THE ROLE OF THE HUMAN/ANIMAL INTERFACE IN THE ZOONOSES

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Human + Animal Health « ONE HEALTH ».

- Increase in Human and Animal populations
- Ecological change: déforestation
- Climate change
- Sociocultural change

Penetration of Humans in the Animal ecosystem

Human health

Animal health
Ongoing contacts between human and animal
Ongoing contacts between human and animal
Map of Africa showing countries that are affected by viral haemorrhagic fever (VHF) outbreaks
Human, Animal and Environmental Health

- Human health is intimately connected to the animal and environmental health.
- According to the WHO roughly 70% of human diseases have an animal origin. They are called « Zoonoses ».
- Due to the socio-economic, environmental and ecological factors, most of African countries constitute an Emerging Infectious Diseases hotspots.
- I wish to talk about Ebola and Monkeypox viruses because the two pathogens are able to infect both human and non human primates with high case fatality rates.
OUTLINE

1. Ebola Virus Disease (EVD) IN Africa.

- The virus
- Geographic distribution
- Clinical features
- Epidemiology/ecology
- Ebola transmission from animal to humans
- Ecological research
- DRCongo sharing experience
OUTLINE

2. Human Monkeypox Infection

- The virus
- Geographic distribution
- Epidemiology/transmission
- Clinical manifestations
- Differential diagnosis
- Prevention
EBOLA VIRUS

Ordre Mononegavirales
Family Filoviridae

Genus Marburgvirus
Species Marburg marburgvirus
Virus 1: Virus Marburg
Virus 2: Virus Ravin

Genus Ebolavirus
Species Forêt de Tai
Virus: Virus de la Forêt de Taï

Species Reston
Virus: Reston (RESTV)

Species Soudan
Virus: Sudan virus (SUDV)

Species Zaire
Virus: Ebola virus (EBOV)

Species Bundibugyo
Virus: Bundibugyo (BDBV)

Genus Cuevavirus
Species Lloviu virus
Virus: Lloviu (LLOV)

Species and virulence

Virulence by Species.

- Ebola Zaire: lethality 60-90%.
- Ebola Sudan: lethality 40-60%.
- Ebola Bundibugyo: lethality 25-50%.
- Ebola forêt de Taï: lethality 0%.

Virulence by modes of contamination.

- Infection by injection: incubation period 6.3 days and lethality 100%. (Yambuku).
- Infection by contact: incubation period 9.5 days and lethality 80%.
What happened in West Africa: Virus Yes but Context also?

West Africa Ebola Zaire was the most virulent? May be but ….

Outbreak in Nigeria, Senegal and Mali caused by the same strain were quickly contained

Unprecedented outbreak in Guinea, Liberia and Sierra Leone occurred in the context of lack of preparedness, community engagement and funeral practices
Geographic distribution of Ebola species.

**Virus Ebola**

- **Zaire Ebolavirus**
  - RD Congo
  - Gabon
- **Soudan Ebolavirus**
  - Senegal
  - Guinea
  - Liberia
- **Bundibugyo Ebolavirus**
  - DR Congo
  - Uganda

**Ebola Reston**
- Philippines: porcs (problèmes de SP, Agriculture, sécurité alimentaire).

**Taï Forest Ebolavirus**
Clinical features of Ebola

Incubation period: 2-21 days.

- Fever
- Severe headache
- Myalgia
- Extreme fatigue
- Conjunctival injection
- Severe sore throat
- Chest and abdominal pain
- Skin rash
- Diarrhoea, vomiting
- Haemorrhage
- Hiccups
- Somnolence, delirium, coma

CFR 25-90%
Hemorrhagic manifestations in Ebola Patients (<50%).
Epidemiology and ecology of Filoviruses

- Lake Kyoga in Uganda, from where monkeys were exported to Germany.
- Kitumu cave, Mont Elgon, Kenya, 1980-1987
- Presence of bats in mine and cave.
This graphic shows the life cycle of the ebolavirus. Bats are strongly implicated as both reservoirs and hosts for the ebolavirus. Of the five identified ebolavirus subtypes, four are capable of human-to-human transmission. Initial infections in humans result from contact with an infected bat or other wild animal. Strict isolation of infected patients is essential to reduce onward ebolavirus transmission.
An hypothesis for the transmission of Marburg virus in caves or mines.
Ebola virus transmission from animal to human.

Role of the bushmeat?

- Community amplification: traditional burial.
- Hospital amplification:
  - Shortage of PPE, disinfectant.
  - HCW not familiar with Ebola.
  - Lack of infection control policy.
In the Search of Ebola Reservoir

Since the first Ebola outbreak in Yambuk in 1976, the virus remains a mystery.

Among multitude of animal studied, bats are the most suspected. Why?

- Bats suspected in the first 1976 Sudan Ebola virus outbreak.
- In the 2007 Mweka Ebola outbreak was associated with the consumption of bats.
- In 2014 West-African Ebola outbreak, the index case a 2 year-old boy was in contact with an insectivorous bat.
- Because of similarity between Ebola and Marburg virus.
DRC a country with 8 EBOLA outbreaks.

