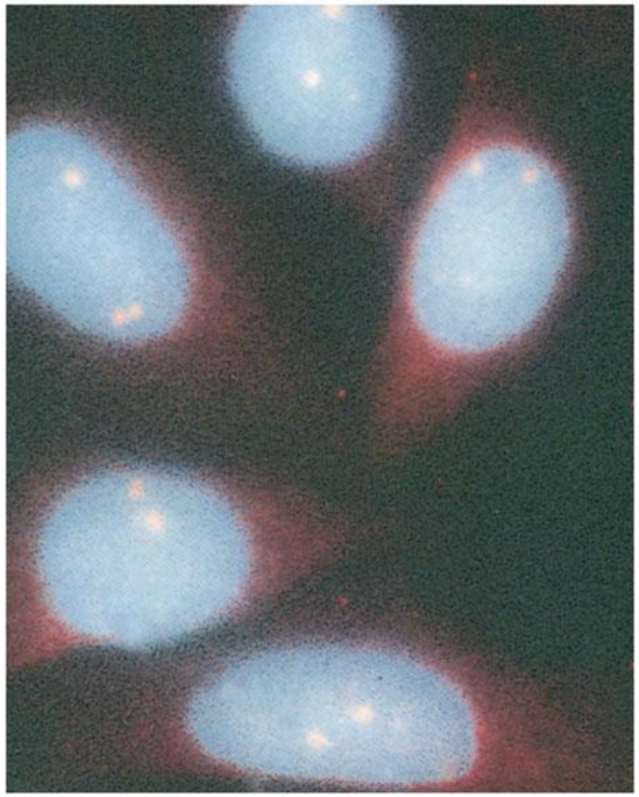


Introduction to the Viruses of Medical Importance: The DNA Viruses

Chapter 24

viruses

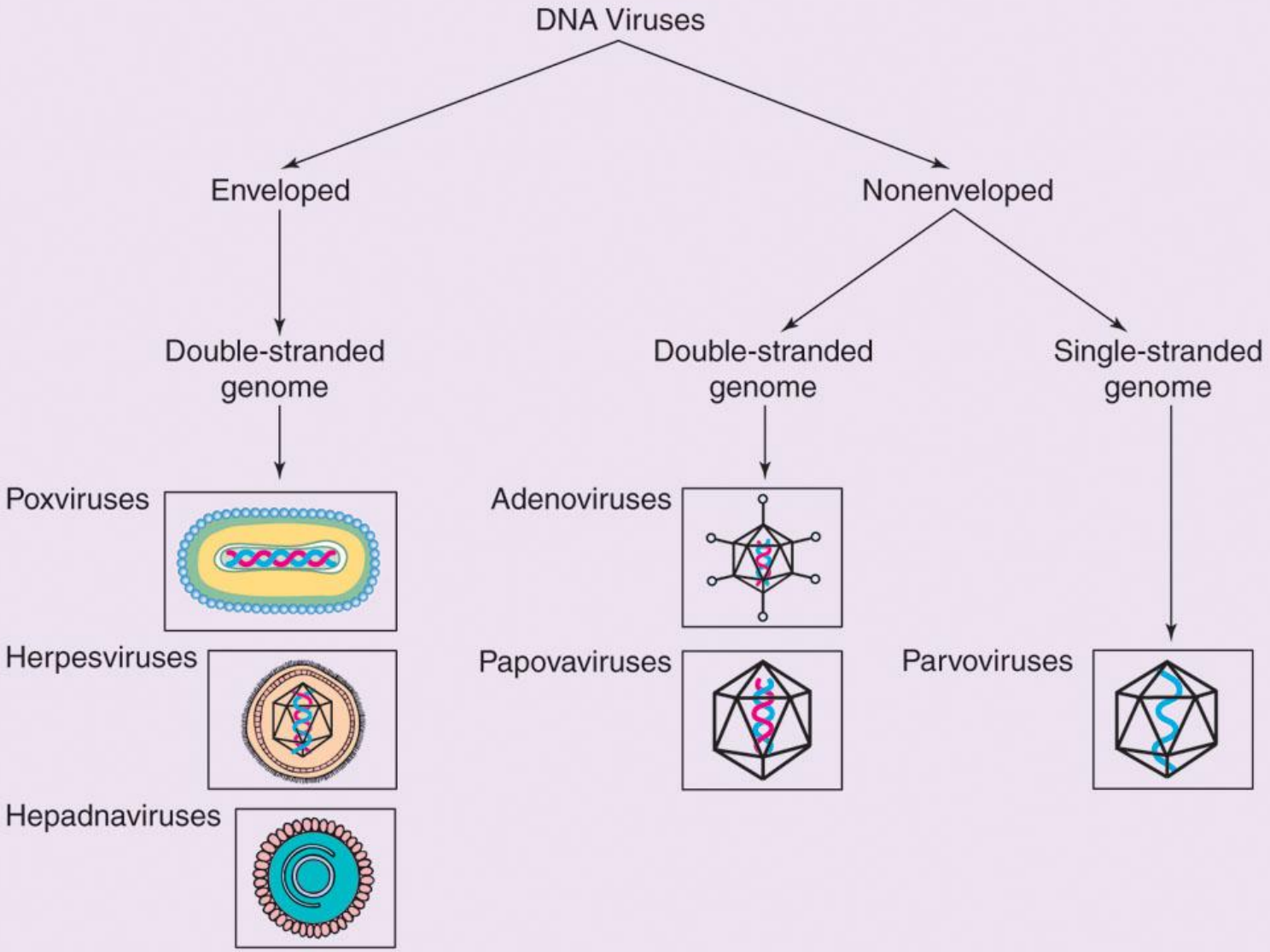
- obligate parasites
- infect animals, plants, & other microbes
- All DNA viruses are double-stranded except for parvoviruses, which have ssDNA.
- All RNA viruses are single-stranded except for dsRNA reoviruses.
- Viruses are limited to a particular host or cell type.

