



SIMIAN IMMUNODEFICIENCY VIRUSES (SIV's)

ANIMAL GROUP AFFECTED	TRANSMISSION	CLINICAL SIGNS	FATAL DISEASE ?	TREATMENT	PREVENTION & CONTROL
Naturally : mainly African nonhuman primates. In captivity and experimental -ly : Asian macaques	Contact, sexually, in infants perorally (milk)	In natural hosts usually none, in Asian macaques wasting, diarrhea, anaemia, hypergamma-globulinaemia, CNS-symptoms, secondary infections	In Asian macaques infected with SIV smm PBJ		<i>In houses</i> <i>in zoos</i> Avoidance of contact between newly imported African species and resident Asian macaques.

Fact sheet compiled by Manfred Brack, formerly German Primate Center, Göttingen / Germany.	Last update 22.11.2008
Susceptible animal groups Naturally : mainly African nonhuman primates, in Asia only <i>M.arctoides</i> is considered to be the natural host of SIV stm. Asian macaques susceptible to natural and experimental infections. SIV cpz- antibodies and nucleic acids demonstrated in fecal samples of wild living chimpanzees in southern Cameroon.	
Causative organism SIV agm, SIV smm, SIV tal, SIV l'hoest, SIV syk, SIV stm, SIV cpz, SIV gor, SIV schm, SIV gsn, SIV bkm (Retroviridae, type E lentiviruses).	
Zoonotic potential Yes, considering the suggested origin of the HIV's from SIV's.	
Distribution As natural infections : Africa, in captivity World-wide.	
Transmission contact (biting ?), sexually, maternal- offspring via milk.	
Incubation period strain and host dependent, in SIV smm PBJ 14 infections of <i>M.mulatta</i> and <i>M.arctoides</i> as short as only a few weeks.	
Clinical symptoms Wasting, diarrhea, cardiac diseases, arteriopathies, dermatitis, hypergammaglobulinaemia, cognitive- and motor deficits. Other symptoms caused by secondary infections (Pneumocystosis, cryptococcosis, atypical or avian tuberculosis, cytomegalo-, adeno- or other viral infections).	
Post mortem findings Encephalitis (mononuclear infiltrates, gliosis, glial nodules), cardiac necroses, myocarditis, coronary or systemic arteriopathy, glomerulosclerosis, giant cellular pneumonia, follicular hyperplasia and – fragmentation in lymphoid tissues, extramedullary haematopoiesis in lymph nodes, epididymitis, prostatitis, urethritis, malignant lymphomas (B- cell type). Other lesions dependent on the secondary infections. Malignant lymphomas of B-cell lineage.	
Diagnosis Virology: reverse transcriptase – activity, electron microscopy. Serology: antibody- demonstration.(ELISA, Western blot).	
Material required for laboratory analysis whole blood.	
Relevant diagnostic laboratories 1. Virus Reference Laboratories, Inc. 7540 Louis Pasteur Road SAN ANTONIO, Tx. . 78229 Phone: (210) 614 – 7350 Fax: (210) 614 – 7355	



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Treatment

None.

Prevention and control in zoos

Separation of newly arrived African from Asian nonhuman primates species. Vaccines may fail due to viral mutation and viral escape from cytotoxic T-lymphocytes.

Suggested disinfectant for housing facilities**Notification****Guarantees required under EU Legislation****Guarantees required by EAZA Zoos****Measures required under the Animal Disease Surveillance Plan****Measures required for introducing animals from non-approved sources****Measures to be taken in case of disease outbreak or positive laboratory findings****Conditions for restoring disease-free status after an outbreak****Experts who may be consulted**

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References:

