Department of Biotechnology Medical

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Sera and Vaccine

Stage (Third)

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Introduction and History

By

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HISTORY of Serology

In 1901, Karl Landsteiner announced one of the most significant discoveries of the 20th Century – the typing of blood – a finding that 29 years later earned him a Nobel Prize.

 For years, physicians had attempted to transfuse blood from one individual to another, but their efforts often ended in failure because the transfused blood tended to coagulate, or clot in the body of the recipient, causing instantaneous death.

 Landsteiner was the first to recognize that all human blood was not the same; instead, he found that blood is distinguishable by its group or type.

Out of Landsteiner's work came the classification system that we call the A-B-O system. Now physicians had the key for properly matching the blood of a donor to that of a recipient.

One blood type cannot be mixed with a different blood type without disastrous consequences. This discovery had important implications for blood transfusion and the millions of lives it has since saved.

Karl Landsteiner (1868-1943)

Landsteiner's findings opened a new field of research in the biological sciences. Others began to pursue the identification of additional characteristics that could further differentiate blood. By 1937, the Rh factor in blood had been demonstrated and, shortly thereafter, numerous blood factors or groups were discovered. More than 100 different blood factors have been identified. However, the ones in the A-B-O system are still the most important for properly matching a donor and recipient for a transfusion.

Until the early 1990's, forensic scientists focused on blood factors, such as A-B-O, as offering the best means for linking blood to an individual. What made these factors so attractive was that in theory, no two individuals, except for identical twins, could be expected to have the same combination of blood factors. In other words, blood factors are controlled genetically an d have the potential of being highly

highly distinctive feature for personal identification.

What makes this observation so relevant is the great frequency of bloodstains at crime scenes, especially crimes of the most serious nature: homicides, assaults, and rapes.

- Serology is the scientific study of blood serum and other bodily fluids in vitro. In practice, the term usually refers to the diagnostic identification of antibodies in the serum. Such antibodies are typically formed in response to an infection (against a given microorganism), against other foreign proteins (in response, for example, to amismatched blood transfusion), or to one's own proteins (in instances of autoimmune disease).

- Serological tests may be performed for diagnostic purposes when an infection is suspected and in many other situations, such as checking an individual's blood type.

Serology blood tests help to diagnose patients with certain immune deficiencies associated with the lack of antibodies.

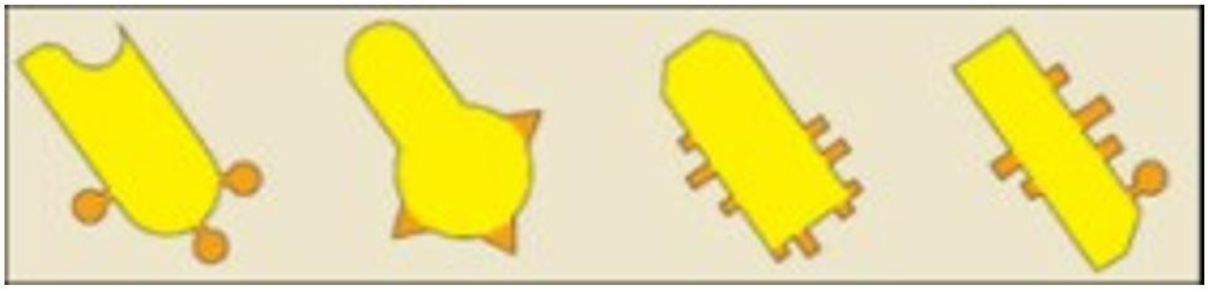
- There are several serology techniques that can be used depending on the antibodies being studied. These include:

- Agglutination. “Haemagglutination (HA), Haemagglutination Inhibition Test (HAI)”.
- Precipitation.
- Neutralization.
- Complement Fixation (CFT).
- Labeled immunoassay:
- Radioimmunoassay (RIA) (rarely used nowadays).
- Enzyme linked immunosorbent assay (ELISA).
- Immunofluorescence (IF).

- Some serological tests are not limited to blood serum, but can also be performed on other bodily fluids such as semen and saliva, which have (roughly) similar properties to serum.
- All tests of serology are depending on Antigen-Antibody Reaction.

