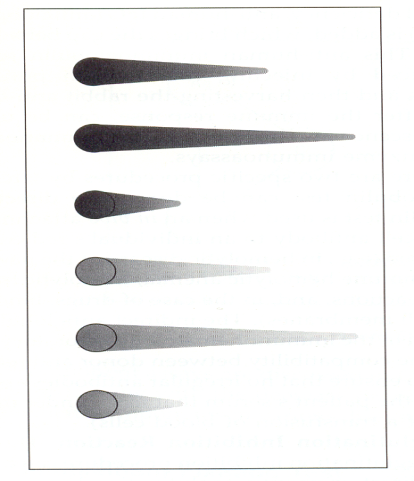
#### Rocket electrophoresis

In rocketelectrophoresis**,** a negatively charged antigen is electrophoresedin a gel containing antibody. The precipitateformed between antigen and antibody has the shape of arocket, the height of which is proportional to the concentrationof antigen in the well. One limitation of rocketelectrophoresis is the need for the antigen to be negativelycharged for electrophoretic movement within the agarmatrix.



#### Counter Current immunoelectrophoresis (CIE)

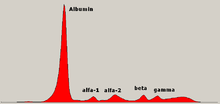
CIE is a variation of the classic precipitin procedure; it merely adds an electrical current to help antigens and antibodies move towards each other more quickly than in simple diffusion. The procedure takes advantage of the net electric charge of the antigens and antibodies being tested in a particular test buffer.

Variables such as types of gel, amount of current, a concentration of antigen and antibody must be carefully controlled for maximum reactivity. The sensitivity of CIE is 10 to 20 times greater than in immuno-double diffusion, however, it is more expensive than other techniques such as immunodiffusion.

# Serum Protein Electrophoresis

Blood serum contains two major protein groups: albumin and globulin. Both albumin and globulin carry substances through the bloodstream. Using protein electrophoresis, these two groups can be separated into five smaller groups (fractions):

* **Albumin.** Albumin proteins keep the blood from leaking out of blood vessels. Albumin also helps carry some medicines and other substances through the blood and is important for tissue growth and healing. More than half of the protein in blood serum is albumin.
* **Alpha-1 globulin.** High-density lipoprotein (HDL), the "good" type of cholesterol, is included in this fraction.
* **Alpha-2 globulin.** A protein called haptoglobin, which binds with [hemoglobin](http://www.emedicinehealth.com/script/main/art.asp?articlekey=133662&ref=129736), is included in the alpha-2 globulin fraction.
* **Beta globulin.** Beta globulin proteins help carry substances, such as iron, through the bloodstream and help fight infection.
* **Gamma globulin.** These proteins are also called [antibodies](http://www.emedicinehealth.com/script/main/art.asp?articlekey=133279&ref=129736). They help prevent and fight infection. Gamma globulins bind to foreign substances, such as bacteria or viruses, causing them to be destroyed by the [immune system](http://www.emedicinehealth.com/script/main/art.asp?articlekey=135507&ref=129736)



|  |  |  |
| --- | --- | --- |
| **Serum Protein Fraction** | **Increased** | **Decreased** |
| **Albumin** | Severe dehydration | Malnutrition, cachexia, liver disease, nephrotic syndrome, protein-losing enteropathies, severe burns |
| **Alpha-1** | Inflammatory states, pregnancy | Alpha-1 antitrypsin deficiency |
| **Alpha-2** | Inflammatory states, nephrotic syndrome, oral contraceptive use, steroid use, hyperthyroidism | Hemolysis, liver disease |
| **Beta** | Hyperlipidemia, iron-deficiency anemia | Hypo-B-lipoproteinemia, malnutrition |
| **Gamma** | Polyclonal and Monoclonal Gammopathies | Agammaglobulinemia, hypogammaglobulinemia |

**Immunofixation electrophoresis**

Identifies the type of immunoglobulin protein(s) present in monoclonal bands on a protein electrophoresis pattern; typically immunofixation determines the presence of a heavy chain ([IgG](https://labtestsonline.org/glossary/igg/), [IgM](https://labtestsonline.org/glossary/igm/) or [IgA](https://labtestsonline.org/glossary/iga/)) and a light chain (kappa or lambda).

