ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Serum Protein Electrophoresis Pattern In Patients With Suspected Plasma Cell Disorders: Single Centre Experience In One Year.

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ABSTRACT

Monoclonal gammopathy is a condition in which single clone of plasma cell gets malignant and produce a single type of immunoglobulin. This condition presents as a sharp peak or 'M' band in Serum Protein Electrophoresis (SPE). SPE is done in patients who present in OPD with clinical features of refractory anaemia, bone pains, chronic fever, back pain, hypercalcemia, raised serum creatinine etc. We have studied the pattern of "M'' bands in SPE and their corresponding Immunofixation Electrophoresis (IFE) in our centre. Changes in the various pathological and biochemical parameters relevant to Monoclonal gammopathy were also taken into consideration. An observational study was conducted in which a total of 958 patients were included from October 2017 to October 2018. Out of 958 cases in whom SPE was advised,707(73.8%)patients showed polyclonal rise in gamma globulins. 183 (19.1%) patients showed "M" band and 68 (7.1%) patients showed suspicious bands in SPE. SPE should be done in all the patients who present with clinical suspicion or features of monoclonal gammopathy followed by IFE to arrive at a final diagnosis.

Keywords: Monoclonal Gammopathy; Serum Protein Electrophoresis; Immunofixation Electrophoresis

https://doi.org/10.33887/rjpbcs/2022.13.6.18

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ISSN: 0975-8585

INTRODUCTION

Monoclonal gammopathy refers to a condition in which a single pro-B germ cell produces an abnormal amount of immunoglobulin. There is an overproduction of a single abnormal clone of a plasma cell or B lymphocyte [1]. This abnormal immunoglobulin is recognised as "Monoclonal" band or "M" band on Serum Protein Electrophoresis (SPE). The M protein is characterized by the presence of a sharp, well-defined band in the gamma, beta 2, rarely beta 1 and very rarely in alpha 2 region in SPE [2]. "M" band can be seen in various benign and malignant conditions like multiple myeloma, Monoclonal Gammopathy of Undetermined Significance (MGUS), Smoldering Multiple Myeloma, Plasmacytoma (solitary or multiple), Plasma Cell Leukemia, Heavy Chain Disease, Light Chain Disease, Waldenstrom's Macroglobulinemia and Amyloidosis [3]. To confirm the diagnosis of monoclonal gammopathy, Immunofixation electrophoresis must be performed. IFE also tells about the type of heavy and light chains involved in the disease.

Serum protein electrophoresis is performed in the patients with clinical suspicion of multiple myeloma with history of refractory anaemia, CKD with high calcium levels, prolonged and unexplained fever or weakness, bony pain [4].

Patients with infections may present with raised immunoglobulins, but it must be differentiated from monoclonal gammopathy pattern. Polyclonal patterns have a peak in the gamma globulin region that is not sharp and well defined. As all the immunoglobulins are raised in case of infections so the peak seen in the gamma globulin region is round and is spread to whole of the gamma globulin region.

In this study we have observed the pattern of SPE including the location of 'M' band, with their corresponding IFE and the percentage of heavy and light chains.

MATERIAL AND METHODS

An observational study was conducted in the Dept of Biochemistry from October 2017 to October 2018 in all the samples where SPE was advised. Patients in whom "M"band came out to be positive, IFE was done and analysed for the presence of the type of heavy and light chains. Data of laboratory parameters like Serum Calcium, Creatinine, Hemoglobin, Erythrocyte Sedimentation Rate (ESR), clinical signs and symptoms were collected and have been tabulated. Follow-up of the patients was done till the final diagnosis was reached upon. Only new, undiagnosed cases were included in the study. Follow-up cases of SPEP were not included in the study to avoid duplicacy of results.

Serum Protein Electrophoresis was performed on Sebia Minicap Protein E 6 fully automated analyser by capillary electrophoresis method. Immunofixation electrophoresis was done using Sebia Hydragel IF analyser based on the principle of agarose gel electrophoresis followed by immunofixation.

