Emergence of Novel Retroviruses in Human in Central Africa

HTLV-3 and Simian Foamy Viruses

Importance of interspecies transmission

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EMERGING VIRUSES and ASSOCIATED DISEASES

HOW TO DEFINE THEM ?

New disease in humans due to viruses, mainly present in animals (zoonosis) : SIV/VIH - and AIDS, Sin Nombre/Hantavirus and Pulmo. Syndrome, Coronavirus and SRAS,…

Known human disease with discovery of the etiological agent : Hepatitis C and HCV, ATL; TSP/HAM and HTLV-1, Kaposi' sarcoma and HHV-8….

« Emergence of knowledge »

Virus allready known, associated to a known disease but with an abnormal epidemic feature or a modification of its geographical range : West Nile/USA, Avian Flu, Chikungunya….

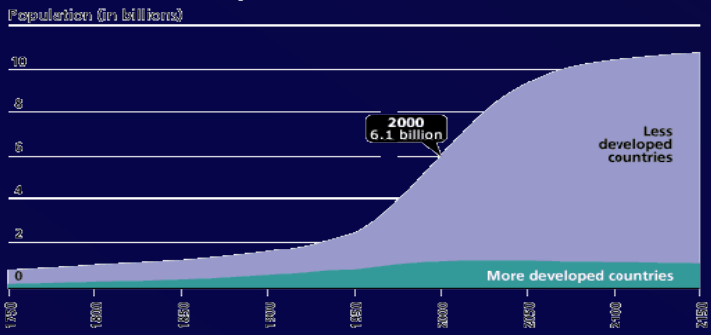
CAUSES of EMERGENCE or RE-EMERGENCE of VIRUSES ARE NUMEROUS AND VARIOUS

The emergence of a new viral disease or of a new virus in Humans is the result of a succession of various steps often complex and is linked to several factors.

- Changes in human behavior and socio-cultural activities,
- Increase in human mobility,
- Demographic or climatic changes,
- Human exploitation of the environment,
- Decrease attention for infectious disease research and control
- Ability to certain viruses to rapidly adapt to a changing environment.

All the factors which increase the density of human population, of vectors and/or of reservoirs but also multiply contacts between these 3 items favor the emergence process.

Human Population 1750 - 2150



EMERGENCE and MICROBIOLOGICAL SURVEILLANCE

A large proportion of viral pathogens that have recently emerged in humans originated in various animals (SRAS, Avian flu, Hantavirus, Ebola, Nipah,…)

Among human pathogens considered as emerging, 70% are considered as zoonotic

After the initial interspecies transmission, these viruses have often evolved and disseminated into the human population through various distinct mechanisms.

However, **understanding the initial steps of the emergence** of some viruses and associated diseases remains poor.

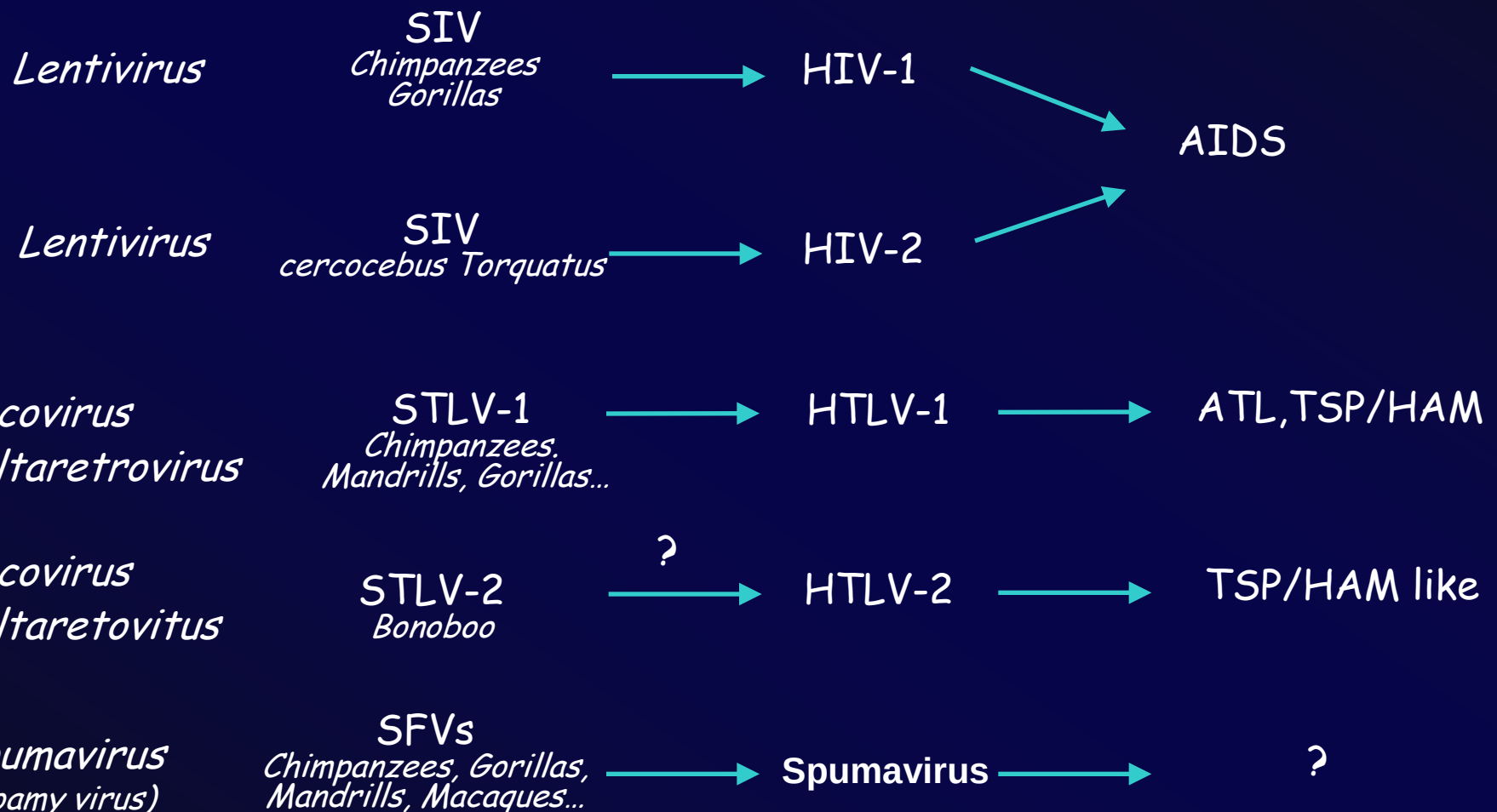
Microbiological studies **in high-risk populations** are necessary to obtain new insights into the early events of this emergence process.

High risk studied Populations studied consist of individuals, mainly hunters of Apes or Monkeys living in Central Africa.

Human infections by simian viruses represent an increasing public health concern.

Indeed, by virtue of their genetic, physiological, and even some behavioural similarities, NHPs are considered to be likely the sources of viruses that can infect humans and thus pose a significant threat to human population .

NHPs are frequently infected by retroviruses and are frequently in contact with Humans. Thus, several retroviruses have already been transmitted from NHPs to Humans

