SNS COLLEGE OF ALLIED HEALTH SCIENCES

SNS Kalvi Nagar, Coimbatore - 35

Affiliated to Dr MGR Medical University, Chennai

DEPARTMENT OF CARDIAC TECHNOLOGY

COURSE NAME: GENERAL MICROBIOLOGY

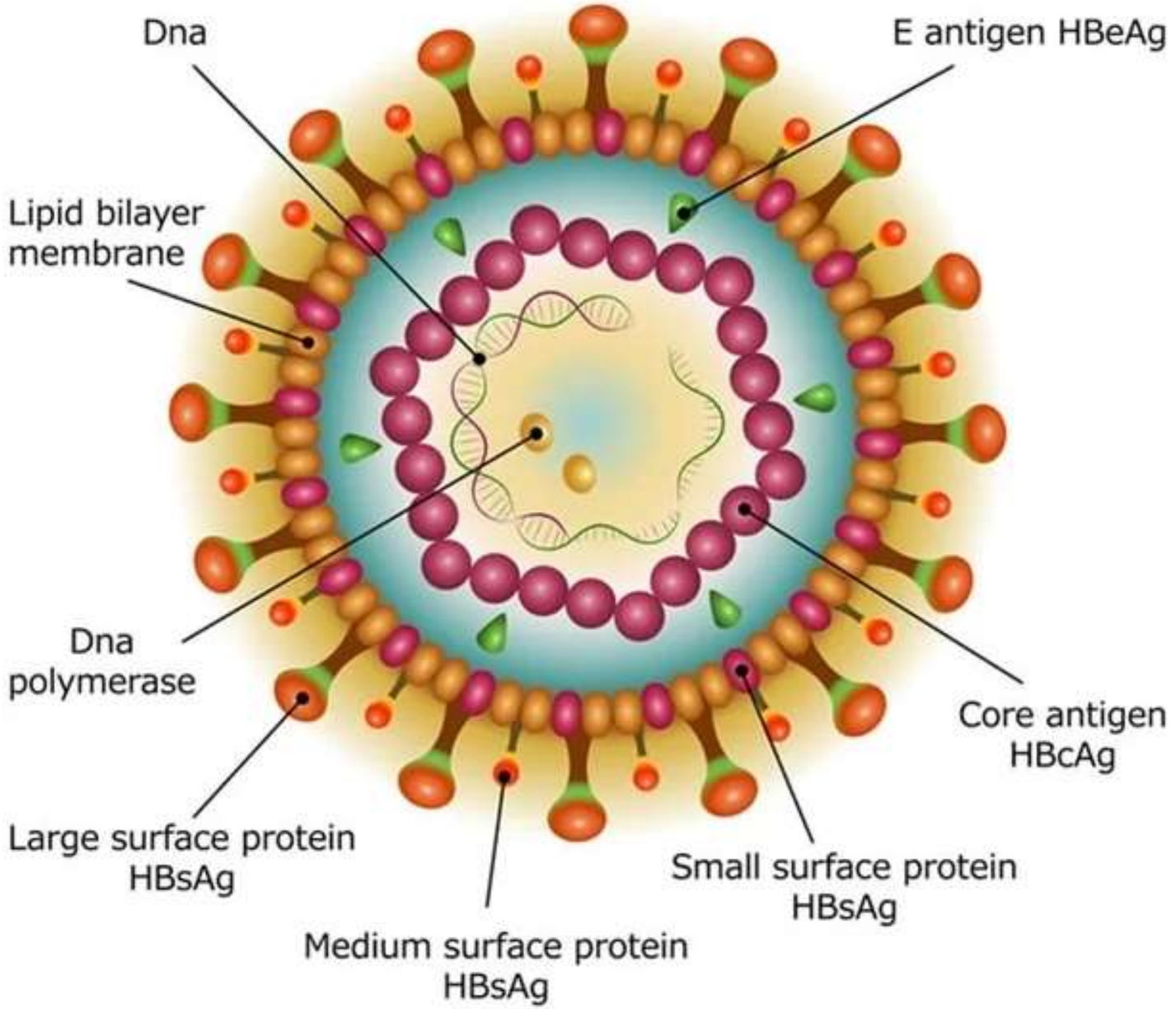
TOPIC : HEPATITIS B VIRUS

Hepatitis B Virus

- Hepatitis – Inflammation of the liver parenchyma due to infectious or non- infectious causes.
- It is a DNA, spherical and enveloped virus with ico-sahedral symmetry
- Genome – ds circular DNA - However one of the strand is shorter than another strand.
- **Dane Particle** : D.S. Dane discovered virus particles in 1970 by electron microscopy.
- It is a **complete virion** and is infectious - measuring 42 nm in diameter.
- **Family** - *"Hepadnaviridae"*
- **Genus** – "*Orthohepadnavirus*"
- Hepatitis B virus (HBV) infects the liver and to less extent kidney and pancreas.

Structure

- The hepatitis B virus contains an outer envelope and an inner core.
- The outer envelope of the virus is composed of a surface protein - hepatitis B surface antigen or "HBsAg".
- The HBsAg - detected by a simple blood test and a positive test result indicates a person is infected with the hepatitis B virus.
- The inner core of the virus is a protein shell - hepatitis B core antigen or "HBcAg,“ - contains the hepatitis B virus DNA and enzymes used in viral replication.


Dna
E antigen HBeAg
Lipid bilayer membrane
Dna polymerase
Core antigen HBcAg
Large surface protein HBsAg
Small surface protein HBsAg
Medium surface protein HBsAg

- **Hepatitis B is the most common serious liver infection, caused by the hepatitis B virus that attacks and injures the liver.**

- Can cause chronic infection leads to high risk of death from cirrhosis and liver cancer.
- Can survive outside the body for at least 7 days.
- During this time, the virus can still cause infection if it enters the body of a person who is not protected by the vaccine.
- I**ncubation period - 30 to 180 days**.
