Status of Erythrocyte Sedimentation Rate, Platelet Counts and Serum Phosphate in Patients with Rheumatoid Arthritis in Owerri

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Abstract

In this study, rheumatoid arthritis patients receiving treatment at the Imo State University Medical Centre in Owerri had their erythrocyte sedimentation rate, platelet counts, and serum phosphate levels examined. For the study, a total of sixty (60) people were chosen. At the Imo State University Medical Center in Owerri, they were divided into two groups: thirty (30) for the test group and thirty (30) for the control group. The Westergreen method was used to measure the rate of erythrocyte sedimentation. Using the "blue" ascorbic acid method, the serum phosphate was measured. Additionally, a manual method was used to count the platelets. The test individuals' erythrocyte sedimentation rate (55.85± 14.75 mm/hr) and the control group's (8.00± 2.98 mm/hr) were compared. Test individuals' platelet count (434.20±183.98x109/L) were contrasted with the control group's (179.90±23.27x109/L). The test subjects' serum phosphate (3.58±0.46 mg/dl) were contrasted with the control group's (2.71±0.62 mg/dl). The erythrocyte sedimentation rate for the male test group (44.71±10.81 mm/hr) and female test group (61.85±13.23 mm/hr) were compared. The male test group's platelet count 473.14±129.06x109/L) and female test group's (413.14±209.54x109/L) were compared. Serum phosphate levels in the male test group (3.20±0.35 mg/dl) and the female test group (3.79±0.37 mg/dl) were compared. For both male and female subjects, the test group's mean and standard deviation of erythrocyte sedimentation rate level were higher than those of the test and control groups of rheumatoid subjects, respectively, as were platelet counts and serum phosphate levels

Keywords

Erythrocyte Sedimentation Rate, Platelet Counts, Serum Phosphate, Rheumatoid Arthritis

1. Introduction

Rheumatoid arthritis is a persistent, or chronic, ailment that results in joint discomfort, swelling, and inflammation. However, it can potentially harm other body components. The skin, eyes, lungs, heart, and blood vessels are a few examples.

When the immune system unintentionally targets its own tissues, rheumatoid arthritis results.

Osteoarthritis is more frequent than rheumatoid arthritis. Some folks possess both. Overuse of the joints can lead to osteoarthritis. Rheumatoid arthritis erodes the bone beneath the joints and damages the joint lining. Over time, this can lead to deformity, which is a painful swelling that can cause joints to flex out of shape. Rheumatoid arthritis's inflammation can harm other bodily parts as well. An autoimmune condition, rheumatoid arthritis (RA) is brought on by the body's own tissues being attacked by the immune system. Joint inflammation brought on by rheumatoid arthritis results in pain, stiffness, and edema. If left untreated, it can be a painful and incapacitating condition that significantly impairs function and movement. A chronic, systemic autoimmune illness, rheumatoid arthritis is linked to pannus development, cartilage degradation, synovial tissue growth, and systemic consequences. [1]

The inflammatory illness known as rheumatoid arthritis (RA) usually affects the joints, but it can also affect other tissues and organs. But because RA is a systemic autoimmune disease, it can affect organs and tissues other than the joints.

RA is an autoimmune illness in which the joints' lining (synovium) is wrongly attacked by the body's immune system. Other areas of the body may have an inflammatory reaction in addition to the joints. RA-induced inflammation extends beyond the joints. In addition to affecting the eyes and skin, it can damage blood vessels, causing inflammation of the heart and lungs.

Although RA can harm various tissues, it can also harm the bone and cartilage in the joints. For instance, inflammation of the lung tissue might result in scarring and respiratory issues. [2].

Although rheumatoid arthritis mostly affects joints, it can also cause issues with other body parts. About 15-25% of people with rheumatoid arthritis have extraarticular (outside the joints) symptoms in addition to anemia, which is rather prevalent. RA patients frequently suffer with anaemia, a disorder marked by a lack of red blood cells or haemoglobin. There are several forms of anaemia, such as haemolytic anaemia, anaemia of chronic illness, and iron deficiency anaemia.

Weakness and weariness are common symptoms of RA that can be exacerbated by anaemia.

Although the precise mechanisms are complicated, inflammation in RA can impact the production of red blood cells in the bone marrow, and specific proteins can obstruct the utilisation of iron.

Anaemia in RA can vary in degree and kind, and in certain situations, a bone marrow examination may be necessary to identify the reason. To detect and treat both joint and extra-articular symptoms, RA patients must have regular monitoring. Results can be enhanced by early detection and management of problems such as pulmonary disease or pericarditis. For RA patients to remain healthy overall, anaemia must be addressed with the right management techniques. [3].