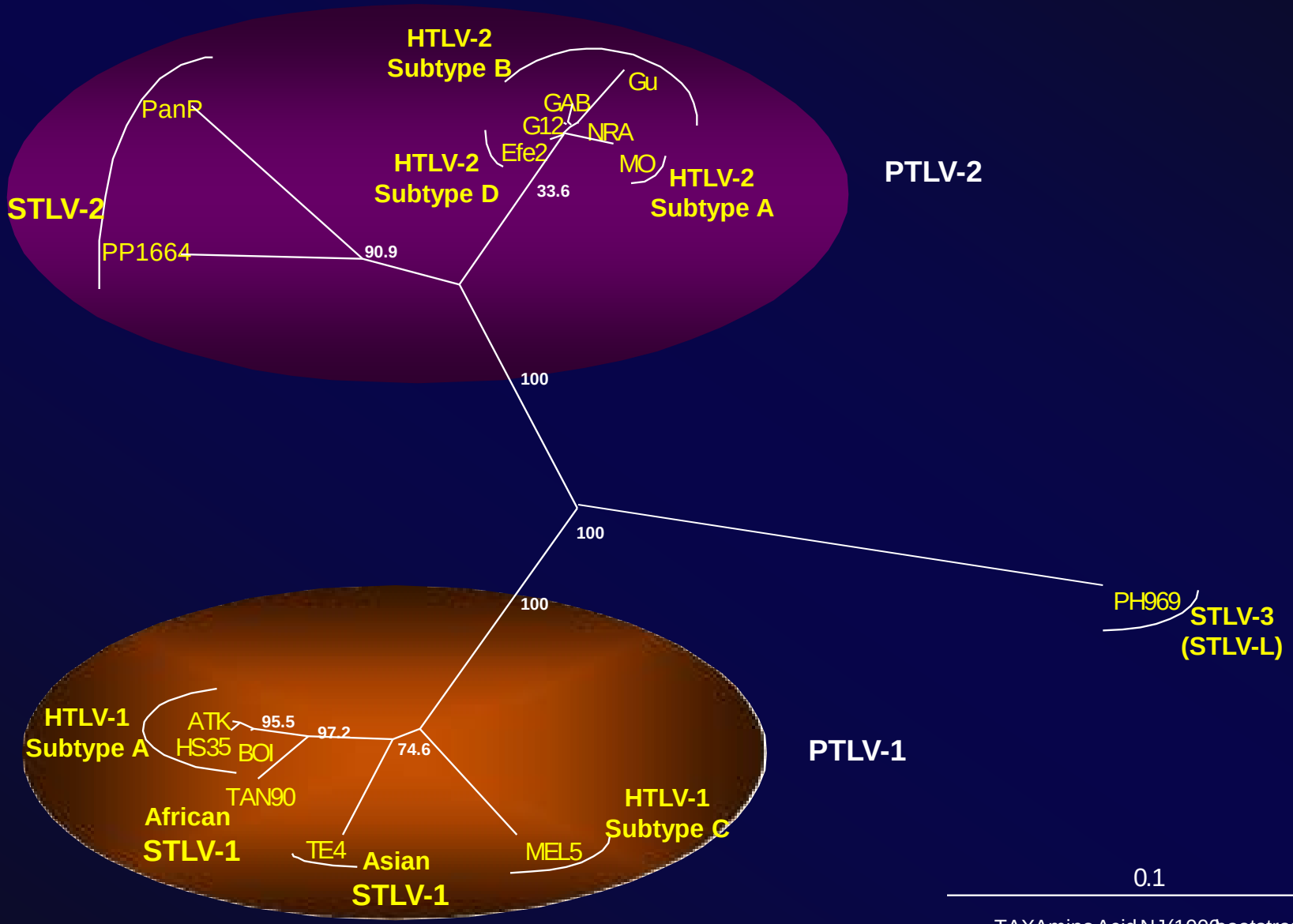


Discovery of Novel STLV-3 Retroviruses in Non Human Primates and of the Related Human Retrovirus HTLV-3

The PTLVs: Primate T-cell Lymphotropic viruses in 2001

	Human (HTLV)	Simian (STLV)
PTLV-1	HTLV-1 10-20 millions of infected people Two main associated diseases (ATL and TSP/HAM) 6 molecular subtypes (A,B,C,D,E,F)	STLV-1 Widespread Old World monkey species Some infected monkeys: Leukemia Cluster in human subtypes (except A,C)
PTLV-2	HTLV-2 Endemic in some Amerindian tribes and IDUs and Pygmies Associated disease (“TSP/HAM like”) 4 molecular subtypes (A,B,C,D)	STLV-2 2 strains isolated in *Pan paniscus* Associated diseases ??? No closely related human homologue
PTLV-3 (PTLV-L)	HTLV-3 ??????	STLV-3 1 strain in *Papio h. hamadryas* from Eritrea STLV-3/PH-969 Associated disease ???

Phylogeny of PTLVs until the end of 2001



Current Geographical Distribution of STLV-3

Meertens et *al*.
JVI 2003

Papio h. papio
STLV-3/PPA-F3

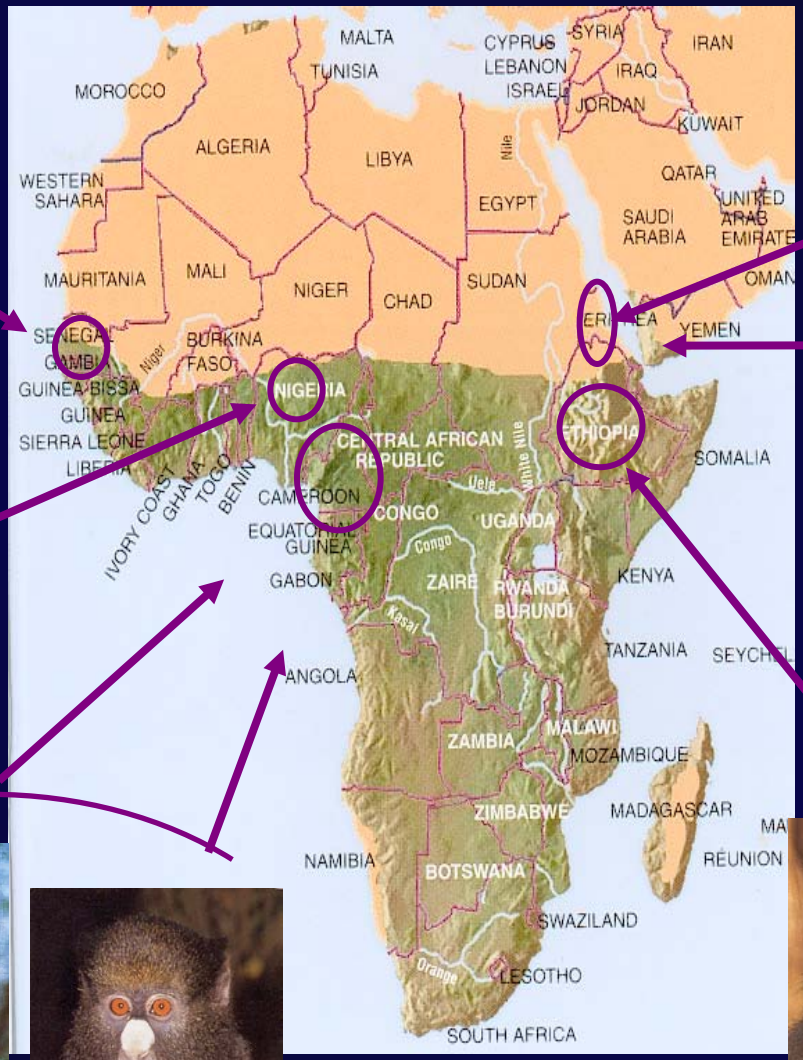
Meertens et *al*.
JGV 2003

Cercocebus tor. torquatus
STLV-3/CTO-DONG

New STLV-3 in Cameroun wild-caught animals.
J Virology 2006 and 2007

Meertens et *al*.
JVI 2002

Cercocebus tor. torquatus
STLV-3/CTO-604
STLV-3/CTO-602



Van Dooren et *al*.
JVI 2001

Cercopithecus nictitans
STLV-3/CNI-217
STLV-3/CNI-227

Goubau et *al*.
PNAS 1994

Papio h. hamadryas
STLV-3/PH969

Theropithecus gelada

Van Dooren et *al*.
JGV 2004

Hybrides
Papio h. hamadryas/anubis
24 sur 50 (48%)

Papio h. hamadryas
22 sur 40 (55%)

Takemura et *al*.
JVI 2002

HTLV-3 in Central Africa, a long search…….

- **STLV-3 viruses infect several species of non human African primates.**

•These monkeys have a wide geographical distribution in Africa and live in very different ecosystems (desert, tropical rain forest, savannah…).

• In the context of interspecies transmission in STLV-1/HTLV-1, it is thus tempting to speculate that some

HTLV strains related to STLV-3 may exist in human populations.

HTLV-3 in Central Africa, a long search (years)…

We tested a large series of rare and selected central African samples

showing indeterminate WB patterns.

240 plasma (117 women and 123 men, mean age 44 years, range 10-75y)

↓

IFA using MT2 and C19 cells

↓

48 IFA reactive samples

↓

Western blot HTLV-2.4

↓

4 HTLV-1, 11 HTLV-2 and 27 HTLV indeterminate

↙ ↘

PCR using degenerated tax primers

↓

4 HTLV-1 and 11 HTLV-2 tax sequences

***pol* semi-nested PCR**

4 HTLV-1 and 11 HTLV-2 sequences

1 PCR positive from an HTLV indeterminate Individual (Pyl43), sequence highly related to STLV-3 strains (86.6% to 99.2% nucleotide identity).