- The virus may be detected within 30 to 60 days after infection and can persist and develop into chronic hepatitis B, especially when transmitted in infancy or childhood.

Antigens of HBV

- **HBsAg – surface proteins** of virus particle clump together into
  - Spherical particles – 22nm diameter
  - Produced in large quantities than required for the assembly of virus particles
  - Found as free particle in serum of the patients

Hepatitis B core antigen (HBc Ag)

– covered by envelop made up of nucleo-capsid which consists of DNA and capsid

- not detectable in blood
- Detectable only in liver cells

Hepatitis B e-antigen (Hbe Ag)

– seen in blood only when virus multiplies in large numbers

Life Cycle of the Hepatitis B Virus

- The virus penetrates and transported into the nucleus of the host liver cell by binding to Sodium/bile acid cotransporter also known as the Na^+-taurocholate cotransporting polypeptide (NTCP) or liver bile acid transporter (LBAT) receptors by endocytosis.
- The partially ds DNA is then converted into covalently closed circular DNA (cc-DNA)
- Serves as a template for viral replication (creation of new hepatitis B virus).
- The viral DNA is then transcribed by RNA polymerase producing 4 mRNA
- The longest mRNA encodes for HBc Ag, HBeAg, and polymerase
- The other two mRNA encode for surface glycoproteins
- Smallest mRNA encodes for X-protein (HBx) which is involved in virus replication and also helps in spread of virus.

- The mRNA are transported to the cytoplasm for translation and the proteins are produced.
- The polymerase synthesize single stranded DNA (-ve sense) from the RNA by its reverse transcriptase activity.
- During this time or later +ve sense DNA is copied from the viral –ve sense DNA strand.
- This virion is then subjected to vesicular transport and is released by exocytosis from the membrane.
- New HBV virus is packaged and leaves the liver cell, with the stable viral cccDNA remaining in the nucleus
- It can integrate into the DNA of the host liver cell, as well as continue to create new hepatitis B virus.