For analysis, we divided the patients into three groups i.e. patients showing monoclonal gammopathy (M Band) (Group 1), patients showing suspicious band (Group 2), patients showing polyclonal pattern (Group 3) in SPE.

RESULTS

A total of 958 samples were analysed for serum protein electrophoresis. Out of these, 643 were male and 315 females. Our patients were from age 2 to 92 years. Analysis of our data in the form of graphs and tables is represented below.

ISSN: 0975-8585

Figure 1: Distribution of various SPEP pattern

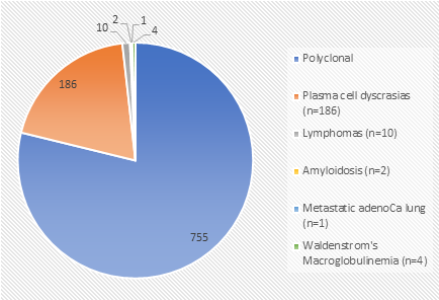

Table 1: Showing Mean ± SD of the various lab parameters in three group

	Mean ± SD (Group 1/M band)	Mean ± SD(Group 2/Suspicious band)	Mean ± SD (Group 3/Polyclonal pattern)
Total Protein	7.28 ± 2.1	6.2 ± 1.20	7.1 ± 1.1
Albumin	3.1 ± 0.78	2.68 ± 0.48	4.2 ± 0.9
Alpha 1 globulin	0.4 ± 0.12	0.5 ± 0.18	0.3 ± 0.10
Alpha 2 globulin	0.77 ± 0.21	0.9 ± 0.21	0.5 ± 0.15
Beta 1 globulin	0.4 ± 0.27	0.3 ± 0.07	0.4 ± 0.21
Beta 2 globulin	1.01 ± 0.12	0.4 ± 0.19	0.8 ± 0.14
Gamma globulin	2.14 ± 1.76	1.0 ± 0.47	0.9 ± 0.93
Haemoglobin	8.65 ± 2.14	8.85 ± 1.14	12.6 ± 3.52
ESR	65.55 ± 27.81	48.0 ± 29.94	10.21 ± 5.22
Calcium	9.61 ± 1.55	8.96 ± 0.89	9.2 ± 1.0
Creatinine	2.22 ± 2.93	3.11 ± 2.08	0.8 ± 1.1
Beta 2 microglobulin	6809.7 ± 10187.9	-	-

Figure 2: Types of Lymphoma in "M' band positive cases

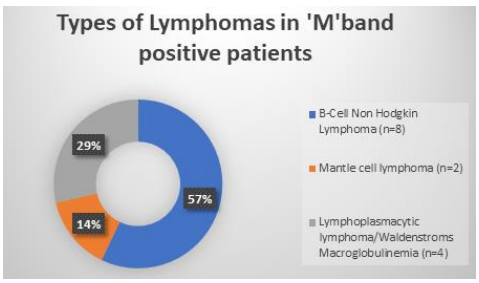

Figure 3: Distribution of Plasma Cell Dyscrasias

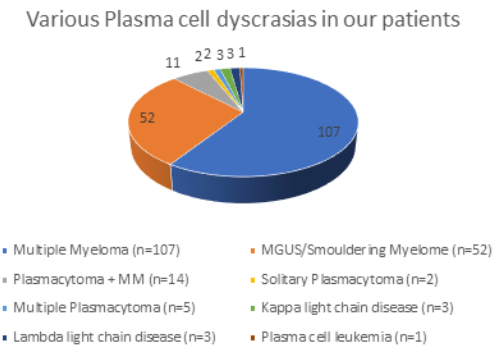

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Figure 4: Percentage of plasma cells in different groups

