

Fatal *Herpesvirus simiae* (B virus) infection in a patas monkey (*Erythrocebus patas*)

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Herpesvirus simiae (B virus) occurs naturally in Asian macaques, particularly rhesus, bonnet, and cynomolgus monkeys^{7,8}. The term B virus was coined after a physician (W.B.) died from encephalitis 3 days after being bitten by a clinically normal rhesus monkey.⁹ *Herpesvirus simiae* was isolated from the patient's brain, medulla, spinal cord, and spleen.⁹

The B virus is well adapted to its natural simian host, frequently causing only transient, mild oral lesions. Like many herpesviruses, a latent form occurs in recovered animals, and the virus can be recovered from kidney, oral secretions, and the trigeminal ganglia in clinically normal monkeys.^{5,7,9} Infected animals may not show clinical signs or have detectable antibody to the B virus.⁷

Surveys of wild and captive monkeys reveal a high variability in B virus infection rates.⁷ Approximately 10% of young recently captured animals were seropositive for B virus, whereas 70-80% of adults had positive titers.⁷ In addition to age, population density also influenced the number of positive animals. In Indonesia, 77% of those monkeys tested had positive titers, in Malaysia, 64%, and in the Philippines, 28%.⁷ Sera obtained from various laboratories utilizing primates revealed approximately 19% of the animals tested had antibody titers to B virus.⁴

The major interest in B virus has been the disease it causes in humans. Infected individuals develop an almost invariably fatal ascending myelitis and encephalitis.⁷ Fatal disease suspected to be caused by B virus has been reported in patas and colobus monkeys.⁶ This report describes a case of fatal B virus infection in a pet patas monkey.

An adult male patas monkey was submitted for necropsy following a brief illness. The monkey had been normal the previous morning, yet developed anorexia and lethargy the evening prior to its demise. The monkey had been purchased from an unknown dealer in Missouri 3 weeks previously. He had been housed in an outside enclosure until 1 week prior to his death, when he was moved into an 8- x 12- x 6-foot indoor cage located in the basement of a house. There were 2 pairs of rhesus monkeys also in the basement. Their cages were separated from the patas monkey's cage by a solid partition. All cages were cleaned at 2-3-day intervals. The patas monkey's cage had never been used for holding other primates. All monkeys were fed a commercial diet formulated for primates and supplemented with various fruits. The patas monkey was fed an all fruit diet for 1 week prior to his death.

The owner indicated that there had never been any evidence of oral disease in either the patas or rhesus monkeys.

The significant gross findings were confined to the liver and were characterized by disseminated 1-2-mm-diameter greyish-white foci located throughout the hepatic parenchyma.

Microscopic examination of hematoxylin and eosin (HE)-stained sections revealed numerous foci of hepatocellular necrosis that were becoming confluent and consisted of abundant cellular debris with hemorrhage. Many hepatocytes had normal to enlarged nuclei containing homogenous basophilic inclusions. Most inclusions filled the nucleus, although a few nuclei contained basophilic inclusions surrounded by a clear halo. The inclusions were most numerous adjacent to areas of necrosis. A few syncytial cells were also located near necrotic foci (Fig. 1). Random individual hepatocytes undergoing necrosis were also evident. Neutrophils occasionally infiltrated necrotic foci, and small numbers of lymphocytes were noted in portal triads. The spleen contained a few well-dispersed necrotic foci that were rarely accompanied by basophilic intranuclear inclusions similar to those seen in the liver. Extensive necrosis of periarterolar lymphoid sheaths was present. The renal cortical interstitium contained a few scattered lymphoid aggregates.

Ultrastructural studies of the liver revealed numerous degenerating hepatocytes containing intranuclear crystalline arrays of predominantly empty capsids. Empty herpesvirus capsids measured 100 nm in diameter. Capsids containing electron-dense cores and capsids with an electron-dense inner shell were also present (Fig. 2).

Cytopathic effect (CPE) was present in inoculated Vero cell cultures at about 24 hours after inoculation. The CPE in primary isolation was characterized by rounded cells. Multinucleated polymorphic syncytial formations, containing 5-10 nuclei, were observed in the third and fourth passage in Vero cells. The isolate was sensitive to chloroform treatment. A negatively stained preparation of cells and fluid from CPE-positive cultures showed virus particles approximately 100 nm in diameter. Only the capsid with a distinctive envelope was observed. Deoxyribonucleic acid fingerprinting analysis with restriction endonucleases indicated that the viral isolate was consistent with *Herpesvirus simiae* (B virus).

