizziness has a wide range like faintness, loss of balance, and feeling weak [6]. Causes of Dizziness include inner ear disturbance, motion sickness, and medication effects. Vertigo belongs to one type of dizziness and has a somatosensory of spinning and rotation. Patients may be unable to move due to strong nausea caused by the spinning environment of vertigo.

4.2. The Relation between Vertigo and the Central Nervous System

There is a crucial relationship between vertigo and neurological disorders. Vertigo can be caused by an abnormality in the central nervous system and labyrinth nerve, or so-called peripheral nerve. Labyrinth is a maze of fluid-filled channels in the inner ear whereas the central nervous system (Figure 3) is more widely dispersed through the human body and surrounded the spinal cord region. Ankylosing spondylitis is less likely to relate to the ear structure and correlates more with the spinal cord according to its anatomy, and vertigo caused by an abnormal central nervous system is suspected. Patients with severe vertigo prefer lying down and maintaining a specific position that prevents further nausea caused by perceptions of revolving surroundings [6]. To start with, the central nervous system acts as the body processing center that controls most of the motions of the human body. It stems from the human brain and extends through the rest of the human body with the spinal cord. Its cruciality in feeling and triggering sensations is one possible cause of vertigo and dizziness. From the brainstem, the region where the brain and spinal cord are connected, 31 spinal nerves enter the cord. The motor commands from the human brain travel from the spine to muscles and other body structures. As the spinal cord contains a circuit that regulates reflective response, movement, and balance related to the conditions of the spinal cord, interruptions to the central nervous system cause vertigo because messages and impulses may not correctly transmit through certain mediums and perform in the right way. The loss of certain sensations may further lead to vertigo.

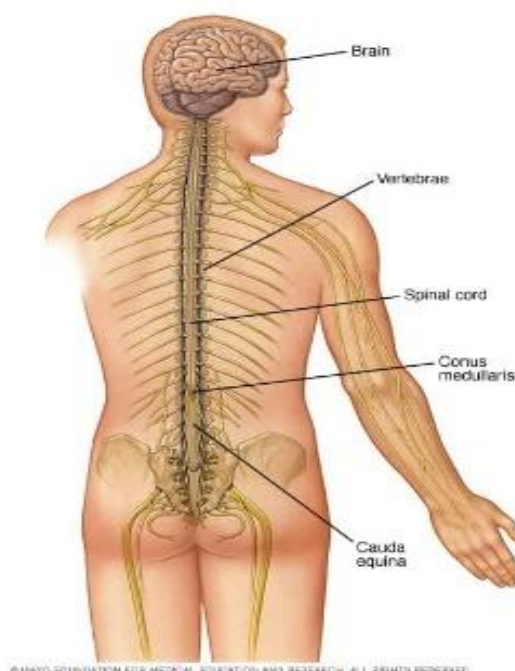


Figure 3. Anatomy of the Central Nervous System

4.3. The Relation between Ankylosing Spondylitis and the Neurological Diseases

Ankylosing Spondylitis is suspected as one of the potential factors that cause neurological disease. D.J Thomas and his team reexamined the past four years' profiles of 45 ankylosing spondylitis patients and found that 10 cases had neurological symptoms and signs [7]. Results show that a couple of neurological diseases may have some connections with ankylosing spondylitis. The first correlation is cauda equina syndrome (Figure 4) [8]. The mechanical compression caused by cauda equina syndrome decreases nutrient delivery to the nerve root, further decreasing blood flow and cerebrospinal fluid (CSF) diffusion [9]. Two cases of cauda equina syndrome likelihood are observed in the tested population.

At the examination, one patient had his buttocks wasted, ankle jerks absent, and sensation lost in all the sacral dermatomes. There was obvious wasting of one buttock but no sensory abnormality for another patient. Another neurological disease related to ankylosing spondylitis is focal epilepsy, which occurs when seizures arise from a specific lobe of the brain. One focal epilepsy case is a 57-year-old man with a 32-year history of ankylosing spondylitis. In 1971 over two or three days he had several fits, starting with clonic movements of his left hand, spreading to his arm and face, and becoming generalized. Ankylosing Spondylitis tends to make the spine much more vulnerable, making surgeons hard to treat as small trauma may trigger neurological diseases like focal epilepsy. In addition, vertebrobasilar insufficiency is one crucial neurological disease connected to ankylosing spondylitis, characterized by deficient blood flow to the brain's posterior, or back, due to the exaggerated burden on the cervical spine of ankylosing spondylitis. Two cases are examined through the experiment. A 56 years old painter had been diagnosed with ankylosing spondylitis for 28 years until his first giddy attack, or vertigo. This routine vertigo had proceeded for 2 years, and the patient's neck movement usually caused it. Vertigo is not felt by the patient at rest but is initiated after being triggered by neck movement. Vertebral arteriography was not attempted, but it is reasonable to assume that both vertebral arteries were kinked forwards by this new bone formation. Another case is a 58-year-old motor mechanic. Nystagmus was present with his neck in the neutral position and showed gross intention tremor and ataxia of gait between attacks of giddiness. His symptoms were controlled to some extent by a collar. Ankylosing Spondylitis, based on the observation of several cases, has a high likelihood of causing and triggering neurological disorders.