Discovery of the first HTLV-3 a new human retrovirus

Retrovirology

BioMed Central

Short report

Open Access

Discovery of a new human T-cell lymphotropic virus (HTLV-3) in Central Africa

Sara Calattini[†1], Sébastien Alain Chevalier[†1], Renan Duprez[1], Sylviane Bassot[1], Alain Froment[2], Renaud Mahieux[†1] and Antoine Gessain[*†1]

Emergence of primate T-lymphotropic viruses among central African bushmeat hunters

Nathan D. Wolfe[*†‡], Walid Heneine[§], Jean K. Carr[§], Albert D. Garcia[§], Vedapuri Shanmugam[§], Ubald Tamoufe[*‖], Judith N. Torimiro[*], A. Tassy Prosser[†], Matthew LeBreton[*], Eitel Mpoudi-Ngole[‖], Francine E. McCutchan[*¶], Deborah L. Birx[**], Thomas M. Folks[§], Donald S. Burke[*†], and William M. Switzer[†§††]

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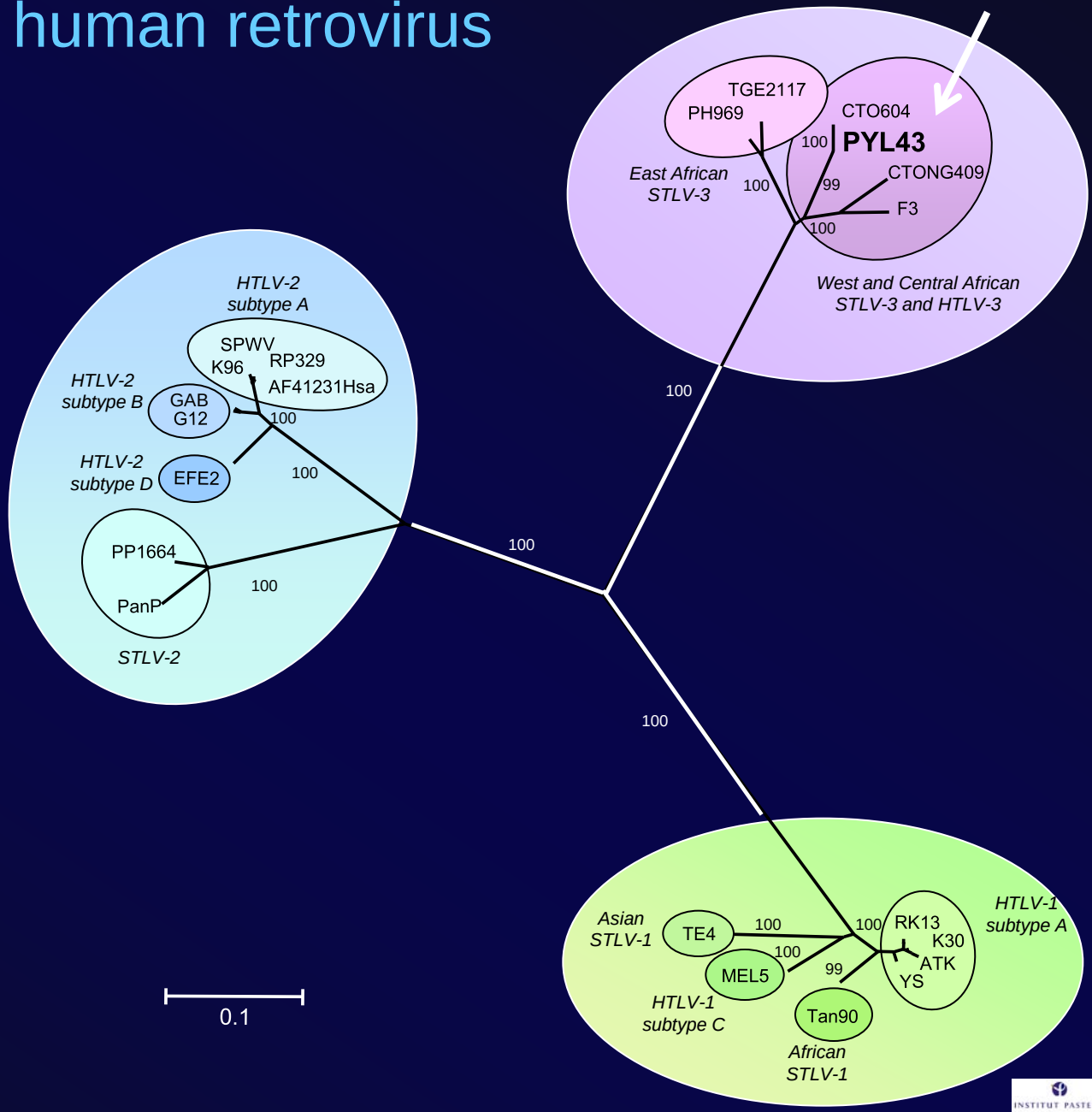

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HTLV-3 in Central Africa…discovery of a new strain (lobak18)

New Strain of Human T Lymphotropic Virus (HTLV) Type 3 in a Pygmy from Cameroon with Peculiar HTLV Serologic Results

Sara Calattini,[1,a] Edouard Betsem,[1,3] Sylviane Bassot,[1] Sébastien Alain Chevalier,[1] Renaud Mahieux,[1,4] Alain Froment,[2] and Antoine Gessain[1]

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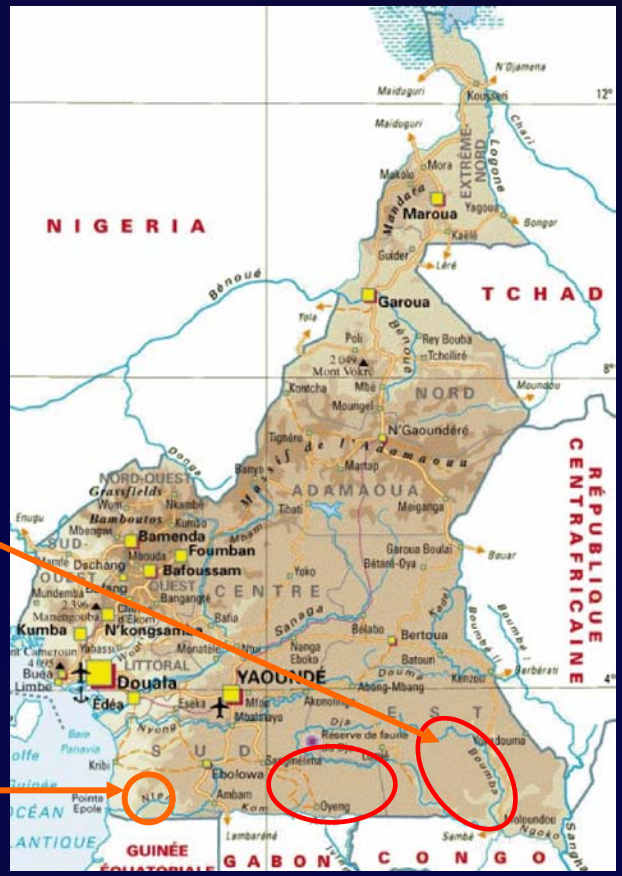
The Journal of Infectious Diseases 2009; 199:561–4

A search for human T lymphotropic virus (HTLV) types 1 and 2 and related viruses was performed by serological and molecular means on samples obtained from 421 adult villagers from the southern Cameroon forest areas. One individual (a 56-year-old Baka Pygmy hunter) was found to be HTLV-3 infected; however, there was a low proviral load in blood cells. Complete sequence analysis of this virus (HTLV-$3_{Lobak18}$) indicated a close relationship to human HTLV-3_{Pyl43} and simian STLV-3_{CTO604} strains. Plasma samples from Lobak18, the HTLV-3 infected individual, exhibited a peculiar "HTLV-2–like" pattern on Western blot analysis and were serologically untypeable by line immunoassay. These results were different from those for the 2 previously reported HTLV-3 strains, raising questions about serological confirmation of infection with such retroviruses.



