Discovering Ebola

Ebola Virus Disease (EVD)

Microbiology - L. Freeman
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History of Ebola

Ebola is a viral hemorrhagic fever
- profuse bleeding inside and outside the body along with a very high fever (Nall, 2014)

Belongs to the Filoviridae family
- two genera Marburg Virus and Ebola Virus (Baijayantimala, 2014, p. 364)

Zoonotic disease
- first reservoir host of EVD may be African fruit bats (Nall, 2014)
  - chimpanzees  - gorillas  - porcupines
  - forest antelopes  - monkeys
Species of the Ebola Virus

EVD has 5 species, each one is named for the region where first outbreak occurred
- Zaire 90%
- Sudan 53-66%
- Bundibugyo 40%
- Tai Forest has only one known case with no fatalities
- Reston - no known human fatalities, only non-human primates (Baijayantimala, 2014, p. 365)

Radically different outcomes of EVD are unclear but may include: route of infection, size of inoculum, cell type initially infected (Leroy et al, 2011, p. 971) and previously acquired immunity (Groseth et al, 2012)

EVD is also appears to be mutating at a rapid rate as it spreads through people, which may alter the course of the virus (Ebola virus, 2014)
- form long, sometimes branched filaments of varying shapes
- diameter is 80 nm and may measure up to 1400 nm in length
- contain a single strand of nonsegmented, antisense RNA
- enveloped in a lipid membrane
- viral particles bud from the surface of host cell
(Ebola Virus, 2014)
Viral envelope contains only glycoproteins (GP) (Baijayantimala, 2014, p. 364)
- they form a shield over the proteins on cell surface
- maintains viral stability when outside host cell (often for long periods of time)

GP contains 2 subunits presenting as trimeric spikes (Baijayantimala, 2014, p. 364)
- With separate structural and functional roles
- GP 1 is responsible for receptor engagement
- GP 2 mediates the fusion of viral and host membranes, through an interaction with Niemann-Pick C1 receptor in the host cell (Adu-Gyambi et al, 2014, p. 3838)
EVD encodes only 7 genes—more complex viruses can encode 100-200 genes

- Nucleoproteins (NP) (3’ leader)
- Virion protein (VP) 35
- VP30 (RNA binding protein)
- RNA dependent RNA polymerase (5’ trailer)
  - these are linked with viral replication and transcription (Baijayantimala, 2014, p. 364)
- Glycoproteins (GP)
- VP40
  - a viral matrix protein involved with the budding and release of viral particles (Adu-Gyambi, 2014, p. 3838)
- VP24
  - a minor matrix protein associated with nucleocapsid formation

*Both VP40 and VP24 are known to block interferon signaling (Baijayantimala, 2014, p. 364)
How the Ebola virus attacks

Viruses are parasitic, they hijack living cells to reproduce their own genome

**Ebola Hemorrhagic Fever (EHF)**

Pertaining to bleeding or the abnormal flow of blood

**Symptoms**

- Early stage: sudden onset of fever, intense weakness, muscle pain, headache, sore throat
- Followed by: vomiting, diarrhoea, rash, impaired kidney and liver, internal and external bleeding
- Pertaining to bleeding or the abnormal flow of blood

1. Virus enters body through contact with infected blood, urine, feces, semen or other bodily fluids
   - Incubation 2 – 21 days

2. Attacks immune system, destroys white blood cells

3. Infected cells transport the virus throughout the body

4. Forms blood clots that damage organs and also depletes clotting agents

The virus is thought to transmit among some fruit bat species without causing them harm

5. The immune system goes into dangerous overdrive known as a "cytokine storm", ultimately turning against itself

6. The disease can attack all organs including brain, liver, kidneys, intestines, eyes, genitals

7. Overall vascular system damaged. Internal and external bleeding, from wounds, mucus membranes and orifices

Death can be caused by organ failure or hypovolemic shock, the loss of more than 20 percent of blood or fluid supply

Men who have recovered can still transmit the virus through semen for up to 7 weeks

Source: WHO/emedicine.medscape.com/CDC/MedicineNet.com/Medterms.com/Healthline/Boston University

(Leroy, Gonzalez, Baize, 2011) (md-health, 2014)
Symptoms

Within the first 5 days:
- headache, cough, fever, sore throat (Diseases, 2001, pg 188)
- diarrhea, muscle pain and stomach pain (Ebola Virus, 2014)
- bruising throughout the body, hematemesis, bleeding gums, melena (Diseases, 2001, pg 188)

6-21 days (and final stages):
- blood pressure begins to drop significantly
- blood loss and fluid loss (Ebola Virus, 2014)
- kidney function ceases
- skin blisters and falls off, blood seeps out of body orifices, organs liquify and patient vomits (Diseases, 2001, pg 189)
- shock (which often is the cause of death)

Long Term Complications:
- virus can affect vision and joints (Ebola Virus, 2014)
How to Diagnose Ebola

-Blood tests show the most accurate results

-antigens and antibodies specific to the virus will show up in the lab tests
  -tests for IgM and IgG antibodies (Ebola Hemorrhagic Fever, 2014)

-tests for microangiopathic hemolytic anemia, neutrophil leukocytosis (Diseases 2001, pg, 189)

-platelet counts and white blood cell counts are tested for signs of infection (Ebola Virus Disease, 2014)
Treatment

- there is no approved vaccine or cure yet
- experimental trials are ongoing
- Antibody Therapy (Zimmerman, 2003, pg 127)
  - antibodies may last in body for up to 10 yrs.
- Blood plasma transfusions
- patient must be treated in isolation 21 days
- receives I.V. fluids (Diseases, 2001, pg 189)
- Effectiveness of treatment is based on immune response, age, and early treatment

(www.mirror.co.uk - photo)
Transmission

-transmission of Ebola is NOT airborne
-can not be spread through mosquitoes or insects
-EVD can only be spread while patient is showing symptoms
-contact with infected bodily fluids, vomit, or feces
-Ebola can enter through an open wound, nose, mouth, or eyes
-EVD can also be spread through wild meat, and contaminated bedding and clothing
-Healthcare workers are at a high risk, and family members of infected patients
-contaminated needles, medical supplies, or syringes must be disposed of properly

(Ebola virus, 2014) (Ebola Hemorrhagic Fever, 2014)
Precautions and Prevention

-EVD victims are highly infectious

-Deceased victims still carry the disease

-Dispose properly of all soiled medical equipment

-Use alcohol based soap products for hand hygiene

-Avoid travel to areas with high risk of infection
  (Ebola Hemorrhagic Fever, 2014)

-If caring for an EVD patient, where proper gear

-Prompt burial after death to lower risk of disease spreading
  (Diseases, 2001, pg 189)