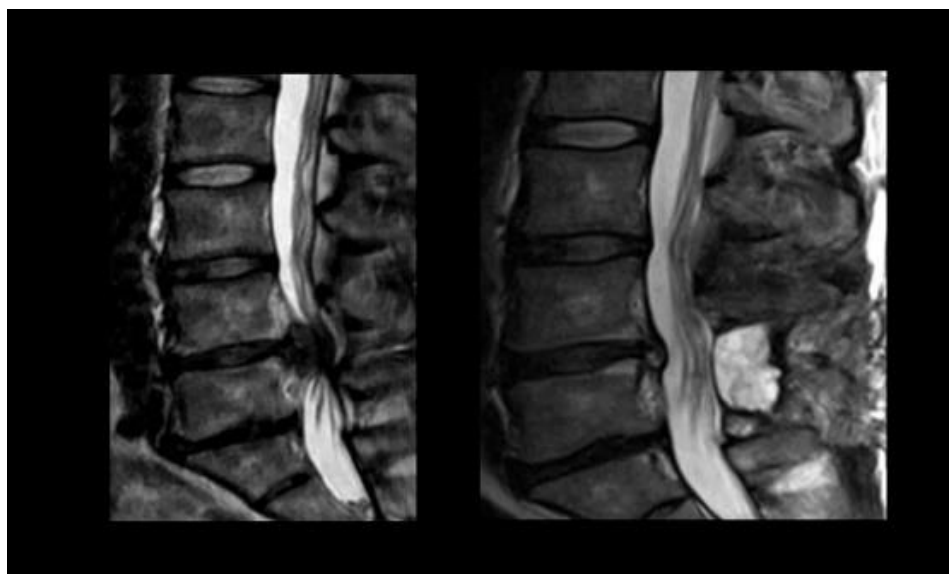


Figure 4. Spinal cord MRI image of cauda equina syndrome patients

4.4. The Relation between Ankylosing Spondylitis and Vertigo

Predictions about the relation between ankylosing and vertigo are proposed given that both vertigo and ankylosing spondylitis have some connections with the nervous system and neurological disease. A small 2012 study was conducted on 59 patients with ankylosing spondylitis and 46 people without ankylosing spondylitis. It was found that 6 people with AS experienced vertigo, while only 2 people without AS developed the condition. Another research published in 2011 involving 690 people showed a higher prevalence of AS in people with Meniere's disease, which sometimes manifests as vertigo. The route that offers the ankylosing spondylitis cause of vertigo cannot be confirmed, but there is a possible hypothesis given. Before demonstrating its possible relation to the central nervous system, the major effect ankylosing spondylitis has on patients is chronic inflammation, which is not limited to the spine and vertebrae. Severe inflammation as introduced early in the essay can affect several different parts of the human body, like the eyes where uveitis happens.

As patients with inflammation often feel pain and stiffness in their joints, the limitation of their movements negatively affects their posture and balance. Ankylosing spondylitis may cause vertigo in the nervous system due to its coupling effect. Patients with ankylosing spondylitis are likely to have spinal instability, which can develop into neck pain and further cause cervical spondylitis. Cervical spondylosis is the degeneration of the bones and disks in the neck. A stable is balanced by ligaments and muscles (Figure 5). If there is damage to these parts for neck support, more weight is transferred to the other side of the neck. This may result in frequent recurrence of catching neck pain and feeling of dizziness and vertigo. In this sense, ankylosing spondylitis does not directly cause vertigo by interfering with the working of the central nervous system but triggers several coupling infections like inflammations and cervical spondylitis that ultimately lead to vertigo [10]. This is the part that set obstacles for medical faculties as it is hard for them to derive the pathogen as ankylosis spondylitis but other more apparent and direct-related diseases. The treatment given to patients may only be helpful in the short term by alleviating some pain, but the disease is not eradicated in the long term.