1. Barouch, M. L., J. Kunstman, M. J. Kuroda, J. E. Schmitz, S. Santra, F. W. Peyerl, G. R. Krivulka, K. Beaudry, M. A. Lifton, D. A. Gorgone, D. C. Montefiori, M. G. Lewis, S. M. Wolinsky, and N. L. Letvin. 2002. Eventual AIDS vaccine failure in a rhesus monkey by viral escape from cytotoxic T-lymphocytes. *Nature* 415 : 335 – 339.
2. Beer, B. E., E. Bailes, R. Goeken, G. Dapolito, C. Coulibaly, S. G. Norley, R. Kurth, J. – P. Gauthier, A. Gauthier – Hion, D. Vallet, P. M. Sharp, and V. M Hirsch. 1999. Simian immunodeficiency virus (SIV) from sun – tailed monkeys (*Cercopithecus solatus*): Evidence for host – dependent evolution of SIV within the *C. lhoesti* superspecies. *J. Virol.* 73 : 7734 – 7744.
 4. Chalifoux, L. V., M. A. Simon, D. R. Pauley, J. J. MacKey, M. S. Wyand, and D. W. Ringler: 1992. Arteriopathy in macaques infected with simian immunodeficiency virus. *Lab. Invest.* 67: 338 – 349.
 5. Chapman, L. E., T. M. Folks, D. R. Salomon, A. P. Patterson, T. E. Eggerman, and P. D. Noguchi. 1995. Xenotransplantation and xenogeneic infection. Is there a risk for transplant recipients. *N. Engl. J. Med.* 333 : 1498 – 1501.
 6. Cohen, J. 1999. Aids virus traced to chimp subspecies. *Science* 283 : 772 – 773.
 7. Desrosiers, R. C. 1990. A finger on the missing link. *Nature* 345 : 288 – 291.
 8. Emau, P., H. McClure, M. Isahakia, J. G. Else, and P. N. Fultz. 1991. Isolation from African sykes monkeys (*Cercopithecus mitis*) of a lentivirus related to human and simian immunodeficiency viruses. *J. Virol.* 65 : 2135 – 2140.