Inflammatory symptoms of rheumatoid arthritis include swollen, heated, painful, and stiff joints, especially in the morning when you wake up or after being inactive for a long time. A common symptom of disease is increased stiffness in the morning, which usually lasts for more than an hour. In the early stages of the illness, mild motions may help with symptoms. These symptoms aid in differentiating between rheumatoid arthritis and non-inflammatory joint conditions, such as osteoarthritis or wear-and-tear arthritis. Signs of inflammation and stiffness in the morning are less noticeable in arthritis with non-inflammatory origins; stiffness usually lasts less than an hour, and mechanical arthritis causes pain when you move [4].

About 30% of individuals have rheumatoid nodules, which are the most prevalent extra-articular characteristic. Nearly 10% of patients, also in the early stages of the disease, have secondary Sjogren's syndrome and pulmonary symptoms. An elevated risk of these characteristics has been linked to active RA with high disease activity. The following factors have been identified as clinical predictors of the incidence of these rheumatoid complications: male gender, smoking habit, severe joint disease, worse function, high levels of pro-inflammatory markers, high titer of rheumatoid factor, and HLA-related common epitope. Additionally, people with rheumatoid arthritis may experience cognitive impairment due to a number of causes, including depression, cardiovascular illness, other systemic and chronic diseases, concurrent drug use, etc. [4]

The amount of phosphate in the blood is known as serum phosphate or serum phosphate level. As a mineral that carries an electric charge, phosphate is an electrolyte. It plays a role in the body's many vital functions, such as the synthesis of energy and bone. A low serum phosphate level in rheumatoid arthritis patients may indicate inflammation or malnourishment. Malnutrition is common among RA patients. Nevertheless, there aren't many research examining the connection between RA patients' all-cause mortality and malnutrition. [5]

An autoimmune condition that is becoming more prevalent globally, rheumatoid arthritis is unaffected by a person's gender, ethnicity, age, or social standing. People worldwide are receiving diagnoses with this crippling illness on a daily basis, despite the fact that there is insufficient research on the condition. Rheumatoid arthritis is currently treated using a number of different medical procedures. Naproxen and ibuprofen are two examples of anti-inflammatory drugs that, regrettably, over time, might result in stomach pain, occasional bleeding, and even ulcers. [5]

Therefore, in order to enhance treatment options and patient outcomes, it is critical to recognize and comprehend the underlying mechanisms that contribute to these problems.

A systemic autoimmune disease, rheumatoid arthritis (RA) can present with a variety of symptoms. Symmetric polyarticular inflammation is the disease's main manifestation in the synovial tissues, and it can cause gradual joint destruction. According to estimates, 0.24% of people worldwide suffer from RA, with women being more affected than men [6].

Although there isn't a clear consensus on when to employ one, others, or both, laboratory tests like serum phosphate, platelet count, and erythrocyte sedimentation rate (ESR) have long been a crucial component of the clinician's toolkit as indicators of inflammation. In the past, a lot of researchers used imaging techniques including magnetic resonance imaging and x-rays to diagnose RA patients [7].

Serum phosphate levels, platelet counts, and the Erythrocyte Sedimentation Rate (ESR) are frequently changed in RA patients and may be connected to inflammation and disease activity. Serum phosphate levels can be influenced by a number of factors, such as drug use and kidney function, while ESR and platelet counts are often affected in active RA, indicating the inflammatory state. The non-specific test known as the Erythrocyte Sedimentation Rate (ESR) gauges how rapidly red blood cells sink to the bottom of a test tube. Red blood cells in RA clump together due to inflammation, which speeds up their settlement and raises the ESR. A common finding in active RA is elevated ESR, which is frequently utilised as a gauge of inflammation and disease activity. ESR is not a conclusive diagnostic tool, though, as it can be influenced by other variables such as age, gender, and certain drugs. Active RA is characterised by thrombocytosis, which is characterised by high platelet levels. It is believed that this thrombocytosis is a reaction to the

prolonged inflammation and reduced platelet survival that occur in RA. Research on platelets' significance in RA is still in progress, however they are involved in inflammation and blood coagulation. platelet counts don't necessarily correspond well with other indicators of inflammation, but they can be a sign of disease activity [3].

Although serum phosphate levels can be impacted in RA patients, they are not usually a primary indicator of RA activity.Phosphate levels can be impacted by kidney issues, which might arise in RA patients. Phosphate levels can also be affected by several RA treatment drugs, such as corticosteroids. Serum phosphate levels should therefore be checked even though they are not a direct indicator of RA activity, particularly in individuals who have kidney problems or are on certain drugs.