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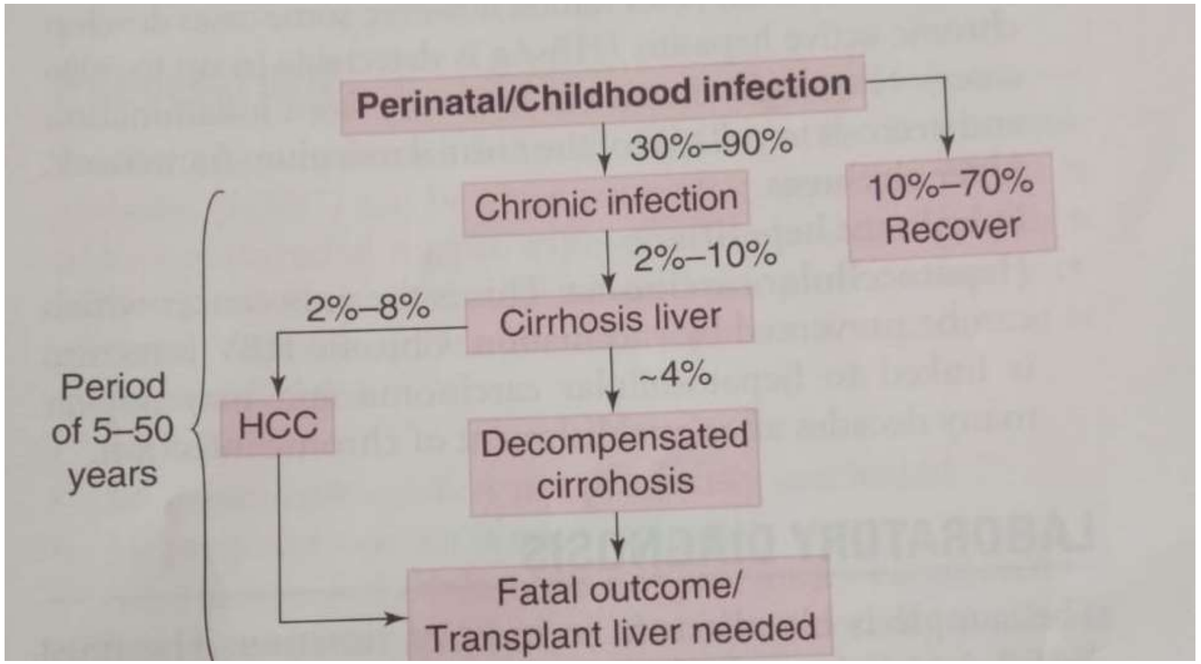
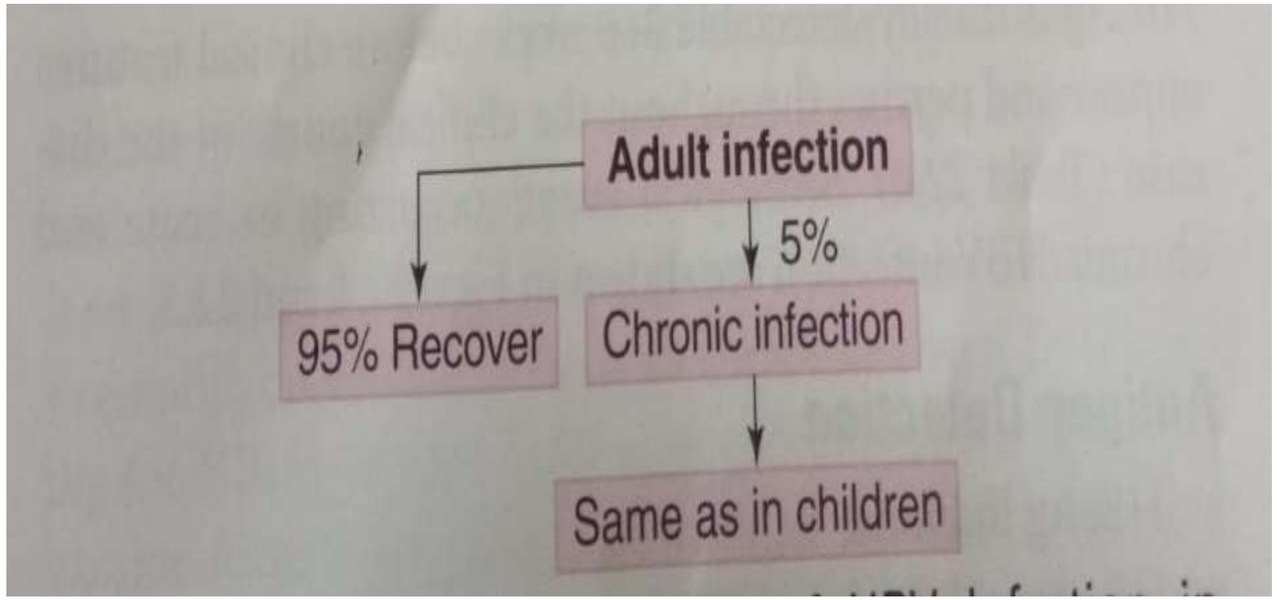
Pathogenesis





