

THE IMPORTANCE OF SERUM PROTEIN ELECTROPHORESIS: A CASE REPORT

Hamide Shllaku-Sefa¹, Ervin Marku², Manjola Qordja¹, Gentian Kasmi¹, Ndok Marku¹

¹Laboratory Department, Catholic Hospital "Our Lady of Good Counsel", Tirana, Albania

²Department of Pre-Clinical Subjects, Faculty of Technical Medical Sciences, University of Medicine, Tirana, Albania

Correspondent E-mail: sefadea@gmail.com

Abstract

Background: Serum protein electrophoresis is a test that measures specific proteins in the blood. Electrophoresis separates proteins based on their physical properties. The principal clinical use of an serum protein electrophoresis is to determine which of the globulin proteins is elevated and to differentiate monoclonal from polyclonal gammopathies. This differentiation is vitally important because monoclonal gammopathies, which are indicated by evidence of a monoclonal M band on the serum protein electrophoresis, indicate malignant or premalignant conditions.

Methods: During our daily routine in the laboratory, we casually found an elevated total protein. In this case, we decided to perform a serum protein electrophoresis. We used the cellulose acetate electrophoresis system ADALYA IFE.

Results: K.Z., female, 57 years old, come to the laboratory for a general checkup. Blood sugar 121 mg/dl, urea 40 mg/dl, creatinine 0.89 mg/dl, alkaline phosphatase 90 UI/L, ALT 53 UI/L, AST 33 UI/L, total bilirubin 0.4 mg/dl, GGT 40 UI/L, total protein 9.8 g/dl, albumin 3.8 g/dl, sodium 138 mmol/l, potassium 4.1 mmol/l, chloride 99 mmol/l, normal prothrombin time, erythrocyte sedimentation rate 94 mm/h, and a normal complete blood count, except platelets $127 \times 10^3/\mu\text{L}$. We performed serum protein electrophoresis, and we found a monoclonal gammopathy (34.7 % gamma globulin). After that, we did immunofixation: IgA 31 mg/dL, IgM 26 mg/dL, IgG 3518 mg/dL, kappa 0.170 g/L, lambda 10.186 g/L, and kappa/lambda ratio 0.02. Considering the importance of these results, we refer the patient to a hematologist for further investigation, diagnosis, treatment, and follow up.

Conclusions: Serum protein electrophoresis is an easy, inexpensive test that should always be performed in patients with elevated levels of total protein.

Keywords: protein, electrophoresis, monoclonal, gamma.

RËNDËSIA E ELEKTROFOREZËS SË PROTEINAVE: STUDIM RASTI

Abstrakt

Hyrje: Elektroforeza e proteinave është një test që mat proteinat specifike në gjak. Elektroforeza ndan proteinat në bazë të vetive të tyre fizike. Përdorimi kryesor klinik i një elektroforeze të proteinave është të përcaktojë se cila nga fraksionet e globulinave është e rritur dhe të diferencojë gamopatitë monoklonale nga ato poliklonale. Ky diferencim është me rëndësi jetike, sepse gamopatitë monoklonale, të cilat tregohen nga evidenca e një brezi monoklonal në elektroforezë, tregojnë gjendje malinje ose paramalinje.

Metodat: Gjatë rutinës sonë të përditshme në laborator, rastësisht gjetëm një proteinë totale të rritur. Në këtë rast vendosëm të kryejmë një elektroforezë të proteinave. Ne përdorëm sistemin elektroforezë të acetatit të celulozës ADALYA IFE.

Rezultatet: K.Z, femër, 57 vjeç, vjen në laborator për një kontroll të përgjithshëm. Glicemi 121 mg/dl, urea 40 mg/dl, kreatinina 0,89 mg/dl, fosfataza alkaline 90 UI/L, ALT 53 UI/L, AST 33 UI/L, bilirubina totale 0,4 mg/dl, GGT 40 UI/L, proteina totale 9,8 g/dl, albumina 3,8 g/dl, natriumi 138 mmol/l, kalium 4,1 mmol/l, klor 99 mmol/l, koha e protrombinës normale, eritrosedimenti 94 mm/h dhe gjaku komplet normal, përveç trombocitet 127 x 10³/μL.

Në elektroforezën e kryer kemi gjetur një gamopati monoklonale (34,7 % gama globulinë). Pas kësaj kemi bërë imunofiksion: IgA 31 mg/dL, IgM 26 mg/dL, IgG 3518 mg/dL, kappa 0,170 g/L, lambda 10,186 g/L, dhe raporti kappa/lambda 0,02. Duke marrë parasysh rëndësinë e këtyre rezultateve, ne e referuam pacientin tek një mjek hematolog për ekzaminime të mëtejshme, diagnostikim, trajtim dhe ndjekje.

Përfundime: Elektroforeza e proteinave është një test i lehtë dhe i lirë që duhet të kryhet gjithmonë te pacientët me nivele të larta të proteinës totale.

Fjalë kyçe: proteina, elektroforezë, monoklonale, gama.

Introduction

Serum protein electrophoresis (SPEP) is a method of separating proteins based on their physical properties. Serum is placed on a specific medium, and a charge is applied. The net charge (positive or negative) and the size and shape of the protein are commonly used in differentiating various serum proteins. The proteins are stained, and their densities are calculated electronically to provide graphical data on the absolute and relative amounts of the various proteins. Further separation of protein subtypes is achieved by staining with an immunologically active agent, which results in immunofluorescence and immunofixation (1). There are two types of proteins present in the serum: albumin, and the globulin proteins. Albumin is the biggest component of serum proteins and represents the largest peak that lies closest to the positive electrode. Globulins are divided into five categories: alpha-1, alpha-2, beta-1, beta-2, and the gamma fraction, which is closest to the negative electrode (2).