viruses

- Most DNA viruses are budded off the nucleus.
- Most RNA viruses multiply in & are released from the cytoplasm.
- Viral infections range from very mild to life-threatening.
- Many viruses are strictly human in origin, others are zoonoses transmitted by vectors.
- Most DNA & a few RNA viruses can become permanent resident of the host cell.
- Several viruses can cross the placenta & cause developmental disturbances.

TABLE 24.1

DNA Virus Groups



Poxviruses

- produce eruptive skin pustules called pocks or pox, that leave scars
- largest & most complex animal viruses
- have the largest genome of all viruses
- dsDNA
- multiply in cytoplasm in factory areas
  - Variola – cause of smallpox
  - Vaccinia – closely related virus used in vaccines
  - Monkeypox
  - Cowpox

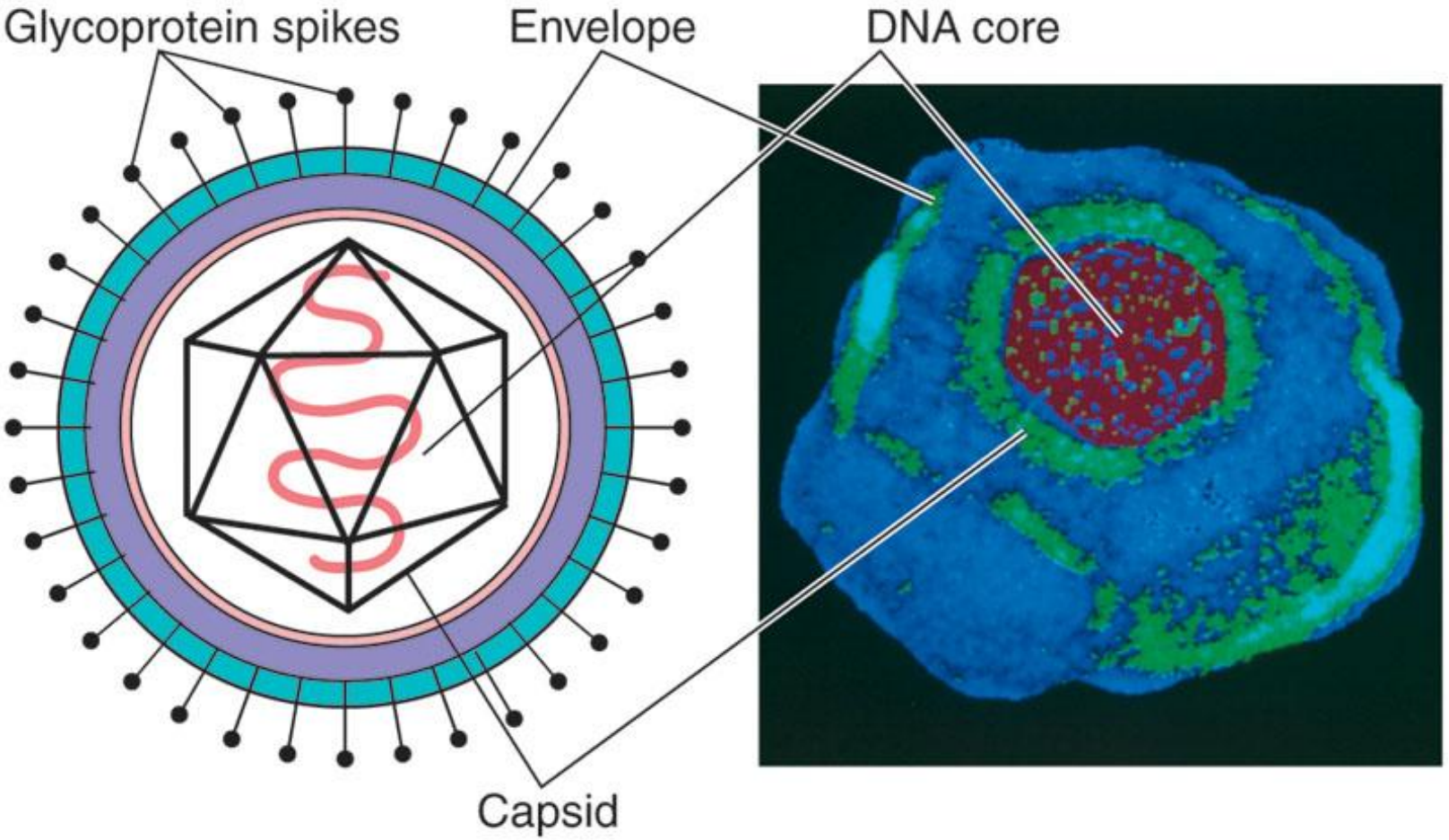
Smallpox

- first disease to be eliminated by vaccination
- exposure through inhalation or skin contact
- infection associated with fever, malaise, prostration, & a rash
  - Variola major – highly virulent, caused toxemia, shock, & intravascular coagulation
  - Variola minor –less virulent
- routine vaccination ended in US in 1972
- vaccine reintroduced in 2002

Herpesviridae

- large enveloped icosahedra dsDNA
- replication within nucleus
- large family; 8 infect humans
  - HSV-1
  - HSV-2
  - VZV
  - CMV
  - EBV
  - HHV-6
  - HHV-7
  - HHV-8

Herpesviruses



Herpesviridae

- latency & recurrent infections
- complications of latency & recurrent infections become more severe with age, cancer chemotherapy, etc
- most common & serious opportunists among AIDS patients

Herpes Simplex Virus (HSV)

- **HSV-1** lesions on the oropharynx, cold sores, fever blisters
  - occurs in early childhood
- **HSV-2** lesions on the genitalia
  - occurs in ages 14-29
  - can be spread without visible lesions
- humans only reservoir
- treatment: acyclovir, famciclovir, valacyclovir