- Boende, 2015
- Tandala, 1977
- Yambuku, 1976
- Likati, 2017
- Isiro, 2012
- Mweka, 2007
- Mweka, 2009
- Kikwit, 1995
DRC sharing its experience with other African countries;
Congolese team of experienced lab technicians were selected to run the KPLAN EBOLA mobile lab in Guinea, 2013-2015.

Congolese teams of ± 100 multidisciplinary members epidemiologists, hygienists, medical doctors, anthropologists, social mobilisation
EBV outbreaks are more and more moved closer

Ebola Reservoir still a scientific enigma....
Bat’ Survey In DRC

More than 25 bat species investigated (<2000 samples)... analysis is in progress
HUMAN MONKEYPOX INFECTION

- The virus
- Geographic distribution
- Epidemiology/transmission
- Clinical manifestations
- Differential diagnosis
- Conclusion
Monkeypox virus is a zoonotic orthopoxvirus, family Poxviridae.
MPX: background.

- Human MPX is a smallpox-like disease mainly reported in the rainforests of central and western Africa.
- First case detected in rural area in DR Congo, in 1970, after smallpox global eradication.
- Human MPX is a tropical zoonotic disease.
- Transmission: contact with infected rodent or monkey (72%) or with a patient (28%).
- Majority of patients: children (86%) and non smallpox vaccinated adults.
MPX: background

- 1958: MPX virus was isolated (Von Magnus) in monkey in the Zoo (Denmark)
- 1970: first human MPX infection in a baby 9 months old in Basankusu, DRC.
- 1980-1985: MPX active surveillance program (WHO) to assess the burden of human MPX infection in Africa
- 1986: program ended. Human MPX infection did not constitute a threat to the global smallpox eradication initiative. It was not a major public health problem.
## Notification of MPX in Africa: 1970-1986

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Source: Monographie de Dr Z. JEZEK, K. FENNER 1988

N.B. Superficie totale de la forêt humide tropicale de tous ces pays est de 74.7 mille hectares.

La RDC à elle seule représente 56.2 MILLE HECTARES
La RDC a 95.5 % des cas.
MPX cases reported by Health Zones, 1996-2014, DRC.

But in 1996 a major outbreak in Katako-Kombe with 511 cases, 78% secondary cases.
Transmission of MPX: risk factors for children

- Trapping.
- Hunting
- Handling.
- Dead rodents found in the forest are source of food

Squirrels are particularly the source of MPX in young children in rural areas in DRC.

Gambian Rats
MPX transmission: risk factors for adults

- Preparing game for cooking.
- Monkeys found dead in the forest are source of food

Trapping
Hunting
MPOX: clinical manifestations

Severe infection  Benign infection  Subclinical infection

Lymphadenopathy: 90%
Swollen inguinal and cervical lymph nodes

Adult severe cases
Clinical complications of MPX

Bacterial conjunctivitis

Corneal opacity
Muco-cutaneous complications of MPX
Differential Diagnosis

- **Secondary Syphilis:** Palm lesions
- **MPX:** Palm lesions

Prevalence in Pregnant women in Lodja (03-04)

- HIV: 6.6%
- Syphilis: 7.2%

- Severe chickenpox
- Residual scars
- Convalescent MPX
- Residual scars
CONCLUSION

- 40 years after the eradication of Smallpox, the incidence of human MPX infection has dramatically increased in DRC.
- The geographic range of MPX has changed: a cluster of cases reported in neighboring ROC, in South Sudan and Nigeria for the first time; even outside the African continent, in the USA in 2003.
- 3 main factors determine the burden of human MPX:
  - Cessation of vaccination against smallpox.
  - Increase exposure to animal reservoir species.
  - Increase of human to human transmission
General conclusion about the two tropical zoonoses.

Since 3-4 decades, the incidence of both EVD and human MPX infection has increased in coincidence with the natural range of their zoonotic reservoir species:

- For MPX: squirrel and other rodents species.
- For Ebola: fruit bats.

Increase of contact with the animal reservoir:

- Agriculture activities with deforestation
- Recurrent civil wars: displacement of the population
- Increased poverty: bushmeat as the only main sources of animal proteins
National Institute for Biomedical Research (INRB)

**Clinical Trials Development**
- Ongoing:
  - Clinical Immunology Laboratory
  - Hospital Pharmacy
  - Institutional Review Board (IRB)
  - Data Monitoring Committee (DMC)
- Planned:
  - INRB Clinical Center

**Applied Research**
- Science Clinic Interface
  - Ebola antibody therapeutics
  - Sleeping sickness diagnostic kit commercialization
  - Virus discovery
  - Phytotherapy (Malaria)

**Outbreak Surveillance & Response**
- Active Surveillance Labs
  - Polio
  - Measles/Rubella
  - Influenza
  - Ebola/Yellow Fever
- Outbreak Response
  - Mobile Laboratory
  - Clinical Care
  - Health Care Worker Training
  - Polio
  - Influenza
  - Measles/Rubella
  - Ebola/Yellow Fever

**Diagnostics**
- National Reference Laboratory
  - Biochemical and microbiological analysis
  - Pathological analysis
  - Parasitology tests
  - Serological tests