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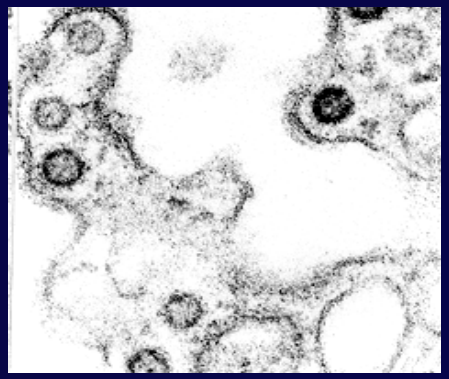
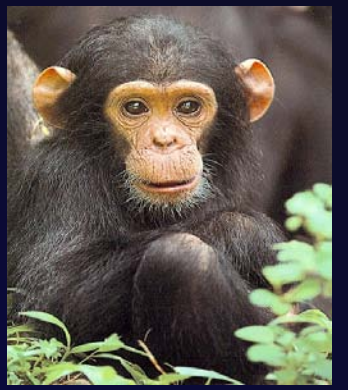
Perspectives for HTLV-3 studies

Studies on a large population, especially among Pygmies, in Cameroon, CAR, Gabon, Zaire are ongoing to:

- Search for other HTLV-3 and HTLV-4 strains.
- Isolate such viruses (try without success).
- To characterize molecularly these viruses (done : Tax). (Mahieux's team Paris/Lyon).
- To construct molecular clones (done).
- Look for specific serological and molecular detection tools.
- Look for clinical and biological features of this new retroviral infection.
- Search for intra-familial dissemination.





Simian foamy viruses in humans

Interspecies transmission of SFV from chimpanzees and gorillas to Hunters in Southern Cameroon

Is there the risk of a new retroviral zoonosis ?

Introduction

- Foamy Viruses (FVs) or spumaviruses were first described in 1954.
- FVs constitute the only genus of the *Spumaretrovirinae* subfamily. .
- *In vitro*: strong cytopathic effect in cell cultures.
- Highly endemic in several animal species including NHPs
- In humans, present in some persons occupationally exposed to NHPs in biomedical research, zoos and animal care facilities in US and Europe. Natural acquired SFV infections in few persons in central Africa and Asia.
- Non pathogenic in Humans ?, very few human cases have been well studied both clinically and biologically with a long and good follow-up. Selection biases in enrolling healthy persons to identify cases

Aims of our study

To evaluate the presence and the origin of the Foamy Virus infections in different human populations at risk for contacts with monkeys and apes in Central Africa.

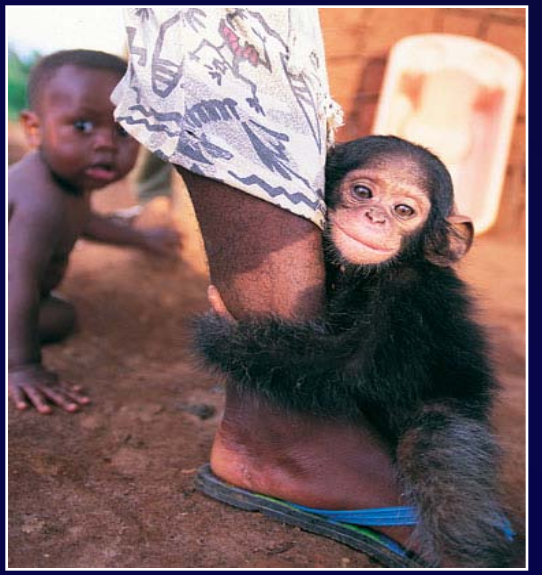
- Calattini S, Betsem EB, Froment A, Mauclère P, Tortevoye P, Schmitt C, Njouom R, Saib A, Gessain A. Emerg Infect Dis. 2007 Sep; 13(9): 1314-20.
- Betsem EB, Rua R, Tortevoye P, Froment A, Gessain A. Plos Pathogens, nov 2011
- Rua et al., J Virology, Janv 2012
- Rua et al., J Virology, in press 2012.

Transmission of simian retroviruses in natural settings

Hunting non Human primates in the wild

Butchering of wild game for consumption

Non Human Primate pets



Populations and methods

II. Retrospective "general population study "

- Blood samples collected during field surveys in 1996-2001, performed for epidemiological studies on human oncogenic viruses (HTLV, HHV8 and HCV)
- **1164 plasmas of adults** aged more than 20 years (mean age 50 years)
- Both men (538) and women (626) including Bakolas Pygmees or Bantus of different ethnic groups (Fang, Mvae, Ngumba…) living in villages of Southern Cameroon lowland tropical forest, close to non-human primate habitats

III. Prospective "Hunters study"

- Carried out between 2004 and 2005 in the same areas than retrospective study.
- Including Bakas Pygmees or Bantus of different ethnic groups living
- We focused on individuals who reported direct contacts (bites, wounds, scratches,..) with animals, especially NHPs during mainly hunting activities.
- **102 persons** including both men (84) and women (18), aged from 1/80 years old.

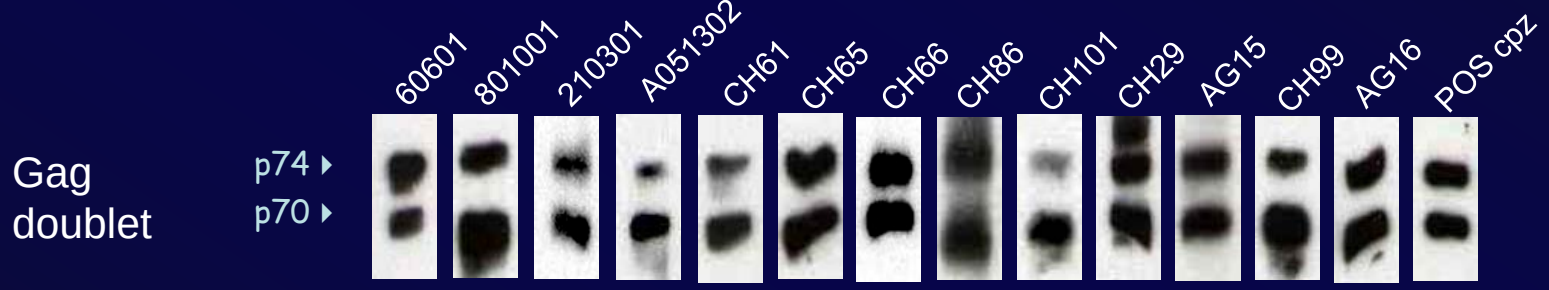
Calattini et al., EID, 2007

Results: 13 persons were found to be infected by a foamy virus:

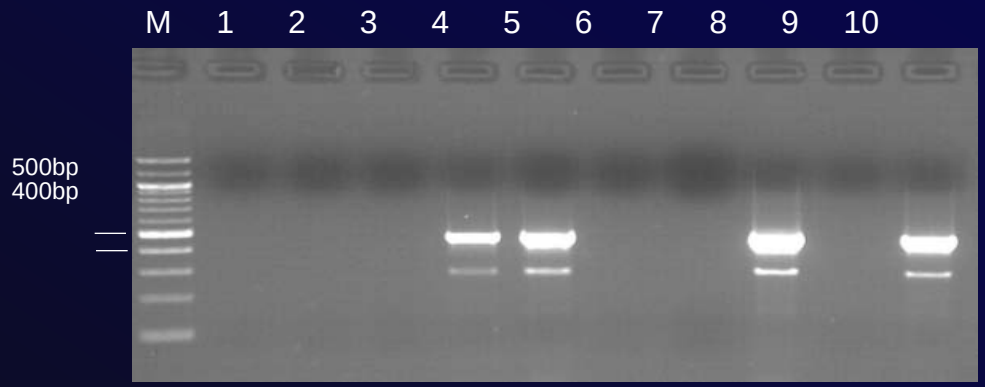
"Retrospective general population study": 4 persons/1164 were seropositive and PCR +

"Hunters study": 9 persons/102 were seropositive and PCR +

Serology



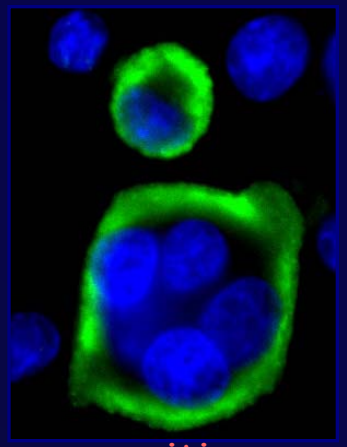
Polymerase chain reaction



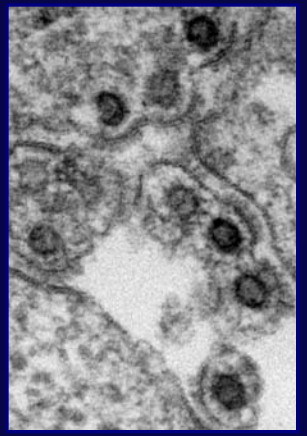
425 bp of the *integrase* gene. Lanes 1, 2, 4, 5, 7, 8: samples; lanes 3, 6, 9: negative controls; lane 10 positive control.