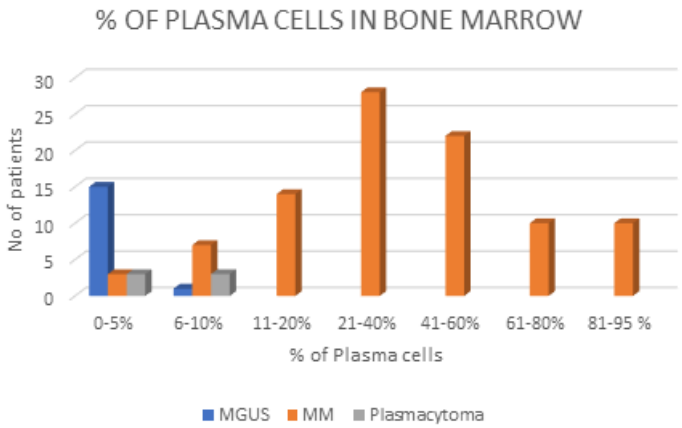


Figure 5: Evaluation of Suspicious cases on SPE on the basis of IFE

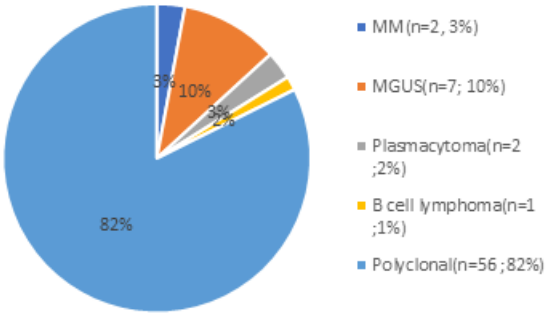
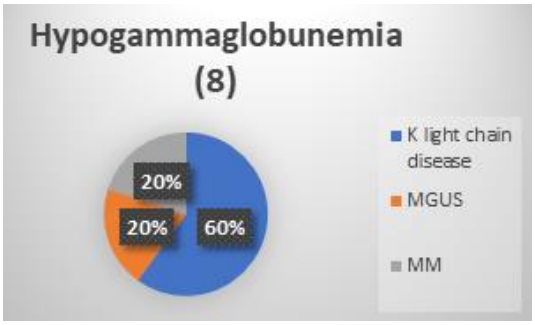


Figure 6: Evaluation of cases presented with hypo-gammaglobunemia on SPE on the basis of IFE



IFE was done in 171 patients out of 183 patients in whom 'M' band was present.

Table 2: Percentage distribution of Heavy and light chains on IFE.

Heavy chain	Light chain	n	%
IgG	K	62	36.2%
IgG	L	44	25.7%
IgA	K	11	6.4%
IgA	L	18	10.5%
IgM	K	10	5.8%
IgM	L	7	4.1%
_	K	4	2.3%
_	L	9	5.3%
Bi-clonal		6	3.5%

ISSN: 0975-8585

DISCUSSION

Serum protein electrophoresis is a technique in which various protein components of the serum are separated on the basis of charge to mass ratio. It is done in alkaline pH, at which the proteins carry a negative charge and move towards the anode. The fractions are separated into albumin (major fraction), alpha 1, alpha 2, beta 1, beta 2 and gamma globulins [5,6].

Any abnormal sharp peak, known as "M" band signifies the presence of monoclonal gammopathy in the patient. In our study it was found that out of 958 patients in whom SPE was advised, 183 (19.1%) patients had "M" band. Dharmishtha N. Kapadiya et al reported it in 11% of cases [7], Koksal Deveci et al reported "M" bands in 31% of patients [8], Chopra et al reported in 24.4% of cases [9], Nihar Ranjan et al found "M" band in 8.89% of cases [10] and Sunita et al reported in 10.66% of cases [11].

