Original Article

Fight Ebola virus disease in Africa: a question related to the environment?

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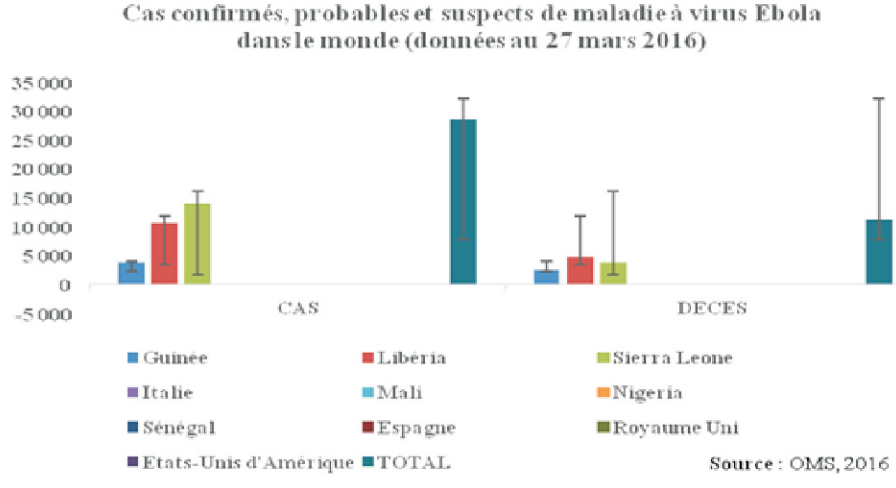
ABSTRACT

Repetitive outbreaks of Ebola virus disease is a major public health problem in Africa. Indeed, since September 1976, date of its isolation and its first description in the north of the ex-Zaire (now Democratic Republic of Congo) and in the south Sudan, many African countries continue to live recurring episodes of epidemics from Ebola virus disease with its corollaries of human suffering, deaths and economic loss. This article, through a review of the literature, a brief overview of the possible environmental origin of these Ebola viruses, before describing how environmental changes may contribute to the emergence or re-emergence of these viruses Ebola in Africa.

INTRODUCTION

Human beings are at the heart of concerns for sustainable development. They are entitled to a productive and healthy life in harmony with nature. Yet the international emergency has represented the outbreak of Ebola virus disease (EVD) in West Africa in late 2013, was unprecedented in the history of Ebola.[1,2] The unprecedented nature of this outbreak is due as much to the large number of deaths recorded at the speed of the spread of the disease.[2] From 1st December 2013 to 30 November 2014, 17,111 Ebola cases were reported, including 6,055 deaths reported by the World Health Organization (WHO) in the three most affected West African countries (Figure 1) namely Guinea, Liberia

Figure 1: case and death status as of March 27, 2016[1]



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and Sierra Leone.[3] In addition, seven countries (Spain, United States of America, Italy, Mali, Nigeria, United Kingdom and Senegal) reported one or more cases imported from a country with extensive and intense transmission.[1]It should also be noted that France, Norway, Switzerland or the United Kingdom repatriated contaminated nationals.[2] Discovered in 1976 following the first two epidemics in Sudan and the Democratic Republic of Congo (DRC), Ebola viruses were responsible for 27 distinct epidemics before the recent outbreak initially observed from Guinea.[2]

In view of this epidemic repetitiveness of the EVD on the continent with its corollaries of human suffering, deaths and economic losses, how not to question the possible origins of this disease?What factors favoring its re-emergence on the continent? Why do some authors claim that the potential for epidemic spread in Europe remains low?

We propose a reading oriented on the environmental aspects of the probable origins of the Ebola virus on the continent.

Historical element of Ebola viruses in Africa

Today, in Africa, there are three isolated viral species responsible for viral hemorrhagic fevers: Ebola Zaire, Ebola Sudan, Ebola Ivory Coast.[4] The current epidemic in West Africa is caused by the Ebola Zaire virus. The DRC (formerly Zaire), where the Ebola Zaire virus was identified and described for the first time in September 1976, has had at least six outbreaks most recently was declared August 26, 2014.[5] Since then, several other African countries have experienced recurrent epidemics of EVD, including Sudan (1976, 1979, 2004), Gabon (1994, 1996, 2001, 2002), Uganda (2000, 2007, 2011, 2012)and the Republic of Congo (2001, 2002, 2003, 2005).[4, 6, 7]

Ebola viruses belong to the family Filoviridae and are filament-shaped. The genus Ebola comprises five chronologically referenced species in this order: Sudan ebolavirus, Zaire ebolavirus, Reston ebolavirus, Taï forest ebolavirus and Bundibugyoebolavirus. The recent outbreak that started in West Africa at the end of 2013 was due to the species Zaire ebolavirus. Ebola viruses are responsible for EVD diagnosed biologically by P4 laboratory tests (Class 4 pathogens).[8]