Calattini et al., EID, 2007

Virus isolation



syncitia



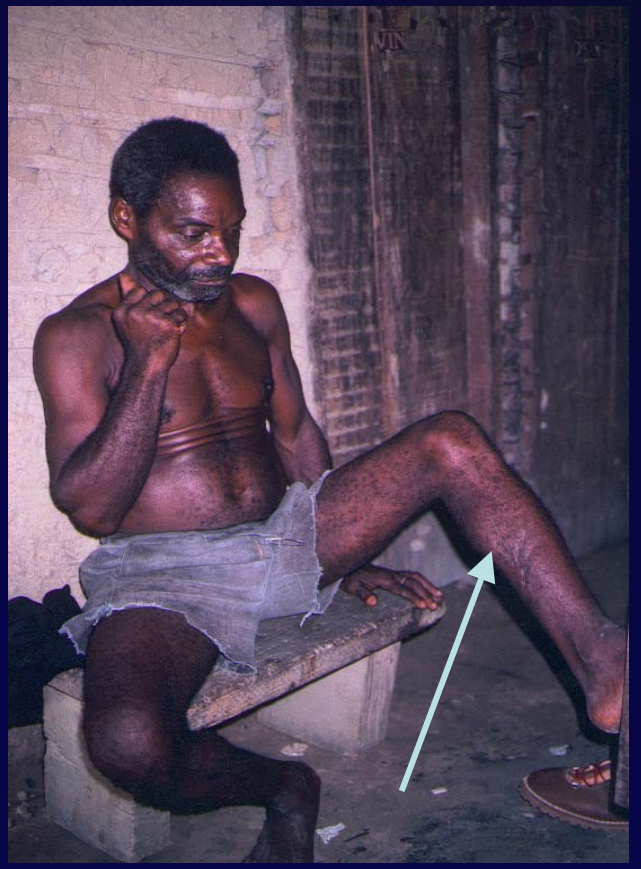
Viral particles

Epidemiology results

In all, but one case, the infected persons were men, great hunters, having been bitten during hunting activities by an ape or a monkey

- A Bantu man (AG 16) had a history of severe bites during an encounter with a small monkey (*cercopithecus*) during hunting, 20 years ago with scars especially on the left foot.

- A Pymgy man (801001) had a history of a severe fight with a gorilla, with multiple bites and bleeding injuries, around 25 years ago with scars, especially on the left leg.



Phylogenetic analyses indicate perfect match between foamy viral sequence findings and history

Calattini et al., EID, 2007

Risk factors according to infection by a SFV analyzed by univariate analysis

Risk factors		Number of individuals			P
		Positive	Total tested	%	
Age at the contact	< 45 years	5	66	7.6	0.025
	>45 years	5	19	26.3	
Sex	men	10	71	14.1	0.135
	women	0	14	0	
Ethnies	Bantus	7	72	9.7	0.169
	Pygmies	3	13	23.1	
Circumstance of contact	pets	0	29	0	0.015
	hunting	10	56	17.9	
Type of NHP	monkeys	2	56	3.6	0.001
	apes	8	29	27.6	
Types of wounds	scratches	0	9	0	0.247
	bites	10	76	13.2	
Localization	Upper body	2	31	6.5	0.249
	Lower body	8	54	14.8	
Presence of scares	No scares	0	12	0	0.172
	scares	10	73	13.7	

The main risk factor associated with SFV infection in Humans was a severe bite by an ape during hunting activities

Calattini et al., EID, 2007

Second Large ongoing study performed in different areas

of Southern Cameroun

General adult population of villages and setlments: 1321individuals

«Contact group» (198 persons, mostly hunters who had encountered a NHP with a resulting bite or scratch)

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PLoS PATHOGENS

Frequent and Recent Human Acquisition of Simian Foamy Viruses Through Apes' Bites in Central Africa

Edouard Betsem[1,2,3]*, Réjane Rua[1,2], Patricia Tortevoye[1,2], Alain Froment[4], Antoine Gessain[1,2]*

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Abstract

Human infection by simian foamy viruses (SFV) can be acquired by persons occupationally exposed to non-human primates (NHP) or in natural settings. This study aimed at getting better knowledge on SFV transmission dynamics, risk factors for such a zoonotic infection and, searching for intra-familial dissemination and the level of peripheral blood (pro)viral loads in infected individuals. We studied 1,321 people from the general adult population (mean age 49 yrs, 640 women and 681 men) and 198 individuals, mostly men, all of whom had encountered a NHP with a resulting bite or scratch. All of these, either Pygmies (436) or Bantus (1085) live in villages in South Cameroon. A specific SFV Western blot was used and two nested PCRs (*polymerase*, and LTR) were done on all the positive/borderline samples by serology. In the general population, 2/1,321 (0.2%) persons were found to be infected. In the second group, 37/198 (18.6%) persons were SFV positive. They were mostly infected by apes (37/39) FV (mainly gorilla). Infection by monkey FV was less frequent (2/39). The viral origin of the amplified sequences matched with the history reported by the hunters, most of which (83%) are aged 20 to 40 years and acquired the infection during the last twenty years. The (pro)viral load in 33 individuals infected by a gorilla FV was quite low (<1 to 145 copies per 10^5 cells) in the peripheral blood leucocytes. Of the 30 wives and 12 children from families of FV infected persons, only one woman was seropositive in WB without subsequent viral DNA amplification. We demonstrate a high level of recent transmission of SFVs to humans in natural settings specifically following severe gorilla bites during hunting activities. The virus was found to persist over several years, with low SFV loads in infected persons. Secondary transmission remains an open question.

Citation: Betsem E, Rua R, Tortevoye P, Froment A, Gessain A (2011) Frequent and Recent Human Acquisition of Simian Foamy Viruses Through Apes' Bites in Central Africa. PLoS Pathog 7(10): e1002306. doi:10.1371/journal.ppat.1002306

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Competing Interests: The authors have declared that no competing interests exist.

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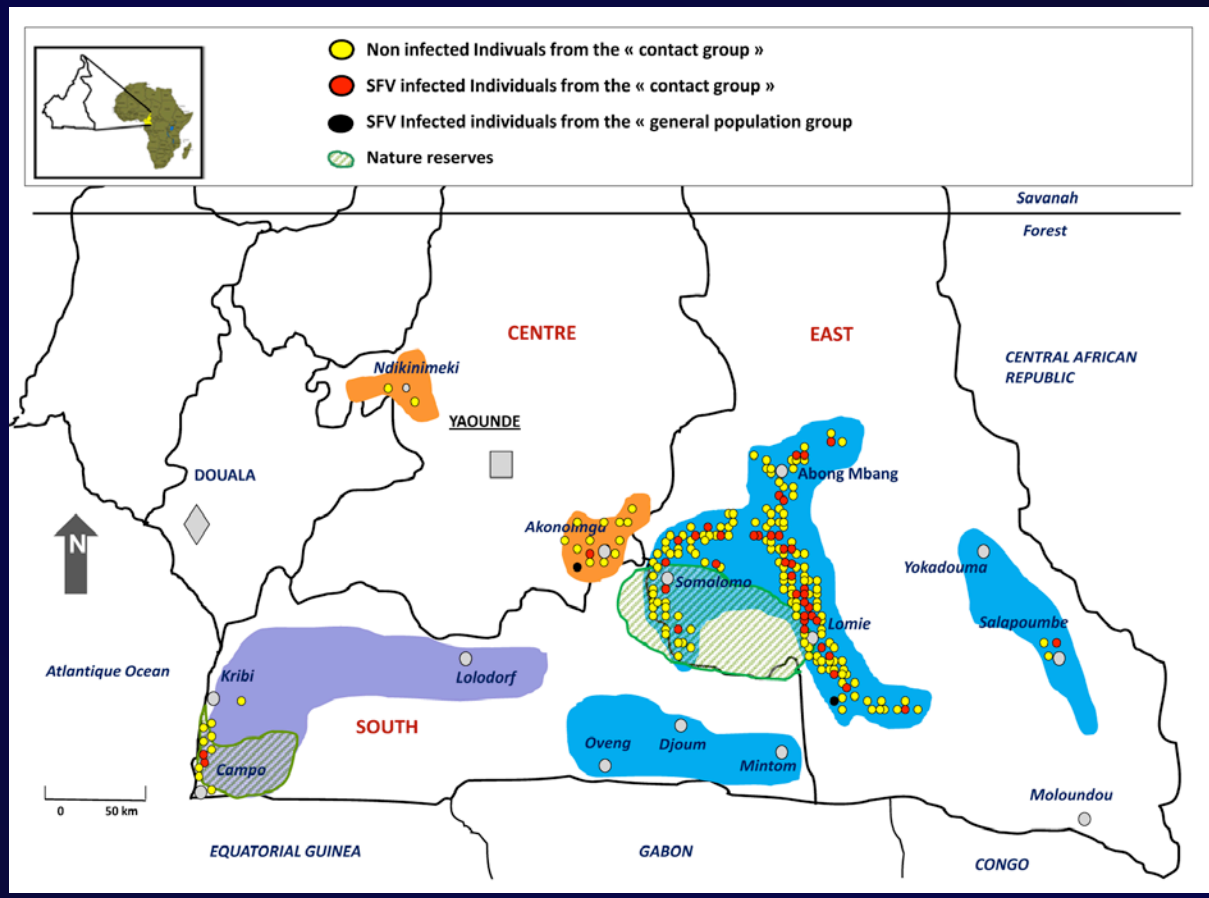