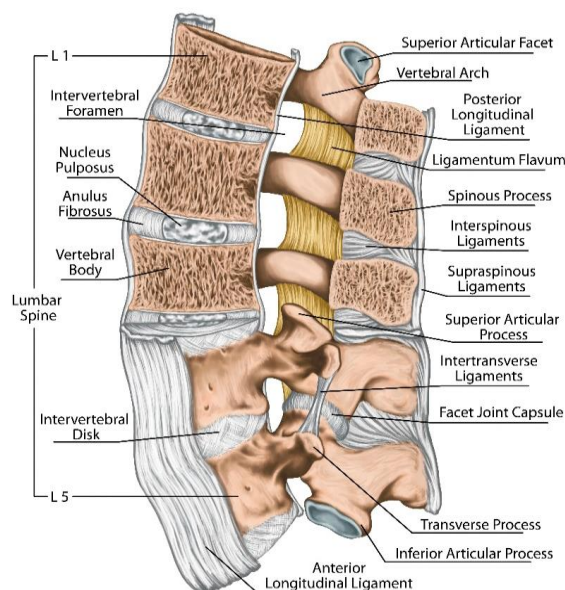


Figure 5. Anatomy of neck ligaments and muscles

5. Advanced diagnosis of Ankylosing Spondylitis

5.1. Radiographs

Radiographs show characteristic changes in longstanding disease but are relatively insensitive in detecting early disease. Radiographic changes usually don't develop until symptoms have been present for five years [11]. As the name "radio" suggests, radiography generates and records an x-ray pattern to provide relatively static images of the exposure parts.

The first case is a 43 years old woman diagnosed with ankylosing spondylitis, chronic back pain, bilateral hip pain, and a combination of active and chronic disease (Figure 6). Image A demonstrates the frontal radiograph of the sacroiliac joints. It shows erosions and a widened appearance of the joints (arrow). Image B is a lateral view of the lumbar spine, which shows the loss of the expected concave anterior surface. This abnormal appearance is due to erosion and bone formation, which produces a "shiny corner" in the radiograph's left downward portion [11]. Subtle erosion in image C along the anterior superior corner of the L5 vertebral body indicative of a Romanus lesion is accompanied by post-inflammatory fatty degeneration (arrow).

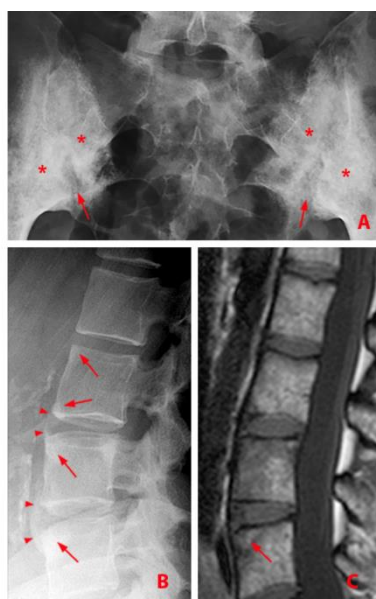


Figure 6. Radiograph of 43 years old ankylosing spondylitis patients

Another case is a 28 years woman with chronic ankylosing spondylitis involving the sacroiliac joints and cervical spine (Figure 7). Image C is a sagittal T2-weighted MR image that shows the interspinous ankylosis at C5-6 (Arrow). Image D is a sagittal T2-weighted MR image that shows the multilevel facet ankylosis (asterisks).