Antigen:

Is a substance that stimulates antibody formation and has the ability to bind to an antibody.



Antibody:

Is specific glycoprotein's referred to as immunoglobulin's (Igs).

Antibody structure

SOME MAJOR CLASSES OF ANTIBODIES IN SEROLOGICAL DIAGNOSIS

IgM:-

is a basic antibody that is produced by B cells.

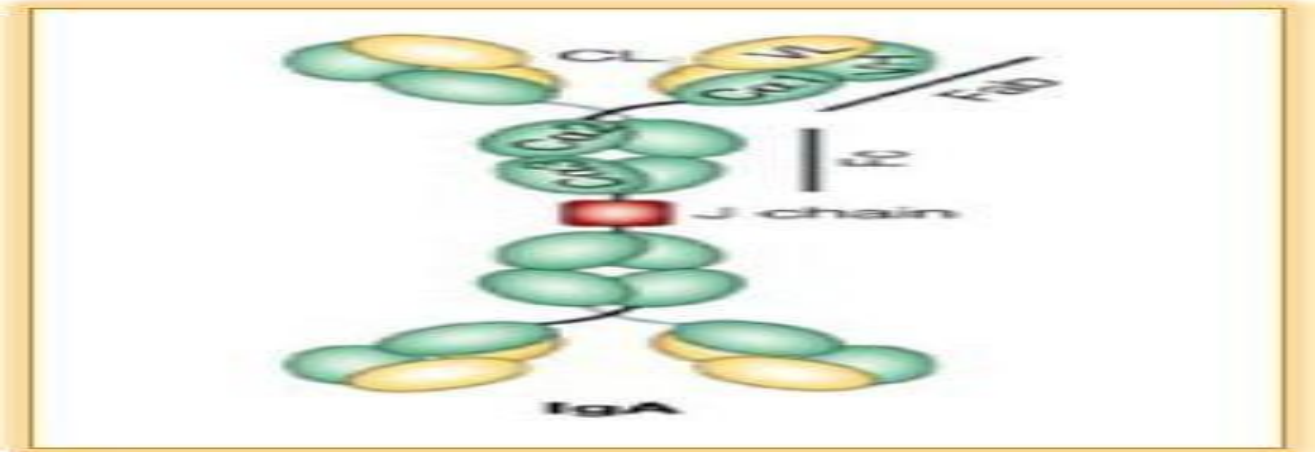
- It is the largest antibody in the human circulatory system.
- It is the first antibody appears in response to initial exposure to antigen.
- Demonstrating of IgM antibodies in a patient's serum indicates recent infection or in a neonate's serum indicates intrauterine infection (e.g. congenital rubella).
- It declines with convalescence.

IgG:

- IgG antibodies are involved in predominantly the secondary immune response.
- Appear following infection or administration of vaccine.
- IgG is the only antibody that can pass through the human placenta.
- The IgG antibodies thereafter increase in titer and remain high during convalescence and for some time afterward.
- There are four IgG subclasses (IgG1, 2, 3, and 4) in humans, named in order of their abundance in serum.

IgA:

- It is an antibody that plays a critical role in mucosal immunity.
- It has two subclasses (IgA1 and IgA2).
- IgA is the main immunoglobulin found in mucous secretions, including tears, saliva and secretions from the genitourinary tract, gastrointestinal tract, prostate and respiratory epithelium.
- It is also found in small amounts in blood.
- I gA found in high concentration in breast milk then transferring the immunity to the newborn infant.



IgD:

- Found on B cell surfaces.

IgE:

- Its main function is immunity to parasites.
- It also plays an essential role in the allergy disorders.