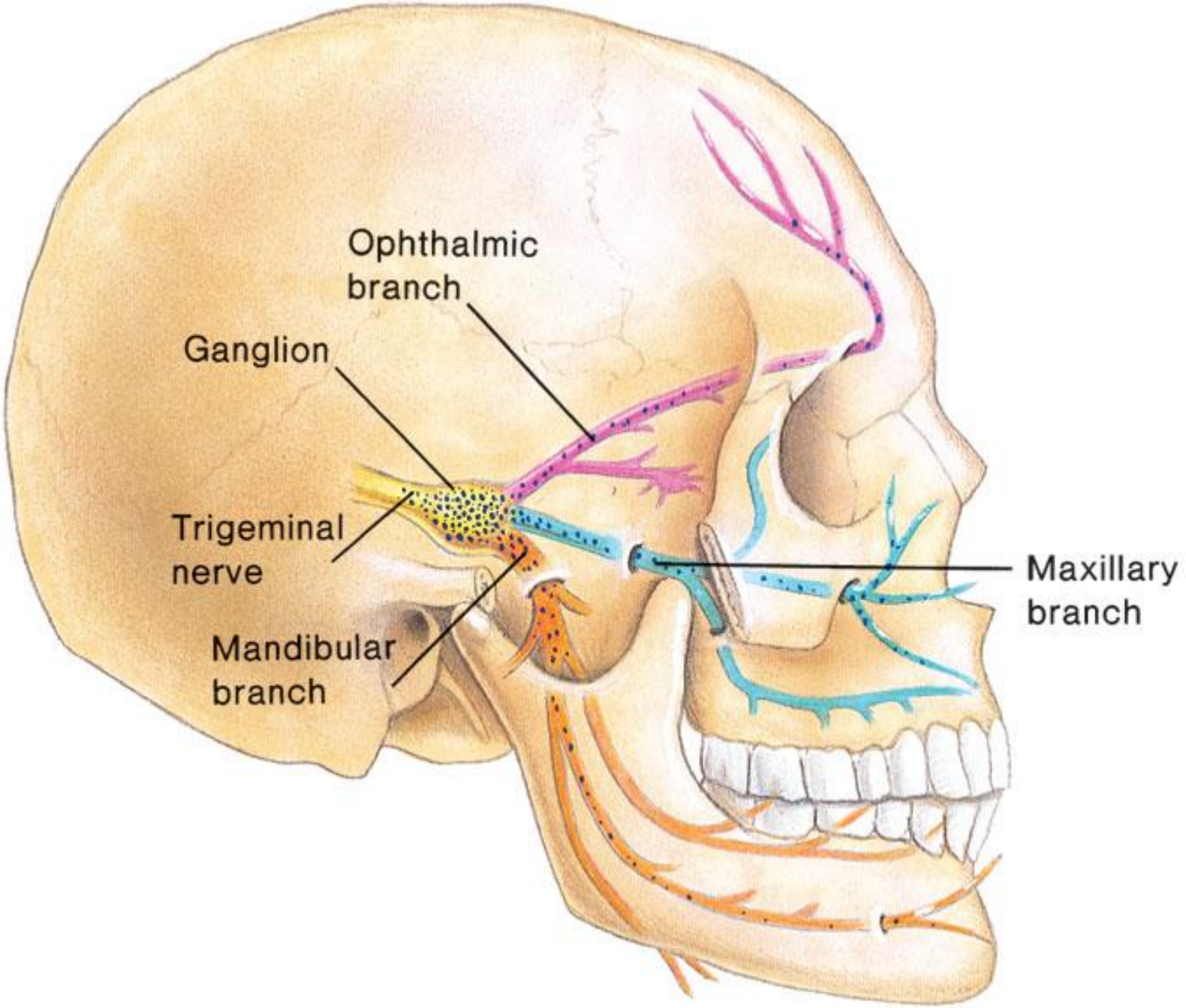
TABLE 24.2

Comparative Epidemiology and Pathology of Herpes Simplex, Types 1 and 2

	HSV-1	HSV-2
Usual Etiologic Agent of:	Herpes labialis Ocular herpes Gingivostomatitis Pharyngitis	Herpes genitalis*
Transmission	Close contact, usually of face	Sexual or close contact
Latency	Occurs in trigeminal ganglion	Occurs primarily in sacral ganglia
Skin Lesions	On face, mouth	On internal, external genitalia, thighs, buttocks
Complications		
Whitlows	Among personnel working on oral cavity	Among obstetric, gynecological personnel
Neonatal encephalitis	Causes up to 30% of cases**	Causes most cases