Naturally occurring fatal disease in nonhuman primates due to B virus is rare, especially in nonmacaque species. Fatal herpesvirus infection was reported in 3 *Erythrocebus patas* and 1 *Colobus abysimicus* from a small colony that contained baboons and rhesus, colobus, and patas monkeys.⁶ Clinical signs in 2 patas monkeys consisted of anorexia, depression, and swollen upper eyelids, which progressed to death over 2 weeks. The third patas monkey and the colobus monkey had similar signs and died within 2 days after the onset of clinical signs. Eyelid lesions consisted of an ulcerative dermatitis with intranuclear eosinophilic inclusions. Disseminated necrosis

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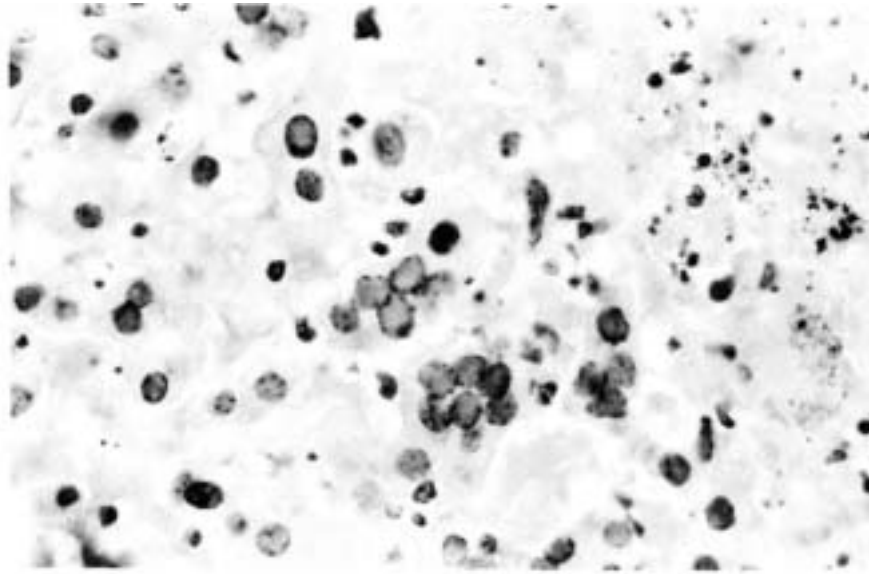


Figure 1. Photomicrograph of section of liver from a patas monkey infected with *Herpesvirus simiae* (B virus). Note syncytial cells containing basophilic intranuclear inclusions adjacent to necrotic foci (right). HE stain.

with similar inclusions was present in the lungs of all the animals. One patas monkey and the colobus monkey had hepatic, adrenal, splenic, and lymph node necrosis with intranuclear inclusions.⁶ An isolated herpesvirus had growth characteristics consistent with B virus.

Renewed interest in *Herpesvirus simiae* (B virus) has been generated with the recent reporting of 6 human cases. In 1987, 4 people were admitted to Florida hospitals with illnesses later confirmed to be caused by B virus infection.^{1,5} The other 2 reported human cases occurred in June 1989.² In each outbreak, rhesus monkeys were involved in the transmission of the disease.

The rhesus monkeys were probably the source of B virus in this case. The mechanism by which transmission occurred is uncertain. Experimentally, B virus has been transmitted via aerosols.⁸ The solid partition separating the patas monkey from the rhesus macaques may have limited direct aerosol transmission, although a common ventilation system served each room. Another potential mode of viral transmission may have been via fomites such as cleaning equipment and feeding utensils.

The diagnosis of a viral hepatitis, which included B virus in the differential, prompted immediate concern for Zoonotic transmission. The owner was informed of the potential car-