Betsem et al., Plos Pathogens, nov 2011

While only two (<0.2%) were found infected in the general population group, 37 (19%) individuals were found infected in the contact group

Ethnicity	Samp/sex	Age at: cont/samp	Samp periods	Wound loc/severity	Foamy Serology	PCR *pol*-In /LTR	Origin	(Pro)viral Load
Pygmies	Pyl149/M	45/60	2008	Hand/2	+	+/+	Cpz	ND
	Bobak153/M	53/59	2006/09	Hand/2	+	+/+	Gor	20
	Mebak65/M	20/40	2006	Body/2	+	-/+	Gor	<1
	Lobak2/M	37/57	2006/09	Thigh/3	+	+/+	Gor	32
	Lobak89/M	20/50	2006/09	Arm/2	+	+/+	Gor	<1
	Sabak36/M	40/68	2006	Forearm/3	+	+/-	Gor	63
	Bak33/M	25/45	2008/09	Multiple/3	+	+/+	Gor	24
	Bak40/M	30/35	2008	Thigh/2	+	+/-	Gor	14
	Bak46/M	26/50	2008/08	Multiple/3	+	+/+	Gor	76
	Bak55/M	30/65	2008	Arm/2	+	+/+	Gor	145
	Bak56/M	40/65	2008/09	Hand/2	+	+/-	Gor	57
	Bak74/M	26/47	2008/09	Foot/2	+	+/+	Gor	117
	Bak82/M	46/50	2008/09	Leg/2	+	+/+	Gor	36
	Bak132/M	30/61	2009/10	Head/3	+	+/+	Gor	27
	Bak133/M	30/51	2009/10	Several/3	+	+/+	Gor	2
	Bak177/M	26/36	2009/10	Leg/3	+	+/+	Gor	122
	Bak188/M	15/48	2009	Hand/1	+	-/+	Cerco	ND
	Bak224/M	19/38	2010	Several/3	+	+/+	Gor	28
	Bak228/M	29/70	2010	Foot/3	+	+/+	Gor	34
	Bak232/M	40/60	2010	Hand/2	+	+/+	Gor	59
	Bak235/M	27/55	2010	Hand/2	+	-/+	Gor	<1
	Bak242/M	30/49	2010	Leg/2	+	+/+	Gor	26
	Bak270/M	25/60	2010	Hand/2	+	+/+	Gor	<1
Bantus	Camvae3/M	25/29	2008	Foot/2	+	-/+	Cerco	ND
	Bad316/M	36/51	2008	Hand/2	+	+/+	Cpz	ND
	Bad327/M	30/33	2008/10	Multiple/3	+	+/+	Cpz	ND
	Bad332/M	25/37	2008	Multiple/3	+	+/+	Gor	31
	Bad348/M	19/27	2008/09	Leg/3	+	+/+	Gor	8
	Bad349/M	32/40	2008	Head/2	+	+/+	Gor	41
	Bad350/M	40/68	2008/08	Leg/2	+	+/+	Gor	22
	Bad436/M	35/56	2009	Hand/2	+	+/+	Cerco	ND
	Bad447/M	40/56	2009/10	Hand/2	+	+/-	Gor	9
	Bad448/M	44/50	2009	Leg/2	+	-/+	Gor	<1
	Bad456/M	24/30	2009/10	Leg/2	+	+/+	Gor	23
	Bad463/M	37/43	2009	Leg/3	+	+/+	Gor	72
	Bad468.M	23/35	2010	Several/3	+	+/+	Gor	26
	Bad551/M	27/38	2010	Arm/2	+	+/+	Gor	<1
Pygmy	Bobak237/M	-/68	2006	Unknown	+	+/+	Gor	57
Bantu	Ako254/F	-/65	2008/09	Unknown	+	+/+	Cerco	ND

Contact group

37/198 = 19%

General population

2/1321 = 02%

Gorillas: 32 cases

Chimpanzees: 3 cases

Monkeys: 4 cases

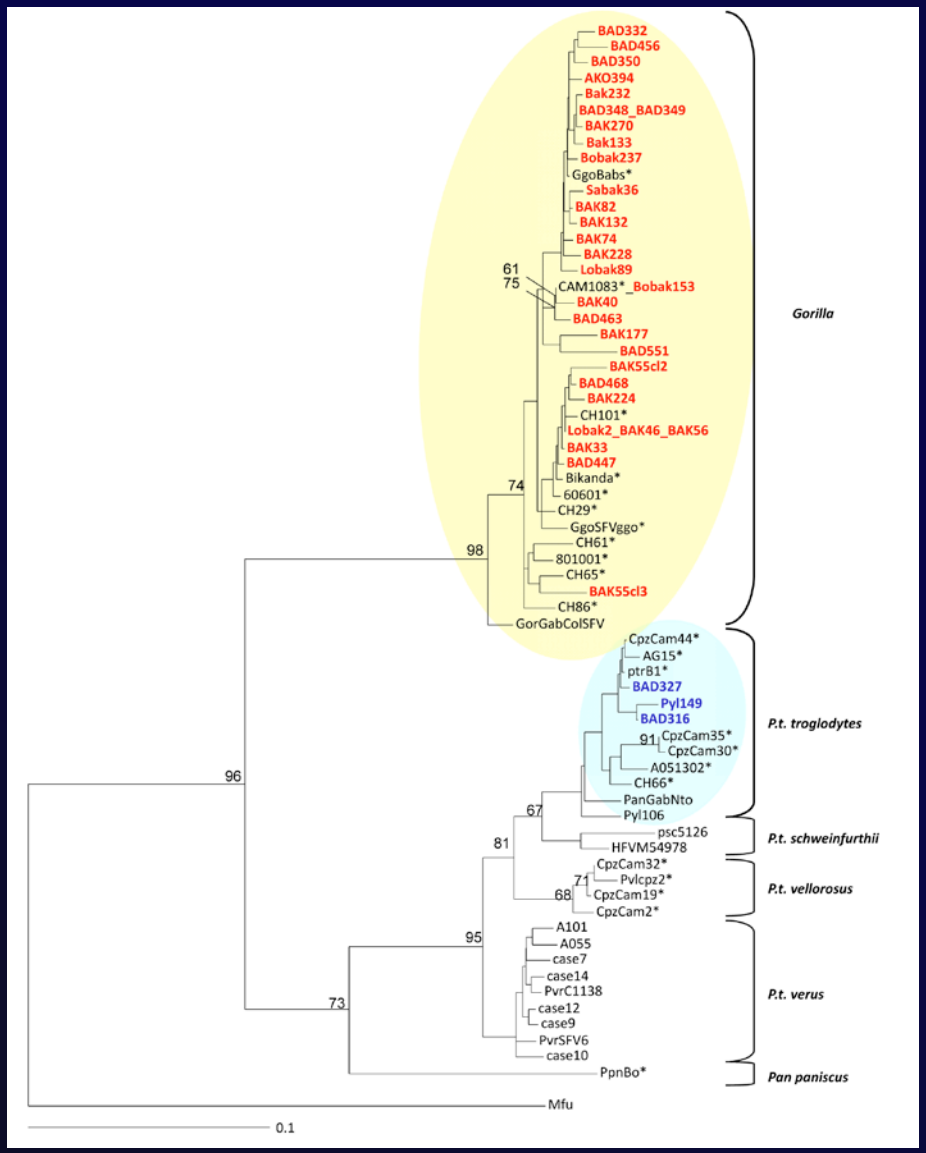
Proviral load determined by quantitative PCR indicate a low load with a mean value of 36 copies /10^5 cells

Viral persistance estimation range from 5 months to 45 years (mean 17 years)

