

1. Microbiology and 2nd Year Curriculum

## Microbiology and 2nd Year Curriculum

- Microbiology
  - How pathogens establish infections and cause disease.
  - How clinicians distinguish among them.
  - Pathobiology and case studies.
- Pharmacology
  - Drugs used to treat infectious diseases
- Infectious Disease Course
  - Pathophysiology/Syndromes/Case studies

(c) 2004, Joan Meccas, Ph.D.

2. Today's lecture

## Today's lecture

- Review key features of microbes
- Gram stain
- How to approach study of microbes for this course

(c) 2004, Joan Meccas, Ph.D.

3.

## Parasitic Protozoans (1)

# Parasitic Protozoans

Eukaryotic!

Unicellular

At least part of the lifecycle of a parasite must be completed in hosts.

Why does a clinician need to know whether infection is due to a protozoa?

(c) 2004, Joan Meccas, Ph.D.

4.

## Parasitic Protozoans (2)

# Parasitic Protozoans

Eukaryotic

Treatment-different than prokaryotes

Toxoplasma,  
Leishmania,  
Malaria—Plasmodium,  
Intestinal protozoans

(c) 2004, Joan Meccas, Ph.D.

5.

## Helminths

# Helminths

Worms!

Eukaryotic

Multicellular

Inhabit 1/5 to 1/3 world's  
population

(c) 2004, Joan Meccas, Ph.D.

6.

## Fungi

# Fungi

Eukaryotic

Free living, not parasites  
Can live independently  
of host

(c) 2004, Joan Meccas, Ph.D.

7.

## Viruses (1)

# Viruses

- Not able to replicate outside of host cells

(c) 2004, Joan Meccas, Ph.D.

8.

## Viruses (2)

# Viruses

- Not able to replicate outside of host cells

-Obligate intracellular parasites

Exploit host cells and often host  
cell enzymes to replicate

(c) 2004, Joan Meccas, Ph.D.

9.

## Bacteria (1)

# Bacteria

Prokaryotic—no nucleus, mitochondria,  
or other membrane bound organelles

Single cell

Different from eukaryotes in

- enzymes essential for life processes
  - replication
  - transcription
  - translation
- composition of ribosomes, lipids
- cell wall

(c) 2004, Joan Meccas, Ph.D.

10.

## Bacteria (2)

# Bacteria

Most bacteria are classified based on two criteria

1. Shape
  - Rods- straight
  - curved
  - Cocci
  - Spirochetes
2. Gram stain

(c) 2004, Joan Meccas, Ph.D.

11.

Bacteria (3)

## Bacteria

- Performing a Gram stain



Heat fix cells and stain with crystal violet dark blue/purple

(c) 2004, Joan Meccas, Ph.D.

12.

Bacteria (4)

## Bacteria

- Performing a Gram stain



Modify with K<sup>+</sup>iodine solution: decolorize with alcohol  
only Gram + will retain crystal violet

(c) 2004, Joan Meccas, Ph.D.

13.

Bacteria (5)

## Bacteria

- Performing a Gram stain



Counterstain with safranin: Gram+ remain dark blue/purple  
Gram- pink

(c) 2004, Joan Meccas, Ph.D.

14.

How material is presented

## How material is presented

- Case
- Encounter
- Entry
- Multiply/Spread
- Damage
- Diagnosis
- Treatment
- Outcome

(c) 2004, Joan Meccas, Ph.D.

15. Case Study

## Case Study

- Case
  - Encounter
  - Entry
  - Multiply/Spread
  - Damage
  - Diagnosis
  - Treatment
  - Outcome
- **Typical Case**
    - Demographic and/or Situation
      - which are important?
    - Symptoms
    - Diagnostic tests
    - Treatment/Outcome

(c) 2004, Joan Meccas, Ph.D.

16. Types of Infectious Diseases encountered by clinician (1)

## Types of Infectious Diseases encountered by clinician

- Current common causes of infectious diseases
  - Flu-Influenza virus
  - Strep throat-Group A Streptococcus
  - *Chlamydia*-most frequent infectious disease in USA of those reported in Morbidity and Mortality Weekly Report (MMRB) – 500,000 cases so far this year
  - Nosocomial

(c) 2004, Joan Meccas, Ph.D.

17. Types of Infectious Diseases encountered by clinician (2)

## Types of Infectious Diseases encountered by clinician

- Emerging/Recently Emerging/Recently Recognized Infectious Diseases
  - SARS 2003
  - West Nile Virus 1999\*
  - AIDS/HIV 1981-1984\*
  - *H. pylori* 1983-ulcers

(c) 2004, Joan Meccas, Ph.D.

18. Types of Infectious Diseases encountered by clinician (3)

## Types of Infectious Diseases encountered by clinician

- Bioterrorism
  - Anthrax-2001 (*Bacillus anthracis*)
  - *Salmonella typhimurium*
    - Oregon-mid 1980's; Salad bars were spiked with it.