What do we know about the origin of Ebola viruses in Africa

The reservoir of these viruses is not known with certainty, however some frugivorous bats are suspected of playing the role of natural reservoir.[2, 4, 6, 8]In addition, the first cases during outbreaks were associated with the hunting and consumption of bush meat, that is to say animals that potentially shared the habitat of these bats.[2]A seasonal component (climatic, epidemic triggers) has been advanced by identifying a link between them and particularly dry conditions at the end of a wet season: this can cause significant behavioral changes (migrations) in bats frugivores.[2, 4]If the transmissibility of the Ebola virus from a primate to humans is clearly established, the virus is transmitted to humans during the handling of living or dead animals carriers of the virus such as chimpanzees, gorillas, monkeys, bats of the genera Hypsignathus and Epomops, forest antelopes and porcupines.[4] Ebola viruses are highly transmissible through direct contact with infected blood, secretions, tissues, organs and other body fluids of dead or living infected persons. Indirect transmission by contaminated inanimate objects by infected body fluids (fomites) is possible.The principal mode of transmission in human settings remains person-to-person transmission through direct contact with a symptomatic or dead Ebola infected person, hence the high risk of transmission during ceremonies and the handling of funeral corpses.In addition, the genome of the Ebola virus was detected in the semen until 91 days after the onset of the disease and the replicative Ebola virus was detected in the semen 41 days after the onset of the disease.[9]

How can the environment contribute to the emergence or re-emergence of these ebola viruses

in Africa

Primary prevention through root cause elimination, source control and/or determinants is an important dimension in the fight against EVD in Africa.This is all the more crucial as WHO reports that 23% of all deaths in Africa, more than 2.4 million deaths per year, are attributable to preventable risk factors related to environmental deterioration, with particular effects on the poorest and most vulnerable groups, including children, women, rural poor people, people with disabilities, refugees or displaced persons and the elderly.[10]

According to Eilstein and al[11], the environment consists of: (1) environments or spaces (virtual or not) in which vectors, agents and populations are found. They may consist of places or situations in which the subject evolves; (2) vectors corresponding to entities carrying and transmitting pollutants by contact with subjects of the population (air, water, food, soil ...); (3)agents, directly responsible for observed effects. These are potentially pathogenic biological agents (viruses, bacteria, parasites and microorganisms), their vectors and their reservoirs.These are also the physical and chemical agents in the environment independently of human activities that may affect the health because of their presence (arsenic, naturally occurring radionuclides, UV, plant toxins ...) or their absence (vitamins, iodine, selenium and antioxidants, lactobacilli ...). These are sometimes potentially harmful physical or chemical agents added to the environment by human activities (ionizing radiation, noise, arsenic, atmospheric pollution from industrial or automotive original byproducts chlorination ...). For these authors, beyond this rather classic definition of the environment, the social context, with its evolution, its reality but also its perception by the actors of the field (population, decision makers, health professionals, associations ...) and its multiple representations is also one of the dimensions of the environment. This definition of the environment underscores the importance and necessity of adopting an ecosystem approach in the management of EVD. A number of factors favoring the emergence of new diseases or the re-emergence of old diseases are known. These include those that increase the density of virus reservoirs, the vectors or that of man, and the contacts of man with its reservoirs and vectors.[8]

Regarding the specific case of EVD, although frugivorous bats have been incriminated as the possible natural reservoir of Ebola, it is legitimate to question the mechanism of environmental modification that could generate an increase in contacts between them and humans. For Guegan,[2] frugivorous bats would have left their disturbed habitats in forest Guinea under the pressure of massive deforestation for the benefit of the mining industry or intensive agriculture. According to him, the bats leave this modified environment, search for food and come into contact with fruit trees, mango trees in particular, in the villages and therefore in contact with humans.[2]

Despite the data obtained since its emergence in 1976, the natural cycle of transmission of these viruses to humans remains an enigma.[8, 12] Why Morvan and al have established the link between the forest ecosystem and transmission.[12]According to them, the transmission of Ebola virus to humans in the natural environment can be attributed to behavioral changes in human or ecological changes that will increase the risk of contact between man and the reservoir of the virus. Human activities (such as the development of agricultural activities, forest explotation, local shops and exchanges) disrupt the forest ecosystem and will destabilize the enzootic cycle and facilitate the escape of the virus from its biotope. These activities lead to fragmentation and degradation of the environment resulting in the formation of a forest-savanna mosaic and an increase in the forest-savanna interface. These areas of selvedge and forest clearings used for agricultural activities are inhabited by very many rodents and insectivores.

