Virology 503 (2017) 76–82

Contents lists available at ScienceDirect

Virology

journal homepage: www.elsevier.com/locate/yviro

Simian Immunodeficiency Virus seroreactivity in inhabitants from rural Cameroon frequently in contact with non-human primates

Claudia Filippone[a,b,1], Fabienne de Oliveira[c], Edouard Betsem[a,b,d,2], Laura Schaeffer[e], Arnaud Fontanet[e], Veronique Lemée[c], Antoine Gessain[a,b,*], Jean-Christophe Plantier[c,f,**]

[a] Unit of Epidemiology and Physiopathology of Oncogenic Viruses, Department of Virology, Institut Pasteur, Paris, France
[b] CNRS, UMR3569 Paris, France
[c] Virology Unit, Associated National Reference Center for HIV, University Hospital Charles Nicolle, Rouen, France
[d] Faculty of Medicine and Biomedical Sciences, University of Yaounde I, Yaounde, Cameroon
[e] Unit of Epidemiology of Emerging Diseases, Department of Epidemiology and Infection, Institut Pasteur, Paris, France
[f] EA2656, GRAM, Rouen University, Rouen, France

ARTICLE INFO

Keywords:
SIV
HIV
Non-human primate
Cross-species transmission
Bite
Pygmies
Cameroon
Central Africa
Seroreactivity

ABSTRACT

Central African tropical forests are home to several species of non-human primates (NHPs), infected by Simian Immunodeficiency Virus (SIV). It is well-known that HIV-1 epidemic is due to cross-transmission and adaptation of SIV to humans. The main goal of this work was to investigate if a NHP bite is a risk factor for SIV acquisition. A cross-sectional study was performed in rural Cameroon on 246 bitten individuals (mostly by adult NHPs), matched, according to sex, age, and ethnicity (Bantus and Pygmies), with an equal number of not-bitten subjects. Following a serological assay for a wide range of SIVs, we observed a high level of indeterminate seroreactivity (25.8%) in the total population, whereas 68.9% were sero-negative and 5.3% HIV-1 positive. Bites do not appear to be a risk factor for SIV seroreactivity, in contrast to Simian Foamy Virus and Simian T-Lymphotropic Virus type 1 in the same studied population.

1. Introduction

Acquired Immuno-Deficiency Syndrome (AIDS) is considered to be the primary epidemic and most devastating infectious disease of the last 30 years. There are currently more than 35 million people infected by HIV-1, the most frequent viral type (www.who.int/hiv/en). Like most emerging infectious diseases in humans, HIV infection has a zoonotic origin (Sharp and Hahn, 2011, 2010; Locatelli and Peeters, 2012; Plantier et al., 2009; Van Heuverswyn and Peeters, 2007; Gürtler, 2004; Apetrei et al., 2004; Keele et al., 2006a; Hahn et al., 2000; Gao et al., 1999; Chitnis et al., 2000; Sharp et al., 2001; Marx et al., 2004; Holmes, 2001). Simian Immunodeficiency Viruses (SIVs) naturally infect great apes (chimpanzees-cpz- and gorillas-gor-) in the western part of Central Africa and are at the origin of HIV-1 (Plantier et al., 2009; Keele et al., 2006a; Gao et al., 1999; Essex, 1994; Delaugerre et al., 2011); those that infect sooty mangabeys (sm) in West Africa are at the origin of HIV-2 (Locatelli and Peeters, 2012). Based on the current genetic diversity of HIV, it is believed that at least 13 events leading to a number of founder effects or dead-end infections occurred during the 20th century (Sharp and Hahn, 2011, 2010; Van Heuverswyn and Peeters, 2007; Gürtler, 2004; Apetrei et al., 2004; Holmes, 2001; Rambaut et al., 2001). This includes at least four instances of independent cross-species transmission for the SIVcpz-SIVgor/HIV-1 lineage leading to HIV-1 groups M to P, and at least 9 events for the different groups (A-I) of the HIV-2/SIVsm lineage (Plantier et al., 2009; Van Heuverswyn and Peeters, 2007; Gürtler, 2004; Keele et al., 2006a; Gao et al., 1999; Sharp et al., 2001; Delaugerre et al., 2011; Rambaut et al., 2001; Van Heuverswyn et al., 2006; Corbet et al., 2000).