9. Essex, M. 1994. Simian immunodeficiency virus in people. *N. Engl. J. Med.* 330 : 209 – 210.
10. Fultz, P. N., and P. M. Zack. 1994. Unique lentivirus – host interactions : SIV smm PBJ 14 infection of macaques. *Virus Res.* 32 : 205 – 225.
11. Galat, G., and A. Galat – Luong. 1996. Social organization and SIV prevalence of green and patas monkeys. *Folia Primatol.* 67 : 91.
12. Gao, F., E. Bailes, D. L. Robertson, Y. Chen, C. M. Rodenburg, S. F. Michael, L. B. Cummins, L. O. Arthur, M. Peeters, G. M. Shaw, P. M. Sharp, and B. H. Hahn. 1999. Origin of HIV – 1 in the chimpanzee *Pan troglodytes troglodytes*. *Nature* 397: 436 – 441.
13. Georges – Courbot, M. C., C. Y. Lu, M. Makuwa, P. Telfer, R. Oranga, G. Dubreuil, Z. Chen, S. M. Smith, and P. A. Marx. 1998. Natural infection of a household pet red – capped mangabey (*Cercocebus torquatus torquatus*) with a new simian immunodeficiency virus . *J. Virol.* 72 : 600 – 608.
14. Gummuluru, S., F. J. Novembre, M. Lewis, H. A. Gelbard, and S. Dewhurst. 1996. Apoptosis correlates with immune activation in interstitial lymphoid tissue from macaques acutely infected by a highly enteropathic simian immunodeficiency virus , SIV smm PBJ 14. *Virology* : 225 : 21 – 32.
15. Habis, A., G. B. Baskin, M. Murphey – Corb, and L. S. Levy. 1999. Simian AIDS – associated lymphoma in rhesus and cynomolgus monkeys recapitulates the primary pathological features of AIDS – associated non – Hodgkin’s lymphoma. *AIDS Res. Hum. Retrovir.* 15 : 1389 – 1398.
16. Hirsch, V. M., B. J. Campbell, E. Bailes, R. Goeken, C. V. Brown, W. R. Elkins, M. Axthelm, M. Murphey – Corb, and P. M. Sharp. 1999. Characterization of a novel simian immunodeficiency virus (SIV) from l’hoest monkeys (*Cercopithecus l’hoesti*) : Implication for the origin of SIV and other primate lentiviruses. *J. Virol.* 73 : 1036 – 1045.
17. Huet, T., R. Cheynier, A. Meyerhans, G. Roelants, and S. Wain – Hobson. 1990. Genetic organization of a chimpanzee lentivirus related to HIV – 1. *Nature* 345 : 356 – 359.
18. Hurtrel, B., L. Chakrabarti, M. Hurtrel, and L. Montagnier. 1993. Target cells during early SIV encephalopathy. *Res. Virol.* 144 : 41 – 46.
19. Jolling, P., D. F. van Wichen, H. K. Parmentier, P. Biberfeld, D. Böttiger, J. Tschopp, L. H. P. M. Rademakers, and H. J. Schuurman. 1992. Simian immunodeficiency virus (SIV sm) infection of cynomolgus monkeys : Effects on follicular dendritic cells in lymphoid tissue. *AIDS Res. Hum. Retrovir.* 8 : 2021 – 2030.
20. Jordan, H., V. Sasseville, H. Knight, B. Kennedy, N. Letvin, and A. Lackner . 1994. The presence of simian immunodeficiency virus (SIV) in reproductive tract tissues of acutely infected male rhesus macaques. *Vet. Pathol.* 36 : 505.
21. Kahnt, K., K. Mätz – Rensing, P. Hofmann, C. Stahl-Hennig, and F. – J. Kaup. 2002. SIV – associated lymphomas in rhesus monkeys (*Macaca mulatta*) in comparison with HIV – associated lymphomas. *Vet. Pathol.* 39 : 42 – 55.
22. Keele, B. F. , F. Van Heuverswyn, Y. Li, E. Bailes, J. Takehisa, M. L. Santiago, F. Bibollet-ruche, Y. Chen, L. V. Wain, F. Liegeois, S. Loul, E. M. Ngole, Y. Bienvenue, E. Delaporte, J.F.Y. Brookfield, P. M. Sharp, G. M. Shaw, M. Peeters, and B. H. Hahn. 2006. Chimpanzee reservoirs of pandemic and nonpandemic HIV-1. *Science* 131 : 523 – 526.
23. Kestens, L., J. Vingerhoets, M. Peeters, G. Vanham, C. Vereecken, G. Penne, H. Niphuis, P. van Eerd, G. van der Groen, P. Gigase, and J. Heeney . 1995. *J. Infect. Dis.* 172 : 957 – 963.
24. Khan, A. S., T. A. Galvin, M. B. Jennings, M. B. Gardner, and L. J. Lowenstine. 1991. SIV of stump-tailed macaque (SIV stm) is a divergent Asian isolate. *J. Med. Primatol.* 20 : 167 – 171.
25. Klumpp, S. A., F. J. Novembre, D. C. Anderson, M. A. Simon, D. J. Ringler, and H. M. McClure. 1993. Clinical and pathologic findings in infant rhesus macaques infected with SIV smm by natural transmission. *J. Med. Primatol.* 22 : 169 – 176.
26. Lewis, M. G., P. M. Zack, W. R. Elkins, and P. B. Jahrling. 1992. Infection of rhesus and cynomolgus macaques with a rapidly fatal SIV (SIV smm PBJ) isolate from sooty mangabeys. *AIDS Res. Hum. Retrovir.* 8 : 1631 – 1639.
27. Mansfield, K., and A. Lackner. 1994. Simian immunodeficiency virus infection in macaques at the New England Regional Primate Research Center during 1970 – 1972. *J. Med. Primatol.* 23 : 244.
28. McClure, H. M., D. C. Anderson, P. N. Fultz, A. A. Ansari, T. Jehuda – Cohen, F. Villinger, S. A. Klumpp, W. Switzer, E. Lockwood, A. Brodie, and H. Keyserling. Maternal