Further, out of a total of 183 cases with "M" band, 139 (75.9%) had "M" band in gamma globulin region, 39 (21.3%) in beta 2 region and 5 (2.7%) in beta 1 region. While Nihar Ranjan Dash et al reported peaks as 89% in gamma globulin, 8% in beta region, 1% in alpha 2 and 2% as bi-clonal [10],Chopra et al reported 84.8% in gamma region and 15.3% in beta region [9], Kapadiya et al reported that 90.9% of their patients had the M band in gamma region and 9.1% had in the beta globulin region [7] and also Sunita et al reported 87.5% of gamma region peaks and 12.5% beta region peaks [11].

Of our total cases, 107 had Multiple Myeloma, 52 had MGUS, 14 Plasmacytoma along with Multiple Myeloma, 2 solitary Plasmacytoma, 5 multiple plasmacytoma, 3 kappa light chain disease, 3 lambda light chain disease and 1 had plasma cell leukemia.

Out of 958 cases, 68 (7.1%) cases showed a suspicious, non-quantifiable band in the gamma or beta 2 globulin region. On performing IFE and Bone marrow aspiration and biopsy, 36 (52.9%) came out to be polyclonal, 2(2.9%) were having Multiple Myeloma, 7(10.3%) were cases of MGUS, 2(2.9%) had Plasmacytomas, 1(1.5%) diffuse B cell lymphoma and 20(29.4%) did not follow-up for further investigations. So, it shows that a faint, non-quantifiable band in the SPE should not be ignored and the case should be further investigated to reach the final diagnosis.

Further, on taking into account, the Hb status, creatinine levels, ESR and Calcium levels, we tried to find the distribution of Anaemia in patients with various diagnosis. In our study, 54% of the total diagnosed Multiple Myeloma patients had Hb<8gm/dl; 37% with Hb 8-10gm/dl and 8 % had a Hb >10 gm/dl. In case of MGUS, anaemia was present in 15.9%(<8gm/dl), 38.5% had Hb between 8-10gm/dl, and >10gm/dl was present in 46.1% of patients with MGUS.

60% of Patients with Plasmacytoma showed Hb >10gm/dl and 40% showed Hb% between 8-10%. None of the patients showed Hb <8%. In case of ESR, 82% of diagnosed Multiple Myeloma patients had an ESR >60 mm/hr which fits in the diagnosis. 54% of the patients had presented with bony pains which appear to be the most common presenting symptom and only 19% presented with Hypercalcemia.

The pattern of heavy and light chains in IFE in the "M" band positive cases is - IgG - 106 (61%), with K light chain (IgG-K) – 62 (36.2%) , with lambda light chain (IgG-L) – 44 (25.7%) ; IgA – 29 (16.9%) with K chain (IgA-K) – 11 (6.4%), with L chain (IgA-L) – 18 (10.5%) ; IgM – 17 (9.9%), with K chain (IgM-K) – 10 (5.8%), with L chain (IgM-L) – 7 (4.1%) ; Only K chain (without heavy chain) – 4 (2.3%) ; Only L chain (without heavy chain) – 9 (5.3%) ; Bi-clonal – 6 (3.5%). In a study conducted by Chelliah and Chauhan, the pattern of heavy and light chains is reported as IgG-K – 70%, IgG-L – 10%, IgA-K – 5%, IgA-L – 5% and IgM-K – 10% cases [12] and according to Koksal Deveci et al IgG-K – 47.9%, IgG-L – 27.1%, IgA-K – 16.7%, IgA-L – 8.3%, no cases with IgM heavy chain. Chopra et al reported IgG-K in 40%, IgG-L in 50%, IgA-L 5% and IgM-K in 5% cases [9] and Nihar Ranjan et al reported IgG (67%) followed by IgA (12%) and free light chains in 19% of cases [10].

B cell lymphoma with bone marrow involvement is associated with para-protenemias and hence presence of "M" band in SPE. It is seen in 17-20% of B cell lymphoma cases [13,14]. Presence of "M" band in B cell lymphomas are associated with aggressive course and poor response to standard chemotherapy [15]. In our study, 6% of "M" band positive patients were diagnosed as having B cell lymphomas.