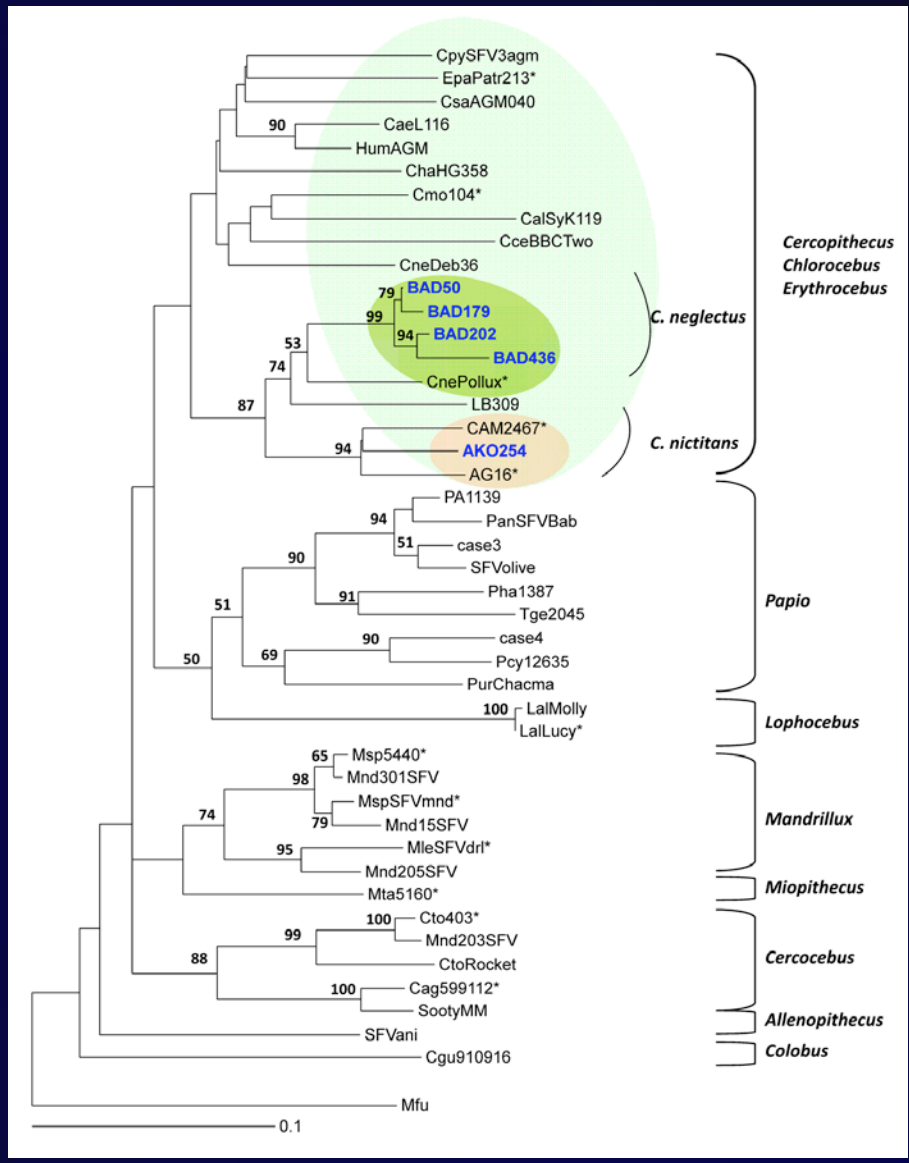
Betsem et al., Plos Pathogens, Nov 2011

Perfect match between foamy viral sequence findings and history

Gorillas and Chimpanzees



Monkeys



Betsem et al., Plos Pathogens, Nov 2011

Epidemiological analysis of associated factors for SFV infection

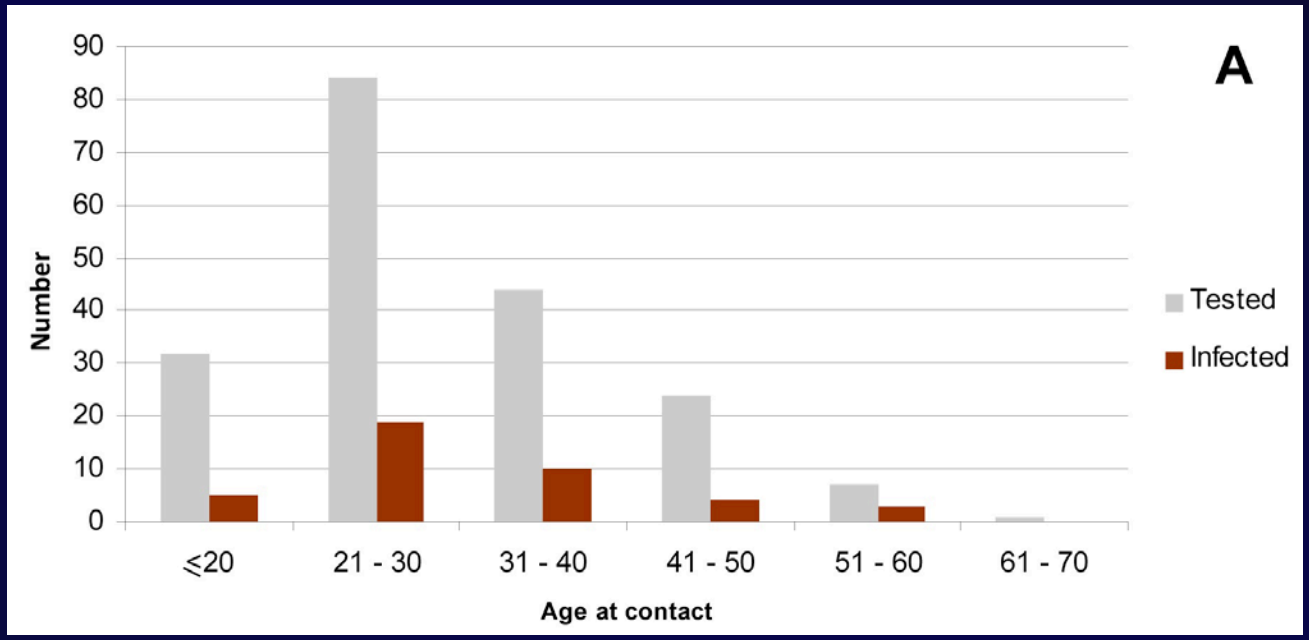
Risk factors		Number of individuals			p
		Tested	Positive	%	
Age at contact					
	<50years	783	19	2.43	
	>50years	736	18	2.45	0.98
Sex					
	Woman	647	1	0.15	
	Man	872	36	4.13	$<10^{-3}$
Ethnicity					
	Bantus	1084	14	1.29	
	Pygmies	412	23	5.29	$<10^{-3}$
Circumstances of contact					
	Hunting	190	35	18.42	$<10^{-5}$
	Pets	8	0	0	
	No contacts	1321	2	0.15	
Type of NHP					
	Monkeys	103	2	1.94	$<10^{-5}$
	Apes	95	33	34.74	
	No contacts	1321	2	0.15	
Type of contact					
	Bites	187	31	16.5	$<10^{-5}$
	Scratches	6	1	16.6	
	Both	5	3	60	
	No contacts	1321	2	0.15	
Localisation of the Wound*					
	Upper body	114	21	18.3	
	Lower body	68	14	20.59	$<10^{-3}$
	No contacts	1332	2	0.15	

Univariate analysis was performed with stata. χ^2 and fisher exact test were realised with a critical *p* value of 0.05.
* missing data in this category (5)