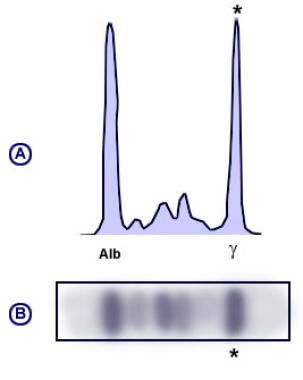
**Protein electrophoresis tests give a health practitioner a rough estimate of how much of each protein fraction is present and whether any abnormal proteins are present. The value of immunofixation electrophoresis is in the identification of the presence of a particular type of** [**immunoglobulin**](https://labtestsonline.org/glossary/immunoglobulin/)**.**

s[erum](https://labtestsonline.org/glossary/serum/) electrophoresis may be ordered:

* As a follow up to abnormal findings on other laboratory tests, such as [total protein](https://labtestsonline.org/understanding/analytes/tp/) and/or [albumin](https://labtestsonline.org/understanding/analytes/albumin/) level, elevated [urine protein](https://labtestsonline.org/understanding/analytes/urine-protein/) levels, elevated [calcium](https://labtestsonline.org/understanding/analytes/calcium/) levels, or low [white](https://labtestsonline.org/understanding/analytes/wbc/) or [red blood cell counts](https://labtestsonline.org/understanding/analytes/rbc/)
* When symptoms suggest an inflammatory condition, an [autoimmune disease](https://labtestsonline.org/understanding/conditions/autoimmune/), an [acute](https://labtestsonline.org/glossary/acute/) or [chronic](https://labtestsonline.org/glossary/chronic/) infection, a [kidney](https://labtestsonline.org/understanding/conditions/kidney/) or [liver](https://labtestsonline.org/understanding/conditions/liver-disease/) disorder, or a protein-losing condition
* When a health practitioner is investigating symptoms that suggest [multiple myeloma](https://labtestsonline.org/understanding/conditions/mult-myeloma/), such as bone pain, [anemia](https://labtestsonline.org/understanding/conditions/anemia/), fatigue, unexplained fractures, or recurrent infections, to look for the presence of a characteristic band (monoclonal immunoglobulin) in the beta or gamma region; if a sharp band is seen, its identity as a monoclonal immunoglobulin is typically confirmed by immunofixation electrophoresis.
* To monitor treatment of multiple myeloma to see if the monoclonal band is reduced in quantity or disappears completely with treatment

**Monoclonal gammopathy**

A dense narrow band that is composed of a single class of immunoglobulins secreted by an abnormally expanded clone of plasma cells is known as M-protein (paraprotein, monoclonal protein or M-component).An M-protein usually presents as a single narrow peak, resembling a "church spire," in the gamma, beta, or alpha-2 region of the densitometer tracing, or as a dense, discrete band on the agarose gel (see image below).

[](javascript:refimgshow(4))

Monoclonal pattern serum protein electrophoresis (SPEP).

The monoclonal antibody must be present at a concentration of at least 0.5 g/dL in order to be accurately identified using SPEP. This corresponds to approximately 109 antibody-producing cells.Plasma cell disorders are typically associated with the presence of an M-protein. In addition, an M component may be detected in other lymphoid malignancies like chronic lymphocytic leukemia, any B- or T- cell lymphomas, breast cancer, colon cancer, cirrhosis, sarcoidosis, and other autoimmune disorders.

**Polyclonal gammopathy**

Infectious, Inflammatory or various reactive processes may be associated with a broad-based peak or band in the gamma region (Figure). This pattern suggests a polyclonal increase in immunoglobulins. Liver disease, autoimmune disease, chronic viral or bacterial infections and various malignancies may cause a polyclonal rise in the gamma fraction (see Table below).

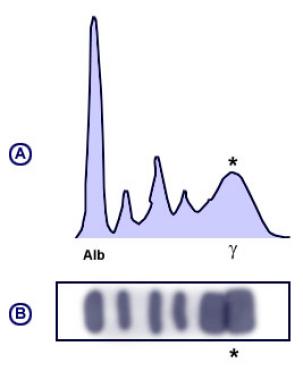
[](javascript:refimgshow(3))

Table. Diseases Associated with a Polyclonal Gammopathy.

|  |  |
| --- | --- |
| **Condition** | **Examples** |
| Liver disease | Cirrhosis, autoimmune or viral hepatitis |
| Connective tissue diseases | Rheumatoid arthritis, systemic lupus erythematosus, scleroderma, Sjogren syndrome |
| Infection | Bacterial: osteomyelitis, endocarditis, osteomyelitis Viral: HIV/AIDS, hepatitis C, Epstein-Barr virus |
| Hematologic disorders/malignancies | Non-Hodgkin lymphoma, chronic lymphocytic leukemia, thalassemia, sickle cell anemia |
| Nonhematologic malignancies | Lung, ovarian, gastric malignancies, hepatocellular carcinoma |

# Serological test for Syphilis

Syphilis tests are used to screen for and/or diagnose infection with *Treponema pallidum*, the [bacteria](https://labtestsonline.org/glossary/bacterium/) that cause syphilis. Several different types of tests are available. Antibody tests are most commonly used.