Serum protein electrophoresis is generally considered in any patient with an elevated total protein, especially those with elevated globulin level relative to albumin, or any signs and symptoms suggestive of an underlying plasma cell disorder (3,4) It is extremely important that during the interpretation of serum protein electrophoresis, to differentiate monoclonal from polyclonal gammopathies. Monoclonal gammopathies are associated with a clonal process that is malignant or potentially malignant.

Diseases that produce an increase in the gamma-globulin level include Hodgkin's disease, malignant lymphoma, chronic lymphocytic leukemia, granulomatous diseases, connective tissue diseases, liver diseases, multiple myeloma, Waldenström's macroglobulinemia, and amyloidosis (1,5).

On the other hand, polyclonal gammopathies may be caused by any reactive or inflammatory process, and they are usually associated with nonmalignant conditions. The most common causes of polyclonal gammopathies are infections. These can include parasitic infections, fungal infections, bacterial infections, spirochete infections, and viral infections (6,7).

We aim to underline the importance of protein electrophoresis in outpatients with increased levels of total protein.

Materials and methods

We collected blood samples through venipuncture using BD Vacutainer k3EDTA 5.4 mg, 3 mL tubes for complete blood count (CBC) and measured on ADVIA 2120i, Haematology System, and for erythrocyte sedimentation rate measured in Diesse Cube 30Touch. We used BD Vacutainer 9NC 0.109M, Buff.Na₃ Citrate 2.7 ml tubes to evaluate prothrombin time measured on Sysmex Ca-600 series.

For the measurement of the other biochemical tests, we collected the blood with a BD Vacutainer SST II Advance 3.5 ml tube, and we measured it with Dimension EXL 200.

We used the cellulose acetate electrophoresis system (ADALYA IFE).

Case presentation.

We present here a 57 year old female patient who comes to our laboratory on the recommendation of the general practitioner to perform a checkup. The laboratory results are as follows: glicemia 121 mg/dl, urea 40 mg/dl, creatinine 0.89 mg/dl, alkaline phosphatase 90 UI/L, ALT 53 UI/L, AST 33 UI/L, total bilirubin 0.4 mg/dl, GGT 40 UI/L, total protein 9.8 g/dl, albumin 3.8 g/dl, sodium 138 mmol/l, potassium 4.1 mmol/l, chloride 99 mmol/l, normal prothrombin time, erythrocyte sedimentation rate 94 mm/h, and a normal complete blood count, except platelets $127 \times 10^3/\mu\text{L}$. Faced with this situation, we decided to perform a serum protein electrophoresis. At the end of the day, we found a monoclonal gammopathy (34.7 % gamma globulin). After that, we did immunofixation: IgA 31 mg/dL, IgM 26 mg/dL, IgG 3518 mg/dL, kappa 0.170 g/L, lambda 10.186 g/L, and kappa/lambda ratio 0.02. Due to an administrative inconvenience, we were unable to communicate with the patient or her general practitioner, but fortunately she came a few weeks later. Once again, after the results were obtained, the general practitioner did not ask for a protein electrophoresis. In the laboratory examinations done a few weeks later, the results are as follows: total protein 12.5 g/dl, urea 77 mg/dl, creatinine 4.02 mg/dl, erythrocyte sedimentation rate 140 mm/h, red blood cells $2.71 \times 10^6/\mu\text{L}$, hemoglobin 8.8 g/dL, hematocrit 24.4%, platelets $110 \times 10^3/\mu\text{L}$.

On the skeletal radiography, the radiologist saw a Th12 compression fracture and osteopenia. Considering the importance of these results we refer the patient to a hematologist - oncologist for further investigation, diagnosis, treatment, and follow-up, and she decided to go for further examinations in a specialized center abroad.

Discussion

Based on the data we have from our case: a M-protein in serum 30 g/l; abnormal kidney function with a serum creatinine 4.02 mg/dL and a calculated creatinine clearance (2021CKD-Epi) 12 ml/min; anemia, with a hemoglobin 8.8 g/dL; and bone lesions, and the diagnostic criteria of monoclonal gammopathies, the most likely diagnosis is multiple myeloma (8).

Multiple myeloma (MM) is a plasma cell neoplasm that accounts for 1%-1.8% of all cancers and is the second most common hematological malignancy, with an estimated incidence in Europe of 4.5-6.0/100 000/y (9).

According to the guidelines developed by the European Hematology Association (EHA) and the European Society for Medical Oncology (ESMO), there are several tests obligatory for the diagnosis of multiple myeloma (10).

These tests are divided into blood tests that include blood count and blood smear, serum electrophoresis and immunofixation, serum-free light chain, serum immunoglobulin levels, renal and liver function tests, calcium, lactate dehydrogenase, albumin, and β 2-microglobulin. In urine: urine sample from a 24 hour urine collection to check for proteinuria and light-chain proteinuria, urine electrophoresis, and immunofixation. In bone marrow: bone marrow cytology and biopsy to confirm plasmacytosis and monoclonality, next-generation flow cytometry or next-generation sequencing to detect clonal plasma cells, cytogenetics: karyotype and FISH for detection of del 17p, t (4;14), t (14;16), ampl 1q/gain 1q, t (11;14). We are aware that we are not a specialized center for onco-hematological pathologies, however, the results obtained from our laboratory made it possible to understand that the patient had a serious health problem for which she would undergo specific examinations.

Conclusion

Serum protein electrophoresis is an easy, inexpensive test, and clinicians should always ask for it in cases where they find an increased level of total protein in their patients.

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