Transmission

- Through direct contact with infected blood or certain body fluids.
- From an infected pregnant person to their baby during childbirth, due to the blood exchange that happens between mother and baby (perinatal transmission)
- Through horizontal transmission (exposure to infected blood), especially from an infected child to an uninfected child during the first 5 years of life.
- Transmitted through unsterile medical or dental equipment,
- Unprotected sex, or unsterile needles, or by sharing personal items such as razors, toothbrushes, nail clippers.
- Spread by needlestick injury, tattooing, piercing and exposure to infected blood and body fluids, such as saliva and menstrual, vaginal and seminal fluids.

Symptoms

- Acute illness with symptoms that last several weeks, including
  - yellowing of the skin and eyes (jaundice),
  - dark urine,
  - fever
  - belly pain
  - Joint pain
  - extreme fatigue that persists for weeks or months
  - vomiting and abdominal pain.
- People with acute hepatitis can develop acute liver failure, which can lead to death.
- Among the long-term complications of HBV infections, develops advanced liver diseases such as cirrhosis and hepatocellular carcinoma, which cause high morbidity and mortality.

Lab diagnosis of HBV

- **Specimen:** Blood, serum, body secretions
- **Antigen detection:** Antigens show up in your blood between 1 and 10 weeks after exposure.
  - HBsAg in blood
  - HBeAg in blood
  - HBcAg in liver cells
- **Antibody detection:**
  - Anti - HBsAg
  - Anti – HBsAg: IgM Ab and IgG Ab
  - Anti HBeAg in blood

- **Microscopy: Immunofluorescence staining:**
  - Immunofluorescence staining of infected hepatocytes show HBV core antigen in the nucleus and infectious Dane particle in cytoplasm.

- **Molecular diagnosis:**
  - Detection of viral DNA by molecular methods such as insitu hybridization and PCR in tissue sample and serum reflects the degree of virus replication in liver.

Hepatitis B Complications

- Cirrhosis, or scarring of the liver
- Liver cancer
- Liver failure - This only happens in severe cases of chronic hepatitis B.
- Kidney disease. Researchers have found that people with cirrhosis caused by hepatitis B may be more likely to have certain types of kidney disease.
- Blood vessel problems. These include inflammation of the blood vessels.

Prevention

- Use condoms
- Wear gloves when you clean up after others, especially if you have to touch bandages, tampons, and linens.
- Cover all open cuts or wounds.
- Don’t share razors, toothbrushes, nail care tools, or pierced earrings with anyone.
- Make certain that any needles for drugs, ear piercing, or tattoos -- or tools for manicures and pedicures -- are properly sterilized.
- Passive immunization using specific hepatitis B Immunoglobulin (HBIG) – given soon after exposure

Treatment

- **Adefovir**
- **Entecavir**
- **Interferon alfa (Intron A, Roferon A, Sylatron) - B**oosts your immune system. It treats liver inflammation but doesn't cure the disease.
- **Lamivudine**
- **Telbivudine (Tyzeka)** is an antiviral medication. Resistance to this medication is common.
- **Tenofovir**
- Some people have access to surgery and chemotherapy which can prolong life for several months to a few years.
- Liver transplantation is sometimes used in people with cirrhosis or liver cancer in high-income countries, with varying success.

Assessment

1. Define HBV and its structure?

2. Mention the antigens of HBV?

3. Transmission of HBV?

4. Symptoms?

5. Lab Diagnosis?

6. Prevention and Treatment?

THANK YOU