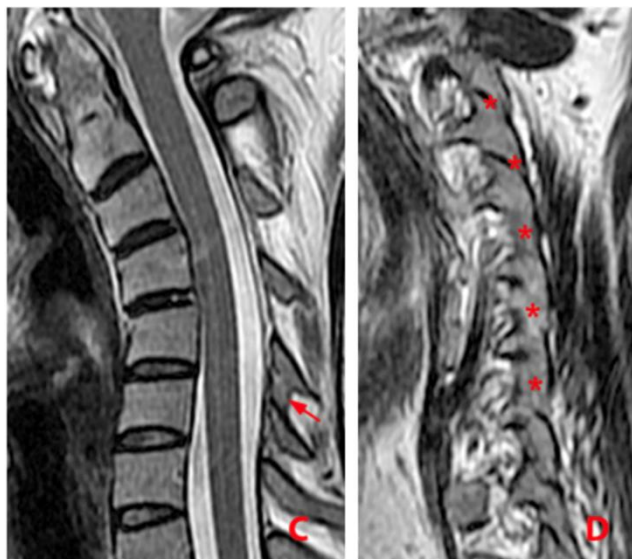


Figure 7. Radiograph of 28 years old ankylosing spondylitis patients

5.2. MRI

MRI derived from the name of NMR, but people change its name to avoid the first word of “Nuclear” of NMR, but they represent the same things. The working mechanism of MRI is based on the magnetic field and the spinning nuclei in it. Spinning nuclei act like tiny magnets and interact with an external magnetic field. If the oriented nuclei are now irradiated with electromagnetic radiation of the right frequency, energy absorption occurs, and the lower-energy state “spin-flips” to the higher-energy state [12]. When this spin-flip occurs, the nuclei are said to be in resonance with the applied radiation—hence the name nuclear magnetic resonance. Within this reaction, the graph is generated and analyzed by medical faculty to give a diagnosis for patients. Magnetic resonance imaging is a major advance in diagnosing ankylosing spondylitis because it enables early detection of disease when radiographs are normal. The case below is a 27 years old man with ankylosing spondylitis, low back pain, and bilateral symmetric sacroiliitis [11]. The image is a lumbar spine MRI that shows a combination of active sacroiliitis with erosions (arrowheads) and joint effusions (arrows) and the chronic disease finding of subchondral sclerosis (asterisks).

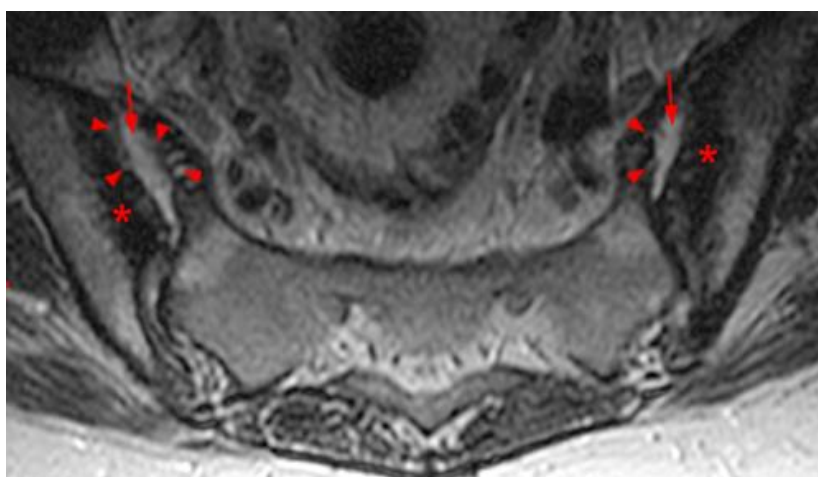


Figure 8. MRI of 27 years old ankylosing patients

6. Conclusion

Ankylosing spondylitis makes it hard for medical faculties to understand and diagnose. Its relation to HLA-B27 is suspected but never reaches an optimal conclusion. The presence of HLA-B27 (positive result) has shown a higher possibility of having ankylosing spondylitis. The complications and symptoms varied as ankylosing spondylitis not only affects part of the human body but many parts simultaneously. Uveitis, as one of the most common symptoms of ankylosing spondylitis, prompted patients to have blurred visions and inflamed eyes. Other symptoms include inflammations all over the human body, fatigue, and back pain or stiffness. The hypothesis about the relation between vertigo and ankylosing spondylitis is further explored through the aspects of central nervous systems and balance control. The major causes of vertigo may derive from the coupling effect of ankylosing spondylitis, which happens when several other diseases appeared after the diagnosis of ankylosing spondylitis. For instance, uveitis may lead to blurred vision, which ultimately causes the inability to balance, and cervical spondylitis may have unstable ligaments and muscles of the human neck, which triggers dizziness and vertigo. Advanced diagnosis of ankylosis spondylitis is revealed through radiographs and MRIs. Patients commonly showed erosions around their spinal cord region, so ankylosing spondylitis' destructive effect can be validated. Still much about ankylosing spondylitis needed to be explored and how to correctly derived the causes of different symptoms of ankylosing spondylitis still posed a tremendous challenge to medical faculties.

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