ESR and platelet counts may be frequently affected in active RA, which is indicative of the inflammatory process. To measure disease activity and track therapy response, these markers can be used in conjunction with other clinical evaluations and laboratory tests. Although serum phosphate levels can be impacted by RA and its therapy, they are not a reliable predictor of RA activity [1]

For RA to be effectively managed, a thorough approach that takes into account a variety of clinical and laboratory results is required.

There is a dearth of data and very little work done in Owerri. It is anticipated that this effort will address information and inform future researchers about the significance of laboratory testing of these parameters in RA and how well they correlate with disease activity measurement.

2. Materials and Methods

2.1 Study Area

This study was carried out on human samples conducted in Imo State University Medical Centre Owerri, Imo State South Eastern part of Nigeria. It has a latitude of 5^{o} 30N and longitude of 7^{o} 2E. The major ethnic group in the area is Igbo, few other tribes also resides in the area. The climate of the area is tropical with a mean daily temperature of 27-5^{o}c for most of the year.

2.2 Study Design

The study was a cross sectional non longitudinal correlation research work that involved individuals with Rheumatoid arthritis for the RA positive subject's blood samples was collected within 8:00am - 11:00am to reduce variability. The anticoagulated blood was used for the ESR level and platelet count. The remaining blood was used for serum phosphate which is a quantitative test.

3. Ethical Consideration

The ethical approval was obtained from Federal Teaching Hospital Owerri to collect samples. Informed oral consent was obtained from the subjects and adequate verbal information was provided for the subjects.

Study Population: Sixty (60) subjects within the age bracket (45-70) years were recruited for the study, and consisted of 30 patients with rheumatoid arthritis and 30 nonrheumatoid arthritis subjects who served as controls. Blood samples were collected from the participants after they have been informed and educated on the significance of the study. The resulting serum specimens were transferred to test tubes for the test to be carried out.

4. Sample Collection

In all subjects, 7mls of venous blood was collected from each subject from the antecubital vein by means of hypodermic syringe. 2mls was dispensed into ethylenediamine tetraacetic acid container for platelet count, 2mls into sodium citrate container for erythrocyte sedimentation rate estimation. The anticoagulated blood was used for the Estimation of Erythrocyte Sedimentation Rate and Platelet

Count (2mls each). The remaining 3mls of blood was labeled and centrifuged for Serum Phosphate and estimation of Rheumatoid Factor (RF).

5. Selection Criteria

5.1 Inclusive Criteria

Apparently healthy individuals with history of arthritis, symptoms and those with positive rheumatoid factor were selected for the study after their consent was obtained. All subjects are within the age of 45-70years. Subjects with no other form of infection age-matched healthy subjects who served as controls.

5.2 Exclusive Criteria

Patients with any history of chronic disorder such as renal disease, diabetes mellitus, hepatic disease, hypertension, were excluded from the study. Also, all those who did not give his/her consent and those below the age of 45years and above 70years were excluded from the study.

6. Laboratory Procedure

The reagents used in the research work were of analytical grade and all reagents used were commercially purchased and manufactured. Standard operating procedure (SOP) was strictly followed.

The determination of rheumatoid factor (RF), **erythrocyte sedimentation rate (ESR), serum phosphate** and **platelet count** were carried out by standard method.

7. Statistical Analysis

All the values were expressed as mean ± standard deviation. The statistical analysis was carried out to determine whether the difference between erythrocyte sedimentation rate, platelet counts and serum phosphate levels in both male and female subjects are statistically significant or not when compared. Values with level of significance ($p<0.000$) were considered to be statistically significant. The statistical formulae used were stated in appendix.

8. Results

Table 1 shows the mean values of Erythrocyte Sedimentation Rate, Platelet Count and Serum Phosphate.

The mean values of ESR (55.85±14.75)mm/hr, Platelet count (434.20±183.98)x10^9/L and Serum Phosphate (3.58±0.46)mg/dl was significantly increased in rheumatoid arthritis patients when compared with control (8.00±2.98)mm/hr, (179.90±23.27) x10^9/L and (2.71±0.62)mg/dl respectively (t=10.07, p=0.000; t=4.32, p=0.000; and t=4.36, p=0.001).