*Antibody tests (serology)*—these tests detect [antibodies](https://labtestsonline.org/glossary/antibody/) in the blood and sometimes in the [cerebrospinal fluid (CSF)](https://labtestsonline.org/glossary/cerebrospinal/). Two general types are available for syphilis testing, nontreponemal and treponemal (derived from the name of the bacterium). Either type may be used for syphilis screening but must be followed by a second test that uses a different method to confirm a positive result and to diagnose active syphilis:

* Nontreponemal antibody tests--these tests are called "nontreponemal" because they detect antibodies that are not specifically directed against the *Treponema pallidum* bacteria. These antibodies are produced by the body when an individual has syphilis but may also be produced in several other conditions. The tests are highly [sensitive](https://labtestsonline.org/glossary/sensitivity/) but, since they are non-specific, [false-positive](https://labtestsonline.org/glossary/false-positive/) results can be caused by, for example, IV drug use, [pregnancy](https://labtestsonline.org/understanding/wellness/pregnancy/), [Lyme disease](https://labtestsonline.org/understanding/conditions/lyme/), certain types of [pneumonia](https://labtestsonline.org/understanding/conditions/pneumonia/), [malaria](https://labtestsonline.org/understanding/conditions/malaria/), [tuberculosis](https://labtestsonline.org/understanding/conditions/tuberculosis/), or certain [autoimmune disorders](https://labtestsonline.org/understanding/conditions/autoimmune/) including [lupus](https://labtestsonline.org/understanding/conditions/lupus/). A positive screening result must be confirmed with a more specific (treponemal) test. Nontreponemal tests include:
  + RPR (Rapid Plasma Reagin)--in addition to screening, this test is useful in monitoring treatment for syphilis. For this purpose, the level ([titer](https://labtestsonline.org/glossary/titer/)) of antibody is measured. It may also be used to confirm the presence of an active infection when an initial test for treponemal antibodies is positive (see below).
  + VDRL (Venereal Disease Research Laboratory)--in addition to blood, this test is primarily performed on CSF to help diagnose neurosyphilis. The basis of the test is that an antibody produced by a patient with syphilis reacts with an extract of ox heart (diphosphatidyl glycerol). It therefore detects [anti-cardiolipin antibodies](https://en.wikipedia.org/wiki/Anti-cardiolipin_antibodies) (IgG, IgM or IgA), visualized through foaming of the test tube fluid, or "flocculation".
* The [rapid plasma reagin](https://en.wikipedia.org/wiki/Rapid_plasma_reagin) (RPR) test uses the same antigen as the VDRL, but in that test it has been bound to several other molecules including a carbon particle to allow visualization of the flocculation reaction without the need of a microscope.
* Treponemal antibody tests--these blood tests detect antibodies that specifically target *T. pallidum*. They are highly [specific](https://labtestsonline.org/glossary/specificity/) for syphilis, meaning other conditions are unlikely to cause a positive result. However, once a person is infected and these antibodies develop, they remain in the blood for life. By comparison, nontreponemal antibodies typically disappear in an adequately treated person after about 3 years. Therefore, a positive treponemal screening result must be followed by a nontreponemal test (such as RPR) to differentiate between an active infection (or reinfection) and one that occurred in the past and was successfully treated. Treponemal antibody tests include:
  + FTA-ABS (Fluorescent treponemal antibody absorption)--this test is useful after the first 3-4 weeks following exposure. In addition to blood testing, it can be used to measure antibodies to *T. pallidum* in the CSF to help diagnose neurosyphilis.
  + TP-PA (*T. pallidum* particle agglutination assay)--this test is sometimes performed instead of FTA-ABS because it is more specific and there are fewer false positives.
  + MHA-TP (Microhemagglutination assay)--another confirmatory method; this test is used much less commonly now.