How SIV was initially transmitted from infected non-human

Abbreviations: SIV, Simian Immunodeficiency Virus; HIV, Human Immunodeficiency Virus; NHP, non-human primate; PLIA, Primate Lentivirus Immuno Assay

* Corresponding author at: Unit of Epidemiology and Physiopathology of Oncogenic Viruses, Department of Virology, Institut Pasteur, Paris, France.
** Corresponding author at: Virology Unit, Associated National Reference Center for HIV, University Hospital Charles Nicolle, Rouen, France.
E-mail addresses: cfilippone@pasteur.mg, cla.filippone@gmail.com (C. Filippone), Fabienne.De-Oliveira@chu-rouen.fr (F. de Oliveira), edouardbetsem@gmail.com (E. Betsem), lschaeff@pasteur.fr (L. Schaeffer), fontanet@pasteur.fr (A. Fontanet), veronique.lemee@chu-rouen.fr (V. Lemée), agessain@pasteur.fr (A. Gessain), Jean-Christophe.Plantier@chu-rouen.fr (J.-C. Plantier).
[1] Current affiliation: Virology Unit, Institut Pasteur de Madagascar, Antananarivo, Madagascar.
[2] Current affiliation: Agence de Medecine Preventive, Ouagadougou, Burkina Faso.

http://dx.doi.org/10.1016/j.virol.2016.12.026
Received 27 October 2016; Received in revised form 19 December 2016; Accepted 20 December 2016
Available online 27 January 2017

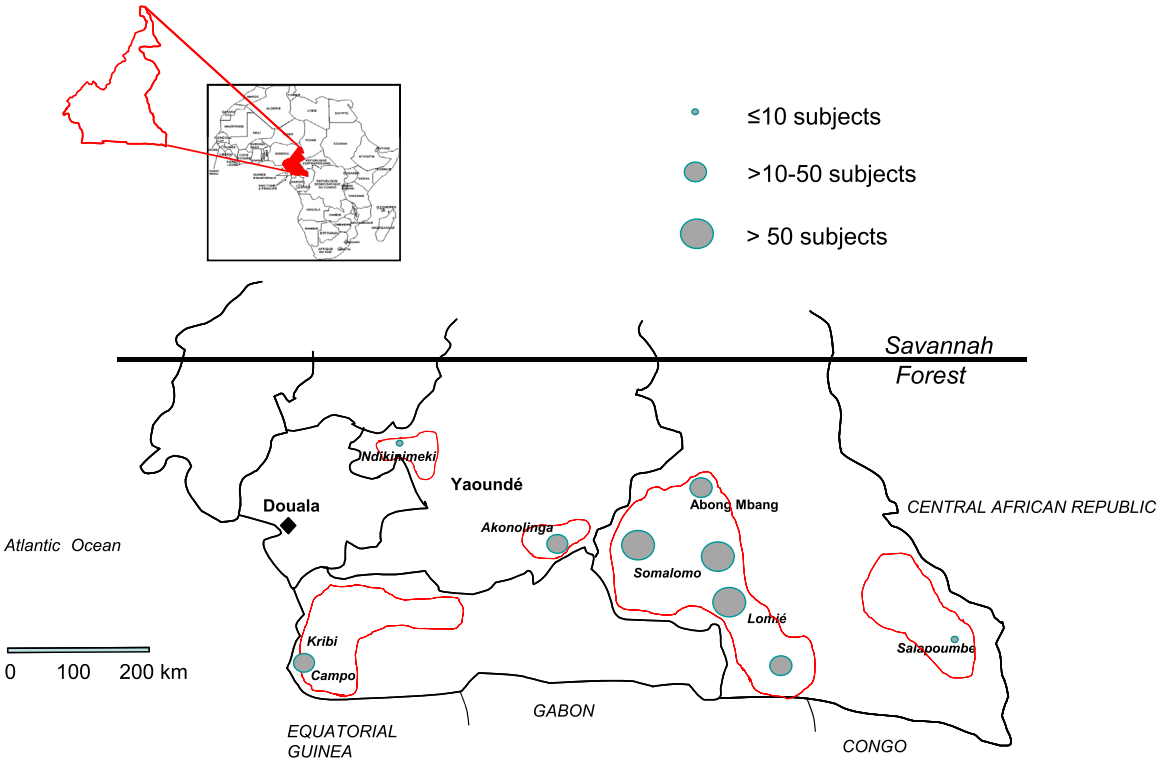

Fig. 1. Localization of the areas (red zones) inhabited by the 492 individuals enrolled in this study in Cameroon. Grey circles indicate the number of subjects for both the individuals bitten by a NHP and the matched not-bitten controls. The bold line indicates the border with the savannah forest. Red borders indicate the area of sampling. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