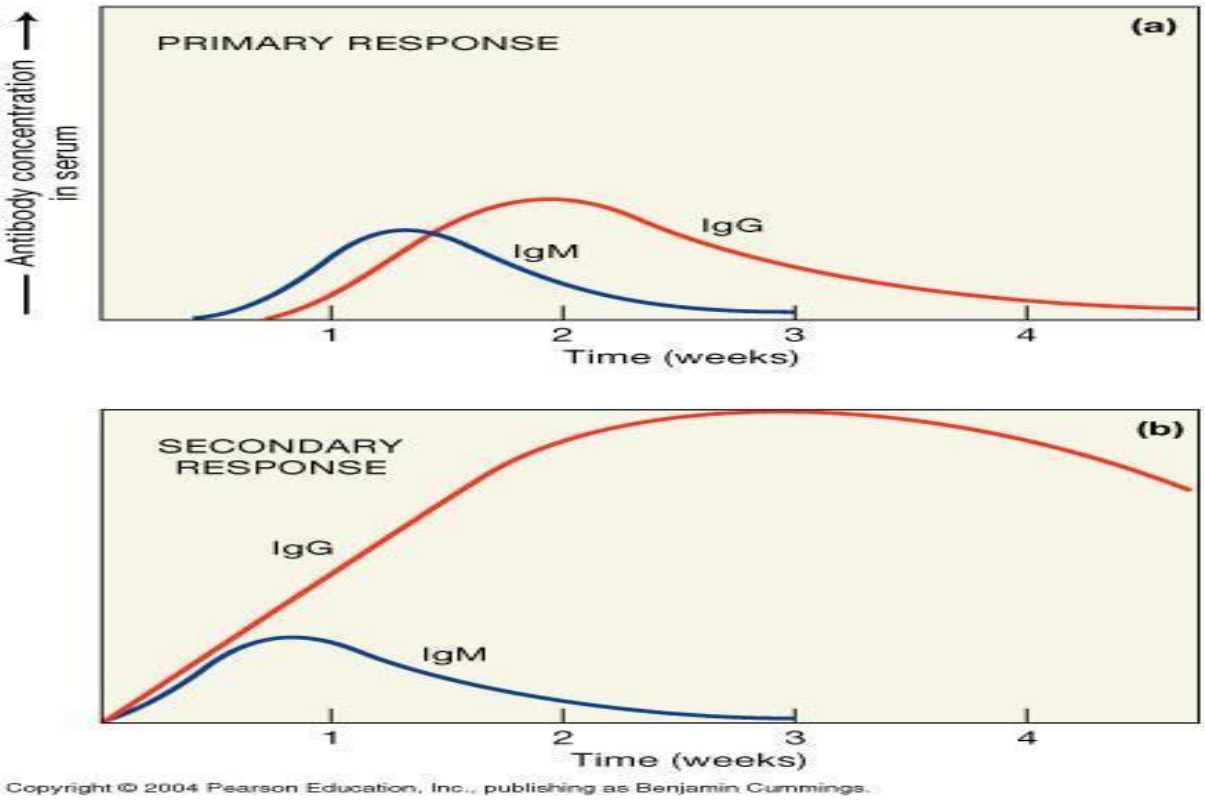
SEROLOGICAL DIAGNOSIS

It is preferred to take paired sera (two serum sample) in which:

1. 1st sample (Acute Serum): it is the serum taken as soon as the viral etiology is suspected, (usually at ≈ 0-5 days "1st few days") after the onset of illness (Acute phase). Here Abs present in very low titer or not yet being produced.
2. 2nd sample (Convalescent Serum): it is the serum sample taken at ≈14-21 days after the onset of illness (convalescent phase). Antibodies are present in high titer.

Titration (quantification) of IgG Antibodies:

The titer is a measure of antibodies concentration in serum sample. It is essential in serological test (antibody detection techniques) because if IgG Abs detected in serum, this may indicate immunization by vaccine or cured previous infection as well as recent infection. To decide whether the patient has a recent infection or immunization, we have to quantify the Ab in the serum by titration. A very high titer in single serum sample may suggest a recent infection, but this single high titer of IgG is very unreliable. It is better to take "paired sera" which is a two weeks separated serum sample from the patient (acute and convalescent) to titrate the Ab (if any) in both of them and then compare between them in Abs titer.



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Immune response curve.

Criteria for diagnosing Primary Infection:

- 4 fold or more increase in titer of IgG or total antibody between acute and convalescent sera.
- Presence of IgM.
- Seroconversion –ve to +ve.
- (A single high titer of IgG "or total antibody" is very unreliable) Criteria for diagnosing Secondary Infection (Reinfection):
- 4 fold or more increase in titer of IgG or total antibody between acute and convalescent sera.
- Absence or slight increase in IgM.