Clinicians are first line of defense/recognition of  
bioterrorist event or emergence of new disease

(c) 2004, Joan Meccas, Ph.D.

19.

## Encounter

# Encounter

- Case
- Encounter
  - Exogenously
    - Flu
    - Enteric pathogens/*Vibrio cholerae*, *Salmonella*
  - Endogenously--Normal flora in “wrong place”
    - Anerobic infections-perforations of colon
    - Staph infections-cuts in skin
    - *E. coli* infections-from GI tract to urinary tract
  - Nosocomial
- Entry
- Multiply/Spread
- Damage
- Diagnosis
- Treatment
- Outcome

(c) 2004, Joan Meccas, Ph.D.

20.

Why is understanding encounter important? (1)

## Why is understanding encounter important?

(c) 2004, Joan Meccas, Ph.D.

21. Why is understanding encounter important? (2)

## Why is understanding encounter important?

- Control transmission/spread to others
  - Exogenously:
    - Contaminated food supply?
    - Treat other susceptible individuals?
  - Nosocomial
    - Decontaminate areas

(c) 2004, Joan Meccas, Ph.D.

22. Entry

## Entry

- Case
  - Encounter
  - Entry
  - Multiply/Spread
  - Damage
  - Diagnosis
  - Treatment
  - Outcome
- Ability to colonize within host
  - D-day, establishing a beach-head
    - Pathway into host
    - Colonization factors
      - Adherence factors on pathogen.
      - Receptors on host.

(c) 2004, Joan Meccas, Ph.D.

23. Entry: Pathway into host (1)

## Entry: Pathway into host

- Case
- Encounter
- Entry**
- Multiply/Spread
- Damage
- Diagnosis
- Treatment
- Outcome

- Example *B. anthracis*

(c) 2004, Joan Meccas, Ph.D.

24. Entry: Pathway into host (2)

## Entry: Pathway into host

- Case
- Encounter
- Entry**
- Multiply/Spread
- Damage
- Diagnosis
- Treatment
- Outcome

- Example *B. anthracis*
- Inhalation
- Cuts, scratches, abrasions
- Ingestion

(c) 2004, Joan Meccas, Ph.D.

25.

## Spread

# Spread

- Case
  - Encounter
  - Entry
  - Multiply/Spread
  - Damage
  - Diagnosis
  - Treatment
  - Outcome
- Does the pathogen spread from site of entry?
  - What drives the tissue tropism?
    - Pathogen factors—are these good therapeutic targets?
    - Host factors—what does the pathogen hijack to get to site of replication  
i.e. cell receptors used by viruses to invade cells

(c) 2004, Joan Meccas, Ph.D.

26.

## Multiply

# Multiply

- Case
  - Encounter
  - Entry
  - Multiply/Spread
  - Damage
  - Diagnosis
  - Treatment
  - Outcome
- Most multiple
    - Time course before symptoms
    - Often very infective when multiplying, but before symptoms
      - Flu : HIV
      - Several days    Years
  - Exception: Some diseases caused by Toxins
    - *Clostridia tetani*
    - *Clostridia botulinum*
    - Fast acting food poisoning agents

(c) 2004, Joan Meccas, Ph.D.

27.

Damage

## Damage

•Case

•Encounter

•Entry

•Multiply/Spread

•Damage

•Diagnosis

•Treatment

•Outcome

- **Bacterial Factors**
  - Toxins-destroy cells
  - Physical damage-helminths block intestines
- **Host response**
  - Pro-inflammatory response:
    - Toxic Shock Syndrome
  - Autoimmune:
    - Lymes disease,
    - Rheumatic Heart Fever

(c) 2004, Joan Meccas, Ph.D.

28.

Diagnosis and Clinical Confirmation

## Diagnosis and Clinical Confirmation

•Case

•Encounter

•Entry

•Multiply/Spread

•Damage

•Diagnosis

•Treatment

•Outcome

- **What tests do you run to confirm diagnosis?**
  - Gram stain of appropriate tissue samples
  - Culture bacteria
  - Test for antibody titers
  - Others....

(c) 2004, Joan Meccas, Ph.D.

29.

## Treatment

# Treatment

- Case
- Encounter
- Entry
- Multiply/Spread
- Damage
- Diagnosis
- Treatment
- Outcome

- Medical Intervention
  - Vaccines—why or why not?
  - Antibiotics...
  - Resistance to commonly used drugs
  - Other therapies/prevention measures

(c) 2004, Joan Meccas, Ph.D.

30.

For every pathogen

## For every pathogen

- Case
  - Encounter
  - Entry
  - Multiply/Spread
  - Damage
  - Diagnosis
  - Treatment
  - Outcome
- } Virulence factors:  
Attachment  
Toxins  
Evasion of host defenses

(c) 2004, Joan Meccas, Ph.D.