- transmission of SIV smm in rhesus monkeys. *J. Med. Primatol.* 20 : 182 – 187.
29. Müller, J. G., V. Krenn, S. Schindler, S. Czub, C. Stahl – Hennig, C. Coulibaly, G. Hunsmann, C. Kneitz, T. Kerkau, A. Rethwilm, V. ter Meulen, and K. Müller – Hermelink. 1993. Alteration of thymus cortical epithelium and interdigitating dendritic cells but no increase of thymocyte cell death in the early course of simian immunodeficiency virus infection. *Am. J. Pathol.* 143 : 699 – 713.
 30. O'Neill, S. P., S. P. Mossman, D. H. Maul, and E. A. Hoover. 1999. Virus threshold determines disease in SIV smm PBJ 14 - infected macaques. *AIDS Res. Hum. Retrovir.* 15 : 183 – 194.
 31. Osterhaus, A. D. M., N. Pedersen, G. van Amerongen, M. T. Frankenhuys, M. Marthas, E. Reay, T. M. Rose, J. Pamungkas, and M. L. Bosch. 1999. Isolation and partial characterization of a lentivirus from talapoin monkeys (*Myopithecus talapoin*). *Virology* 260 : 116 – 124.
 32. Peeters, M., F. Franssen, K. Delaponte, M. van der Haesevelde, G. – M. Gershy – Damet, L. Kestens, G. van der Groen, and P. Piot. 1992. Isolation and characterization of a new chimpanzee lentivirus (simian immunodeficiency virus isolate cpz ant) from a wild – captured chimpanzee. *AIDS* 6 : 447 – 451.
 33. Phillips – Conroy, J. E., C. J. Jolly, B. Petros, J. S. Allan, and R. C. Desrosiers. 1994. Sexual transmission of SIV agm in wild grivet monkeys. *J. Med. Primatol.* 23 : 1 – 7.
 34. Rensburg, E. J. van, S. Engelbrecht, J. Mwenda, J. D. Laten, B. A. Robson, T. Stander, and G. K. Chege. 1998. Simian immunodeficiency viruses (SIVs) from eastern and southern Africa : detection of a SIV agm variant from a chacma baboon. *J. Gen. Virol.* 79 : 1809 – 1814.
 35. Rey – Cuille, M. – A., J. – L. Berthier, M. – C. Bomsel – Demontoy, Y. Chaduc, L. Montagnier, A. G. Hovanessian, and L. A. Chakrabarti. 1999. Simian immunodeficiency virus replicates to high levels in sooty mangabeys without inducing disease. *J. Virol.* 72 : 3872 – 3886.
 36. Sande, M. A. 1999. Infection with human immunodeficiency virus, an epidemic out of control : Personal reflection. *J. Infect. Dis.* 179 : S 387 – S 390.
 37. Santiago, M. L., C. M. Rodenburg, S. Kamenya, F. Bibollet – Ruche, F. Gao, E. Bailes, S. Meleth, S. J. Soong, J. M. Kilby, Z. Moldoveanu, B. Fahey, M. N. Muller, A. Ayoub, E. Nerrienet, H. M. McClure, J. L. Heeney, A. E. Pusey, D. A. Collins, C. Boesch, R. W. Wrangham, J. Goodall, P. M. Sharp, G. M. Shaw, and B. H. Hahn. 2002. SIV cpz in wild chimpanzees. *Science* 295 : 465.
 38. Simon, M. A., R. P. Shannon, C. Romsey, X. Alvarez, and A. A. Lackner. 1999. Cardiac disease in macaques with AIDS. *Vet. Pathol.* 36 : 485.
 39. Tristem, M., A. Purvis, and D. L. J. Quicke. 1998. Complex evolutionary history of primate lentiviral vpr genes. *Virology* 240 : 232 – 237.
 40. Verschoor, E. J., Z. Fagrouch, I. Bontjer, H. Niphuis, and J. L. Heeney. 2004. A novel simian immunodeficiency virus isolated from a Schmidt's guenon (*Cercopithecus ascanius schmidtii*). *J. Gen. Virol.* 85 : 21 – 24.
 41. Villinger, F., G. T. Brice, A. Mayne, P. Bostik, and A. A. Ansari. 1999. Control mechanisms of virus replication in naturally SIV smm infected mangabeys and experimentally infected macaques. *Immunol. Lett.* 66 : 37 – 46.
 42. Weiss, R. A., and R. W. Wrangham. 1999. From *Pan* to pandemic. *Nature* 397 : 385 – 386.
 43. Westmoreland, S. V., J. B. Rottman, K. C. Williams, A. A. Lackner, and V. G. Sasseville. 1998. Chemokine receptor expression on resident and inflammatory cells in the brain of macaques with simian immunodeficiency virus encephalitis. *Am. J. Pathol.* 152 : 659 – 665.
 44. Yanai, T., A. A. Lackner, H. Sakai, T. Masegi, and M. A. Simon. 2006. Systemic arteriopathy in SIV – infected rhesus macaques (*Macaca mulatta*). *J. Med. Primatol.* 35 : 106 – 112.