Introduction to the Virology of HIV

Introduction

This course covers the structure, replication, and immunological pathogenesis and laboratory aspects of HIV. Basic concepts in HIV Laboratory Surveillance, Vaccine Development and Antiretroviral Resistance will also be dealt with. Post exposure prophylaxis in the health care setting will be covered in detail.

Objectives

To facilitate the understanding of the basic science of HIV, this course will accomplish the following objectives:

- The structure and replication of HIV for future understanding of antiretroviral therapy including antiretroviral resistance.
- The pathogenesis of AIDS for future understanding of management of patients with HIV/AIDS.
- The role of laboratory assays in the surveillance of HIV/AIDS, diagnosis and clinical monitoring of patients.
- To develop an understanding of preventative strategies such as post exposure prophylaxis in health care and HIV vaccine development.

Lectures

Please note the following

- Appropriate attendance will facilitate accumulation of adequate knowledge and understanding.
- Attendees are expected to take good notes during the lecture.
- Reading before the lecture will enhance learning during the lecture.
Summary of Lecture Topics

- HIV structure and replication
  A brief introduction to HIV structure and replication including classification, genomic features and molecular epidemiology will facilitate understanding the impact of HIV on clinical management and vaccine development.

- Basic Immunology
  A brief introduction to normal immune reactions to viral infections will be covered to facilitate an understanding of the role of the immune system in the pathogenesis of AIDS.
• Pathogenesis
A brief introduction to the immune derangements which occur in HIV infection.

• Laboratory Diagnosis
Methods in the diagnosis and monitoring of HIV infection will be covered.
An overview of serological methods of diagnosing HIV infection i.e. ELISA and p24 antigen assays, molecular techniques eg PCR and viral load assays and their limitations.
A brief introduction to validity of laboratory tests including an understanding of sensitivity, specificity and predictive values.

• HIV Vaccines
The following will be covered after the Small Group Discussions Plenary:
  ▪ Different types of HIV vaccines
  ▪ Advantages and disadvantages of these various vaccines
  ▪ Challenges in HIV Vaccine development.
  ▪ Current trends and strategies in the development of HIV vaccines
  ▪ Clinical trials of HIV vaccines and ethical considerations.

• ARV Resistance
The following will be covered after the Small Group Assignment Discussions Plenary:
  ▪ Mechanisms of actions of the antiretroviral drugs
  ▪ Mechanisms involved in the development of drug resistance
  ▪ Patterns of drug resistance
  ▪ Laboratory techniques used to identify various resistance patterns.
  ▪ Strategies to overcome drug resistance

• Post-exposure Prophylaxis in Health Care
An understanding of the rationale of post-exposure prophylaxis, and details regarding protocols and procedures in the management of such exposures.

• The role of the laboratory in HIV surveillance.
The design and implementation of surveillance strategies including the interpretation and limitations of surveillance data.

Small Group Discussions

For maximum benefit all students must read the relevant literature before the Small Group Assignments. These will be undertaken in small groups on the second day. Each small group must spend one hour on each of the three topics. An insightful discussion of the topic must be evident during the plenary sessions.

Topics

1. Laboratory validity is crucial in understanding clinical interpretation especially the causes of false positive and negative results. By using a case study from: The Laboratory Diagnosis of HIV Infection : SAMJ ,February 2000;90( 2 ) and the attached explanatory notes, consider and discuss the following concepts:

• Sensitivity
2. **HIV has a high mutation rate due to the lack of proof reading mechanisms during replication. The use of antiretroviral drugs selects out mutations which continuously evolve resulting in antiretroviral drug resistance. Discuss this statement with emphasis on the following:**

- Mechanisms of actions of the antiretroviral drugs
- Mechanisms involved in the development of drug resistance
- Patterns of drug resistance
- Laboratory techniques used to identify various resistance patterns.
- Strategies to overcome drug resistance

3. **Since the eradication of smallpox due to a successful vaccination, a number of successful viral vaccines became available. There have been a few failures in viral vaccine development. Discuss HIV vaccines using the following as a guide:**

- Different types of HIV vaccines
- Advantages and disadvantages of these various vaccines
- Challenges in HIV Vaccine development.
- Current trends and strategies in the development of HIV vaccines
- Clinical trials of HIV vaccines and ethical considerations.

**Reading**

**Compulsory Reading**

Below is a list of books and journals, which will be useful during the course. It is expected that reference be made to every item on the list during the course. These reading materials are provided in the course file to facilitate prior reading for the small group discussions.


   Chapter 2. Laboratory Diagnosis
   Chapter 4. Antiretroviral Therapy: Post Exposure Prophylaxis


Background Reading

Below are two reference books which will be useful during the course. It is not expected that reference is made to every item on the list during the course.


Self-evaluation Questions

Answering the following questions will facilitate an evaluation on the knowledge accumulated during the course. These self assessment questions will be adequately approached using the compulsory reading list and knowledge acquired during the various lectures and small group discussions.

1. Using diagrams, describe the structure and replication of HIV.
2. Outline briefly the classification of HIV.
3. Explain briefly the genetic diversity of HIV.
4. Outline and explain the viral and host factor mechanisms involved in the pathogenesis of AIDS.
5. List the advantages and disadvantages of each of the laboratory assays used in the diagnosis and monitoring of HIV infection. These tests include:
   - HIV ELISA Antibody and HIV ELISA Antigen
   - HIV Rapid
   - HIV DNA PCR
   - HIV Viral Load
   - CD-4/CD-8
   - Genotypic and Phenotypic Resistance
6. Describe briefly laboratory surveillance strategies in the epidemiology of HIV/AIDS.
7. Outline the clinical management of a health care worker who has sustained a deep needle stick injury from an HIV infected patient.
8. Outline and explain the current strategies in HIV Vaccine development.
9. Outline the strategies used to prevent antiretroviral resistance.