Conclusion

SPE should be done in all the patients who present with clinical suspicion or features of monoclonal gammopathy followed by IFE to arrive at a final diagnosis.

REFERENCES

[1] Mohammed Attaelmannan, Stanley S. Levinson. Understanding and Identifying Monoclonal Gammopathies. Clinical Chemistry Aug 2000, 46 (8) 1230-1238

[2] O'Connell TX1, Horita TJ, Kasravi B.Understanding and Interpreting Serum Protein Electrophoresis. Am Fam Physician. 2005 Jan 1; 71(1): 105–112

[3] THEODORE X. O'CONNELL, M.D., TIMOTHY J. HORITA, M.D., and BARSAM KASRAVI, M.D. Understanding and Interpreting Serum Protein Electrophoresis Am Fam Physician. 2005 Jan 1;71(1):105-112

[4] Tripathy S. The role of serum protein electrophoresis in the detection of multiple myeloma: an experience of a corporate hospital. J Clin Diagn Res. 2012;6(9):1458-61.

[5] Skeldon N Interpreting protein electrophoresis in practice In Practice 2018;40:183-193

[6] Al-Farsi K (2013) Multiple myeloma: an update. Oman Med J 28: 3-11.

[7] Dr. Dharmishtha N. Kapadiya1, Dr. R. Varadharajaperumal2, Dr. P.M. Santwani3 Study of serum protein electrophoresis in suspected cases of Multiple Myeloma. International Journal of Advanced Research (2015), Volume 3, Issue 12, 469 – 473

[8] Koksal Deveci1, Serdal Korkmaz2*, Enver Sancakdar1, Duygu Acibucu1, Filiz Alkan1, Hatice Terzi3 and Mehmet Sencan3 The Evaluation of Serum Protein and Serum Immunofixation Electrophoresis Results in Patients with Monoclonal and Polyclonal Gammopathy: A Single Center Experience Int J Blood Res Disord 2015, 2:2

[9] Chopra GS, Gupta PK, Mishra DK. The evaluation of suspected monoclonal gammopathies: the experience in a tertiary care hospital. MJAFI 2006; 62:134-37

[10] Nihar Ranjan Dash, Biswajit Mohanty. "Biochemical Profile and Electrophoretic Pattern in Multiple Myeloma Patients". Journal of Evidence based Medicine and Healthcare; Volume 2, Issue 39, September 28, 2015; Page: 6166-6170, DOI: 10.18410/jebmh/2015/852

[11] Sunita T The role of Serum Protein Electrophoresis in the detection of Multiple Myeloma: An experience of a Corporate Hospital. Journal of Clinical and Diagnostic Research 2012; 6: 1458-1461.

[12] Chelliah & Chauhan. Pattern of serum protein electrophoresis and immunofixation in plasma cell disorders International Journal of Biomedical Research 2017; 8(08): 449-454.

[13] Economopoulos T1, Papageorgiou S, Pappa V, Papageorgiou E, Valsami S, Kalantzis D, Xiros N, Dervenoulas J, Raptis S. Monoclonal gammopathies in B-cell non-Hodgkin's lymphomas. Leuk Res. 2003 Jun;27(6):505-8

[14] Manavi Dang, Smeeta Gajendra, Shalini Goel, Bhawna Jha, Tushar Sahni, and Ritesh Sachdev Diffuse large B cell lymphoma with high M protein: an unusual findingBlood Res. 2015 Mar; 50(1): 61–62

[15] Olga A. Gavrilina, Eugene E. Zvonkov, Elena N. Parovichnikova, Valeri G. Savchenko. The Secretion of Paraprotein Is Associated with Bone Marrow Involvement in Patients with Diffuse Large B-cell Lymphoma. Blood Dec 2015, 126 (23) 2646.