Table 1. Mean Values of ESR, Platelet Count and Serum Phosphate in Rheumatoid Arthritis versus Controls (Mean ± SD)

Parameter	Test n=30	Control n=30	t-value	p-value
ESR (mm/hr)	55.85±14.75	8.00±2.98	10.07	0.000*
Platelet count (x10^9/L)	434.20±183.98	179.90±23.27	4.32	0.000*
Serum Phosphate (mg/dl)	3.58±0.46	2.71±0.62	4.36	0.001*

Key:

SD - Standard Deviation.

*. - Significant p value.

ESR - Erythrocyte Sedimentation Rate.

Table 2 shows the mean values of ESR and Serum Phosphate.

The mean values of ESR (44.71±10.81)mm/hr and serum Phosphate (3.20±0.35)mg/dl was significantly reduced in male rheumatoid arthritis patients when compared with female rheumatoid arthritis patient (61.85±13.23)mm/hr and (3.79±0.37)mg/dl (t=2.93, p=0.009 and t=3.39, p=0.003).

There was no significant increase in the mean value of platelet count (473.14±129.06)x10^9/L in male rheumatoid arthritis patient when compared with female rheumatoid arthritis patient (413.23±209.54)x10^9/L (t=0.68, p=0.502).

Table 2. Mean Values of ESR, Platelet Count and Serum Phosphate in Male versus Female Rheumatoid Arthritis Patients (Mean ± SD)

Parameter	Male n=12	Female n=18	t-value	p-value
ESR (mm/hr)	44.71±10.81	61.85±13.23	2.93	0.009*
Platelet count (x10^9/L)	473.14±129.06	413.23±209.54	0.68	0.502
Serum Phosphate (mg/dl)	3.20±0.35	3.79±0.37	3.39	0.003*

Key:

SD - Standard Deviation.

*. - Significant p value.

ESR - Erythrocyte Sedimentation Rate.

Table 3. Correlation of Serum phosphate with Platelet Count and ESR in Rheumatoid Arthritis Patients

Variable N	r	p-value
Platelet count 20 **($x10^9$/L)**	0.76	0.375
ESR (mm/hr) 20	0.11	0.608

Key:

ESR - Erythrocyte Sedimentation Rate

There was a non-significant positive correlation of serum phosphate with platelet count and ESR in Rheumatoid Arthritis Patients (r=0.76, p=0.375 and r=0.11, p=0.608).

9. Discussion

Although it can damage tissues and organs, rheumatoid arthritis is a chronic, systemic, inflammatory disease that mostly affects flexible (synovial) joints. If left untreated, it can be a painful and incapacitating condition that significantly impairs function and mobility [8].

The synovium, the capsule that surrounds the joints, becomes inflamed during the process. secondary to the development of fibrous structures (pannus) in the synovium, excess synovial fluid, and swelling (hyperplasia) of synovial cells. The illness process' pathophysiology frequently results in the joints' articular cartilage being destroyed [4]. Along with nodular lesions, which are most frequently found in subcutaneous tissue, rheumatoid arthritis can also cause diffuse inflammation in the lungs, the membranes around the heart (pericardium), the lungs (pleura), and the white of the eye (sclera). Rheumatoid arthritis is regarded as a systematic autoimmune illness, and while its exact etiology is unknown, autoimmunity is a major factor in both its chronicity and progression [7]. It is a clinical diagnosis based on physical examination, radiographs (x-rays), laboratory results, and symptoms [2].

Both the platelet counts and the serum phosphate levels significantly increased based on the results. This implies that thrombocytosis is caused by an increase in platelet synthesis that is compensatory for active intravascular coagulation and occurs in more severe forms of rheumatoid arthritis. According to some studies, thrombocytosis, or an elevated platelet count, is a complication of rheumatoid arthritis (RA). The chronic inflammation linked to RA is the cause of this [1]. While fluctuations in leukocyte and erythrocyte counts are not noticeable in rheumatoid arthritis (RA), observational studies have shown that platelet counts steadily rise with radiological disease progression. This increase in platelet is frequently brought on by the body's reaction to the illness, such as the release of thrombopoietic factors from tumours or the inflammatory process itself, which causes the bone marrow to produce more platelets. Indeed, platelets contribute to the growth and spread of tumours, which increases their bloodstream presence. Rheumatoid arthritis and other autoimmune diseases are among the many illnesses that cause inflammation. Cytokines such as IL-6 and other substances are released as a result of this inflammation, which encourages the bone marrow to make more platelets. By releasing different mediators that impact blood artery permeability and other inflammatory processes, platelets themselves can also exacerbate inflammation. An unusually high platelet count, can result from substances released by growing tumours that promote platelet synthesis. These elements include chemicals that affect the bone marrow and cytokines produced by tumours.