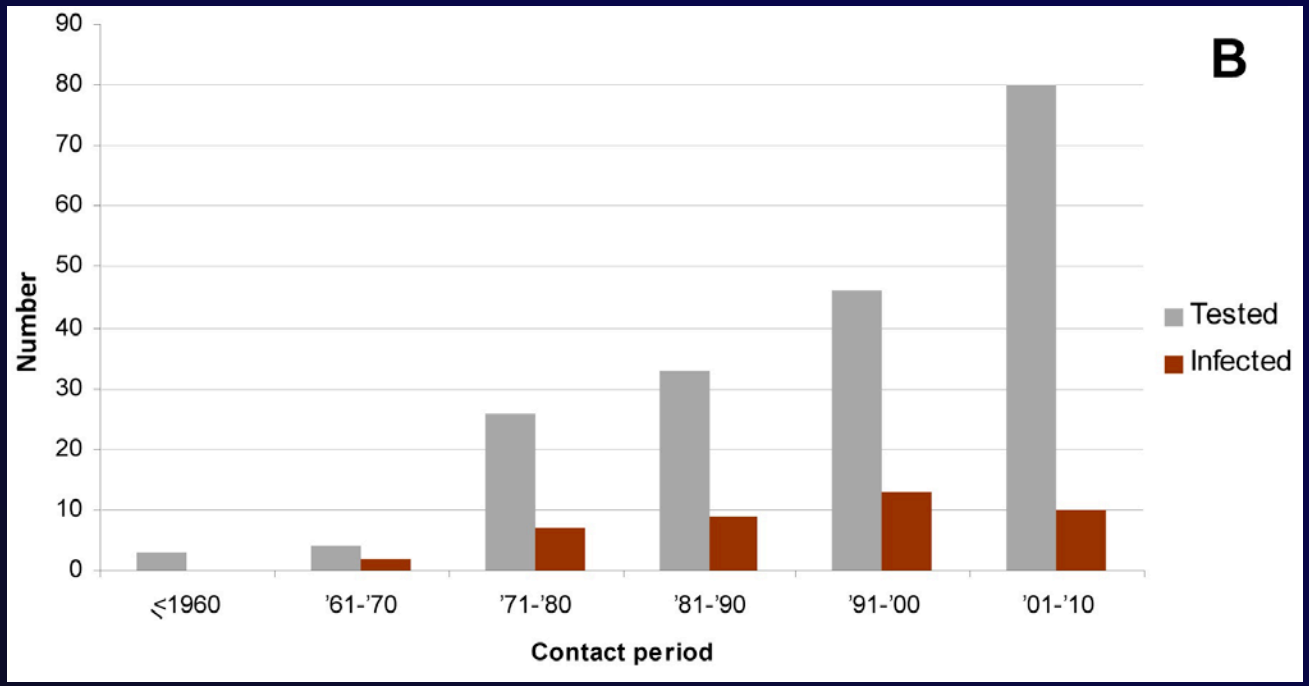
SFV infected individuals harboring scars and lesions caused by NHP bites.

By multiple variate analysis only apes and bites were associated with SFV infection.

Betsem et al., Plos Pathogens, Nov 2011



Most of the hunters infected by SFV are young (aged 20 to 40 years)

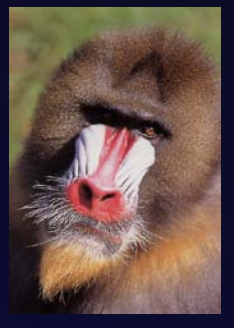


and acquired their infection during the last twenty years.

This is still an ongoing process of viral emergence.

Betsem et al., Plos Pathogens, Nov 2011

Others Collaborative Studies in Gabon, Central Africa



Journal of Virology p. 1255–1260

Cross-Species Transmission of Simian Foamy Virus to Humans in Rural Gabon, Central Africa

Augustin Mouinga-Ondémé,[a] Mélanie Caron,[a] Dieudonné Nkoghé,[b] Paul Telfer,[c] Preston Marx,[c] Ali Saïb,[d] Eric Leroy,[b] Jean-Paul Gonzalez,[a] Antoine Gessain,[e] and Mirdad Kazanji[a,f]

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Species	Common name	No. of animals positive/no. tested (%) by: Serological tests of blood samples[a]	PCR: Buffy coats[b]	PCR: Bush meat (tissues)[c]
Cercopithecus solatus	Sun-tailed monkey	8/16 (50)	6/16 (37.5)	
Cercopithecus pogonias	Crowned guenon	0/6	0/6	
Cercopithecus nictitans	Greater white-nosed monkey	0/30	0/30	3/29 (10.3)
Cercopithecus neglectus	De Brazza guenon	0/3	0/3	1/3 (33.3)
Cercopithecus cephus	Red-eared guenon	0/67	0/67	2/46 (4.3)
Cercocebus torquatus	Red-capped mangabey	1/13 (7.7)	1/13 (7.7)	0/13
Mandrillus sphinx	Mandrill	12/77 (15.6)	12/77 (15.6)	4/78 (5.1)
Pan troglodytes troglodytes	Central African chimpanzee	9/49 (18.4)	8/49 (18.6)	0/34
Gorilla gorilla	Gorilla	0/3	0/3	0/8
Miopithecus ogouensis	Gabon talapoin	0/2	0/2	
Miopithecus talapoin	Talapoin monkey	0/8	0/8	
Colobus guereza	Mantled guereza	0/2	0/2	
Lophocebus albigena	Gray-cheeked mangabey	1/10 (10)	1/10 (10)	
Total		31/286 (10.8)	28/286 (9.8)	10/211 (4.7)

[a] Serological tests were performed by Western blotting using sera obtained from the monkeys.
[b] PCR was performed using buffy coats obtained from monkeys and apes tested serologically with WB.
[c] PCR was performed using only tissue samples obtained from bush meat (lymph nodes, muscles, lung, and heart) collected from dead monkeys.

Characteristic	No. of humans positive for SFV	Total no. of humans tested	No. positive/no. tested (%)	*P* value
Age at contact (yr)				0.533
≤45	10	57	17.5	
>45	5	21	23.8	
Sex				0.035
Male	15	63	23.8	
Female	0	15	0	
Circumstance of contact				0.011
Pet	0	20	0	
Hunting	15	58	25.9	
Type of nonhuman primate				0.001
Monkey	1	36	2.8	
Ape	14	42	33.3	
Type of wound				0.316
Scratch	0	4	0	
Bite	15	74	20.3	
Location of wound				0.860
Upper body	8	40	20.0	
Lower body	7	38	18.4	
Presence of scars				0.018
No	0	18	0	
Yes	15	60	25.0	

[a] Univariate analyses were performed by STATA software with χ^2 tests and Fisher's exact tests, with a critical *P* value of 0.05.

Simian Foamy Virus (SFV) transmission in Humans
A natural model of viral emergence. Multidisciplinary studies

Ongoing Fields missions ++, Ethics ++

Epidemiology

Epidemiology

Sequence phylogeny

Interspecies transmission

Search for familial transmission

Calattini et al. EID 2007
Betsem et al.
Plos Pathogens 2011

Ongoing 2013-2014

Virology DNA/RNA load Reservoir

FV DNA and FV RNA levels in PBMCs subtypes and In saliva

Quasi-species in PBMCs vs saliva

Chronicity molecular patterns

Rua et al. J. Virol.2012
and Plos One, in revision

Clinical aspects

Biological and clinical

case control field (biais)

and hospitals

Co-infection HTLV / SIV

E. Betsem
C. Filippone
Collaborators CPC
Ongoing 2012-2013.

Immunology

Innate and Acquired

Humoral

Cellular

Immunity

Ongoing 2012-2013
J. Gouzil
R. Rua. F. Buseyne
O. Schwartz

Rua et al. J. Virol 2012

Collaboration Pasteur Network and Labex Members

Bush-meat Increases Exposure Risks to Infectious Agents

- Between 3– 5 million tons of bush-meat are killed each year (~15% NHPs) in Central Africa

- Lack of economic options/absence of affordable substitutes (bushmeat ~75% cheaper than domestic meat)

- In Central Africa, the number of contacts between humans (mostly hunters and their wives and butchers) and NHPs has very probably greatly increased during the last decades.

- Due to increased hunting activities, resulting from a combination of urban demand for bush-meat, greater access to NHP habitats provided in part by logging roads, easier accessibility to fire arms, and an increase in populations living in forest areas, and the associated increase in local food needs.

Opening up of “frontier” forests by logging and mining companies

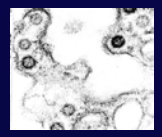
Main factor for viral emergence

FROM NHPs TO HUMANS: THE NATURAL HISTORY

Different steps leading to possible retroviral emergence

NON HUMAN PRIMATES

HUMANS



FOAMY

?

STOP

Very few studied cases

HUMANS

?

STOP

HTLV-3

Very few studied cases

HUMANS

CONTACTS (bites, cuts, wounds…)
~ 50% rural population adults

TRANSMISSION (saliva, blood, other fluids…)

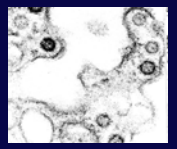
PERSISTENCE in HOST (lymphocytes)
viral replication ?

TRANSMISSION (sexual, nursing, blood…)
HIV/**HTLV-1/2**

DIFFUSION (sex, drug users, traveling…)
HIV/**HTLV-1/2**

EPIDEMIC / ENDEMIC
HIV-1 **HTLV-1/2**

What will be the future story for HTLV-3 and Foamy in Humans ?



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Thank you very much.

Field mission, South Cameroon, Pygmy Settlement