primates (NHPs) to humans has been highly debated resulting in many different theories (Pépin, 2011). The most plausible and accepted theory is called "the cut or wounded hunter" (Pépin, 2011). Many unanswered questions remain concerning what occurred after such potentially infecting contacts, including: the number of successful transmissions to humans, the number of dead-ends in the index cases, how SIV became HIV after viral adaptation in humans, and the number of adapted HIV that led to a chronic persistent infection at the origin of a founder effect in humans. Such events are dependent on the frequency and type of contact between SIV infected animals and the human population and on the prevalence of SIV in the natural hosts.

Various populations have been hunting wild game, including several NHP species, for centuries and/or millennia in several areas of the African continent. Some rely on such hunting activities, as do all hunter-gatherer groups, including several Pygmy tribes living in Central Africa. In most cases, bushmeat hunting and related-activities (butchering, smoking meat, selling, consumption, pets,..) have been highly restricted to remote areas with mostly local meat consumption. The situation has changed considerably during the last few decades with an increase of hunting activities (Locatelli and Peeters, 2012; Wolfe et al., 2005; Abernethy et al., 2013; Coad et al., 2013). This has resulted from a combination of urban demand for bushmeat, greater access to NHP habitats provided in part by logging roads, easier accessibility to fire arms, and an increase in the population living in forest areas with the associated increase in local food demand, as bushmeat is much less expensive than domestic meat. Growing urban populations, the expansion of logging, oil, and mining industries, and in some cases, armed conflicts, have also contributed to the increase of the bushmeat trade (Fa et al., 2002; http://www.bushmeat.org). Today, over five million tons of bushmeat are eaten each year of which approximately 15% originate from primates (1% great apes) in West and Central Africa.

This increase of hunting and related activities also greatly increases the number of contacts at risk for retroviral infections between humans and infected NHPs. Indeed, many NHP species killed for bushmeat in Central Africa are endemic for several retroviral infections including not only several SIVs, but also various Simian T-cell Lymphotropic Viruses (STLVs) and Simian Foamy Virus (SFV) (Locatelli and Peeters, 2012; Van Heuverswyn et al., 2006; Peeters et al., 2002; Neel et al., 2010; Aghokeng et al., 2006; Gessain et al., 2013; Wolfe et al., 2004). In recent studies focused on foamy viruses (Calattini et al., 2007; Betsem et al., 2011) and Primate T-cell Lymphotropic Virus type 1 (PTLV-1) (Filippone et al., 2015), we demonstrated that a severe bite from a NHP was a major risk factor for SFV, and to a lesser extent STLV-1 infections.

In this context, we undertook a survey to assess possible SIV transmission in a high-risk population living in Central Africa in close contact with NHPs (Calattini et al., 2007; Betsem et al., 2011; Filippone et al., 2015). This population comprised villagers and inhabitants of different Pygmy and Bantu tribe settlements living in the rain forest area of South Cameroon. This specific region is the habitat of a wide diversity of NHP species including apes, such as chimpanzees and gorillas, as well as a large variety of monkeys, including Cercopithecus, mandrills, and Cercocebus, which are naturally infected by different SIVs (Locatelli and Peeters, 2012; Van Heuverswyn et al., 2006; Neel et al., 2010; Aghokeng et al., 2006). As all Pygmy men are hunters, they are very frequently in close contact with body fluids of NHPs, potentially infected by simian retroviruses, during hunting, butchering activities, food preparation (smoking meat), or related-activities (selling, consumption, pets). Members of the Bantu population hunt less frequently. However, Bantus are commonly involved in butchering and game preparation of NHP in these rural areas.

The goal of this study was to assess the level of SIV infection in this high-risk population using state of the art of serological and molecular technologies. We previously showed that SFV and STLV-1 transmission is linked to severe bites, mostly by apes (Calattini et al., 2007; Betsem et al., 2011; Filippone et al., 2015). This study thus focused on two large populations of bitten individuals and those who were not bitten but still at high risk of contact with NHP body fluids.