According to certain research [4], platelets may also encourage the growth and metastasis of tumours, resulting in a positive feedback loop in which higher platelet counts fuel the spread of the tumour.

One possible endocrine signal that promotes bone marrow platelet formation is platelet factor-4, a protein secreted by platelets. Ionising radiation can lower platelet counts and harm megakaryocytes, or platelet precursor cells, but some cancer treatments can also raise platelet counts as the body heals or as a defence mechanism. Radiation or chemotherapy may intensify the action of substances released by the tumour itself that promote platelet formation. Platelets contribute to inflammation, immunological responses, and tumour formation in addition to blood coagulation.

Metastasis, or the spread of cancer cells, can be facilitated by platelet activation and aggregation.

Platelet increase can occasionally be a reactive reaction to another illness, such as an infection, iron deficiency, or other inflammatory conditions [8].

In response to biological treatments, such tocilizumab, RA patients with elevated platelet counts (>400x109/L) seem to exhibit more significant improvements in disease activity scores in 28 joints and acute-phase reactants than RA patients with "normal" platelet counts (<400x109/L) [4].

The measurement of erythrocyte sedimentation rate, which is dependent on gamma globulin content and is directly linked to rheumatoid arthritis, may have contributed to the notable increase in the ESR. This is consistent with other work [8].

However, the study showed that, in comparison to female rheumatoid arthritis patients, male rheumatoid arthritis patients had significantly lower serum phosphate and ESR levels.

It is not generally accepted that males with rheumatoid arthritis (RA) have lower serum phosphate levels than females, and it is unclear why any such differences may exist. However, some research points to possible links between glucocorticoid (GC) medication and lipid profiles, especially lysophospholipids, with females showing more noticeable alterations. Other studies show that male and female RA patients have different lipid profiles, especially lysophospholipids (LPLs), and that GC treatment exacerbates these discrepancies. LPL levels are considerably higher in females who use GC than in non-users, although this effect is less noticeable in males.

Although the precise mechanisms underlying these gender-specific differences in LPL metabolism are not entirely understood, they might be related to hormonal impacts or variances in lipid metabolism pathways. Assessment of cardiovascular risk and therapeutic approaches may be affected by the reported variations in LPL profiles between male and female RA patients, especially in response to GC therapy.Variations in phosphate levels and other biochemical markers in RA patients can also be caused by other factors, including co-existing illnesses, disease activity, and genetic predispositions.

Although some research has shown that male RA patients had lower serum phosphate levels than female RA patients, the causes of this discrepancy are unclear and could be related to variations in lipid metabolism and the results of GC treatment. According to researchers, women are more likely to get RA because they make more estrogen. A woman's body may react abnormally to estrogen by attacking itself in a condition known as autoimmunity, which is a misdirected immune system reaction. Subsequent research verified that erythrocyte sedimentation rate levels are typically greater in women and tend to increase with age [9]. Additionally, erythrocyte sedimentation rate values seem to be higher in anemic people than in non-anemic people. According to other studies, the erythrocyte sedimentation rate steadily rises with age and is often higher in females than in males [10]. Inflammation in the body is typically indicated by a higher ESR. Due to a mix of physiological and hormonal causes, ESR levels naturally rise with age and are frequently higher in females than males. Chronic, low-grade inflammation, sometimes referred to as "inflammaging," tends to gradually grow in people as they age. Conditions including cardiovascular illnesses and osteoarthritis are more common in older people, and they can significantly raise ESR. Hormonal changes brought on by menstruation, pregnancy, and menopause might impact ESR levels. Compared to men, women often have slightly lower red blood cell counts, which might cause higher ESR and faster sedimentation. Women are more likely to have lupus and rheumatoid arthritis than males, and these conditions can raise ESR. Women may have greater ESRs than men due to biological differences between the sexes, including variances in body composition and immune system reactions. ESR is a generic measure of inflammation rather than a specialised diagnostic test for any one disease. ESR levels can also be influenced by other variables, such as smoking, drinking alcohol, and using certain drugs. health is essential.

10. Conclusion

Serum phosphate, platelet counts, and erythrocyte sedimentation rate all showed considerable increases. In contrast to female rheumatoid arthritis patients, male rheumatoid patients had significantly lower levels of serum phosphate and erythrocyte sedimentation rate. Serum phosphate levels and platelet counts can be impacted by rheumatoid arthritis. In individuals with rheumatoid arthritis, serum phosphate showed a non-significant positive connection with both platelet count and erythrocyte sedimentation rate, indicating that they are largely unrelated to each other.

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