Ecosystem changes have consequences for wildlife communities:(1) migration of the resident forest

wildlife to degraded areas or cultivated on the edge of forest; (2) introduction of savanna fauna by development of rodent populations (cultivated fields and human food waste).This fauna is likely to serve as an intermediate host. These migration flows result in increased contact between humans and small mammals in this interface.Arthur[4], incriminates climatic conditions by suggesting that a period of drought seems to favor the emergence of Ebola haemorrhagic fevers when vegetation resumes after the return of rains. While Girard[8], only mentions that climate change also play an important role in the abundance of reservoirs. Moreover, Crowcroft[7] notes that the viruses responsible hemorrhagic fever emerging and re-emerging in many countries. Indeed, in these endemic regions, major epidemics have affected people living in inaccessible places or in refugee camps where the living conditions are very difficult. These viruses are a threat as their tank remains unknown and as long as endemic areas suffer from environmental change, poverty and social instability. According to Girard[8], the emergence of Rift Valley fever epidemics in East Africa was a consequence of ecological changes occurred as a result of the construction of large dams, or consecutive floods during the very rainy years that favored the multiplication of the vector.

CONCLUSION

The need to take into account the ecosystem dimension in the fight against EVD in Africa is needed today more than ever. The emergence of new diseases is mainly due to changes in the environment. A major cause of Ebola in Africa (whose lethality can reach 90% with some strains) is deforestation.Without, however, obscure other factors favoring the emergence and / or re-emergence of these viruses in Africa in particular migratory phenomena of population,lack of water and sanitation in rural areasand lack of hygiene.The focus must be on environmental health surveillance. We stress the importance of primary prevention in the fight against Ebola in Africa as advocated by WHO in 2007:"Prevent disease through a healthy environment".Environmental health surveillance can be an innovative strategy for monitoring and alerting health authorities for rapid and effective public health action.

Contribution and conflicts of interest

All authors participated in the writing and approved the final manuscript. The authors declare no conflict of interest

Declaration on competing interests:

The authors declare not competing interest.

REFERENCES

1. Organisation Mondiale de la Santé (OMS). Rapport de situation sur la flambée de maladie à virus Ebola. Genève : OMS ; 30 mars 2016, 15p.
2. Simon-Lorière H, Lysaniuk B. « La diffusion d'Ébola dans les pays de la Mano River : approche géographique », Echo Géo [En ligne], Sur le Vif, mis en ligne le 02 février 2015. Availble on: http://echogeo.revues.org/14096. DOI: http://10.4000/echogeo.14096. Accessed26/08/2017.
3. Organisation Mondiale de la Santé (OMS). Feuille de route pour la Riposte au virus Ebola, rapport de situation du 03 décembre 2014. Genève : OMS ; 2014. Available on: http://apps.who.int/iris/bitstream/10665/145676/1/roadmapsitrep_3Dec14_fre.pdf?ua=1&ua=1. Accessed 22/12/2014.
4. Arthur RR. Ebola in Africa: discoveries in the past decade. Euro Surveill 2002;7(3):33-36.
5. European Centre for Disease Prevention and Control (ECDC). Outbreak of Ebola virus disease in West Africa. Seventh update, 17 October 2014. Stockholm: ECDC; 2014.
6. Organisation Mondiale de la Santé (OMS). Flambées épidémiques de maladie à virus Ebola et Marburg: préparation, alerte, lutte et évaluation. WHO/HSE/PED/CED/2014.xx. Intérim version 1.0. OMS, 2014.
7. Crowcroft NS, Morgan D, Brown D. Viral haemorrhagic fevers in Europe: effective control rquires a co-ordinated response. Euro surveill 2002:7(3):31-32.

8. Girard M. Les maladies infectieuses émergentes. Médecine/sciences 2000;16(8-9):883-891. Avaible on: http://ipubli-inserm.demo.inist.fr/handle/10608/1752. Accessed 16/05/2016.
9. World Health Organization (WHO). Everybody's business strengthening health systems to improve health outcomes. Who's framework for action. Geneva: WHO; 2007.
10. World Health Organization (WHO), WHO Regional Office for Africa. Public health and environment in the African Region: Report on the work of WHO (2008–2009). Geneva: WHO; 2010, 56p. http://www.afro.who.int/en/clusters-a-programmes/hpr/protection-of-the-human-environment/highlights/4666-clim-health-africa-predict-prevent-and-manage.html. Accessed 16/05/2016.
11. Eilstein D, Le Moal J, Lim TA. Les concepts de surveillance en santé environnementale. BEH Thématique 2009(27-28):283-286.
12. Morvan JM, Nakouné E, Deubel V, Colyn M. Ecosystèmes forestiers et virus Ebola. Bull SocPatholExot 2000;93(3):172–175..