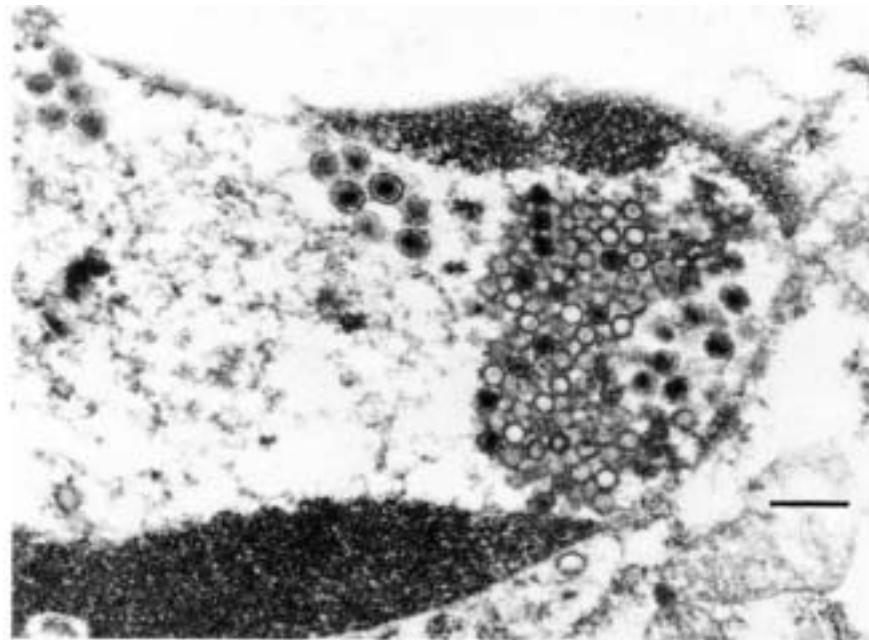


Figure 2. Electron micrograph of liver from a patas monkey infected with *Herpesvirus simiae* (B virus). Note many empty capsids accompanied by capsids containing electron-dense cores and capsids with an electron-dense inner shell. Bar = 300 nm.

rier status of the rhesus monkeys and the high mortality rate in humans clinically infected with B virus. He was advised to limit human contact with the remaining monkeys and consult with his physician. Family members were seronegative for B virus antibodies. The owner, who was the primary caretaker of the monkeys, refused serologic testing. Upon the urging of the owner's wife, the remaining monkeys were sold shortly after the viral isolate was confirmed as B virus. Their serologic status also remains unknown.

The serologic diagnosis of animals and humans infected with B virus is complicated by its close antigenic relationship to other herpesviruses, especially herpesvirus SA8 and *Herpesvirus hominis*.^{3,4,7,9} In addition, infected monkeys may be seronegative carriers. Isolation and identification of the virus from infected tissues or secretions are diagnostic. Isolation of a herpesvirus is not definitive of B virus infection because at least 35 simian herpesviruses have been reported.⁴

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Parvovirus infection in pigs with exudative skin disease

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The role of porcine parvovirus (PPV) as a major cause of maternal reproductive failure in swine has been well documented.^{3,6-8} Recently, PPV has also been reported to be associated with a vesicular-like skin condition in baby pigs.^{4,5} This report describes the gross, microscopic, and virologic findings in 3 pigs with necrotic and exudative skin disease.

Pigs 1 and 2 were 4-week-old mixed breed pigs that originated from a 100-sow herd on a farm in western Kentucky. The owner reported a 10% morbidity rate and low mortality rate due to skin disease among this group of pigs. "Greasy pig disease" (exudative epidermitis) had been a recurring problem in the past, and swine pox had been previously diagnosed in the herd.

Pig 3 was a 2-week-old mixed breed pig from a 20-sow herd in western Kentucky. The owner reported pigs dying of unknown causes within 2-3 weeks of birth. No estimate of the mortality rate was given.

Gross necropsy findings in pigs 1 and 2 consisted of thick,

greasy, dark grey to brown exudate covering portions of the skin. Lesions were most prominent on the face, around the ears, and on the limbs of pig 1. Exudate covered the skin of the entire lateral and ventral trunk, limbs, and head of pig 2. Additional gross findings for pig 2 included a firm, pale focus measuring 0.5 x 1 cm in the left middle lung lobe and dark red to tan mottling of the liver parenchyma. Pig 3 had exudative skin lesions on its face. These lesions were circular and individual or coalescing. The exudate was crusted and grey to brown. Removal of the crusts revealed ulceration of the skin with yellowish-green exudate in the underlying dermis and subcutis. The small intestine was hyperemic and contained yellow fluid.

Sections of skin of all 3 pigs were fixed in 10% neutral buffered formalin, embedded in paraffin, sectioned at 4 µm, and stained with hematoxylin and eosin.

Microscopically, the epidermal surface of the skin of pig 1 was covered with a thick layer of necrotic cell debris, serum, and fibrin. Large numbers of coccoid bacteria and multifocal aggregates of neutrophils were within the surface exudate. Microabscesses located in the epidermis and dermis also contained coccoid bacteria. In pig 2, there was full-thickness

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