**The other herpes simplex type can be involved in this infection, though not as commonly.*

***Due to mothers infected genitally by HSV-1 or contamination of the neonate by oral lesions.*



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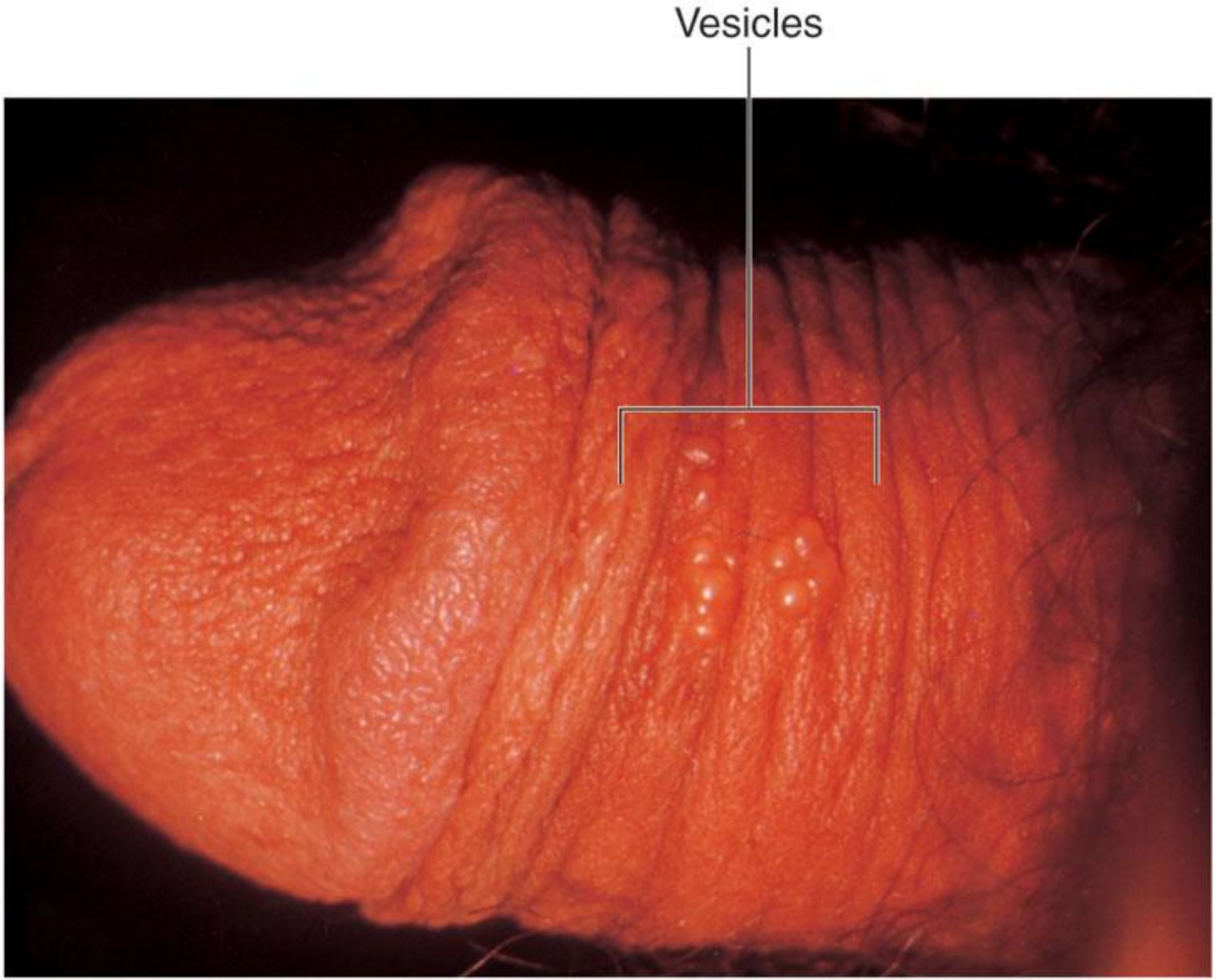
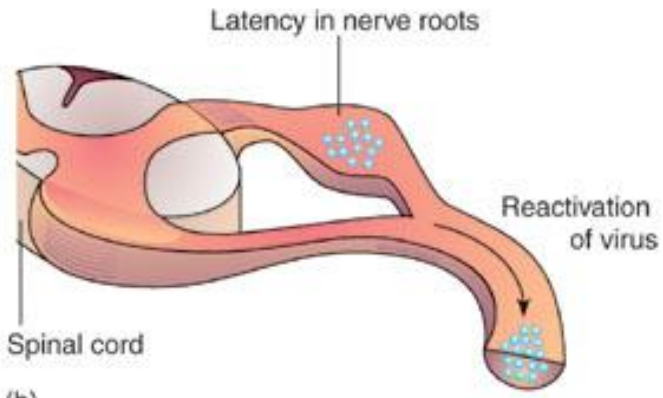


Varicella-Zoster Virus (VZV)

- causes chickenpox & shingles
- transmitted by respiratory droplets & contact
- primary infection – chickenpox – vesicles
- virus enters neurons & remains latent
- later, reactivation of the virus results in shingles with vesicles localized to distinctive areas, dermatomes
- treatment : acyclovir, famciclovir, interferon
- live attenuated vaccine

(a)



(b)

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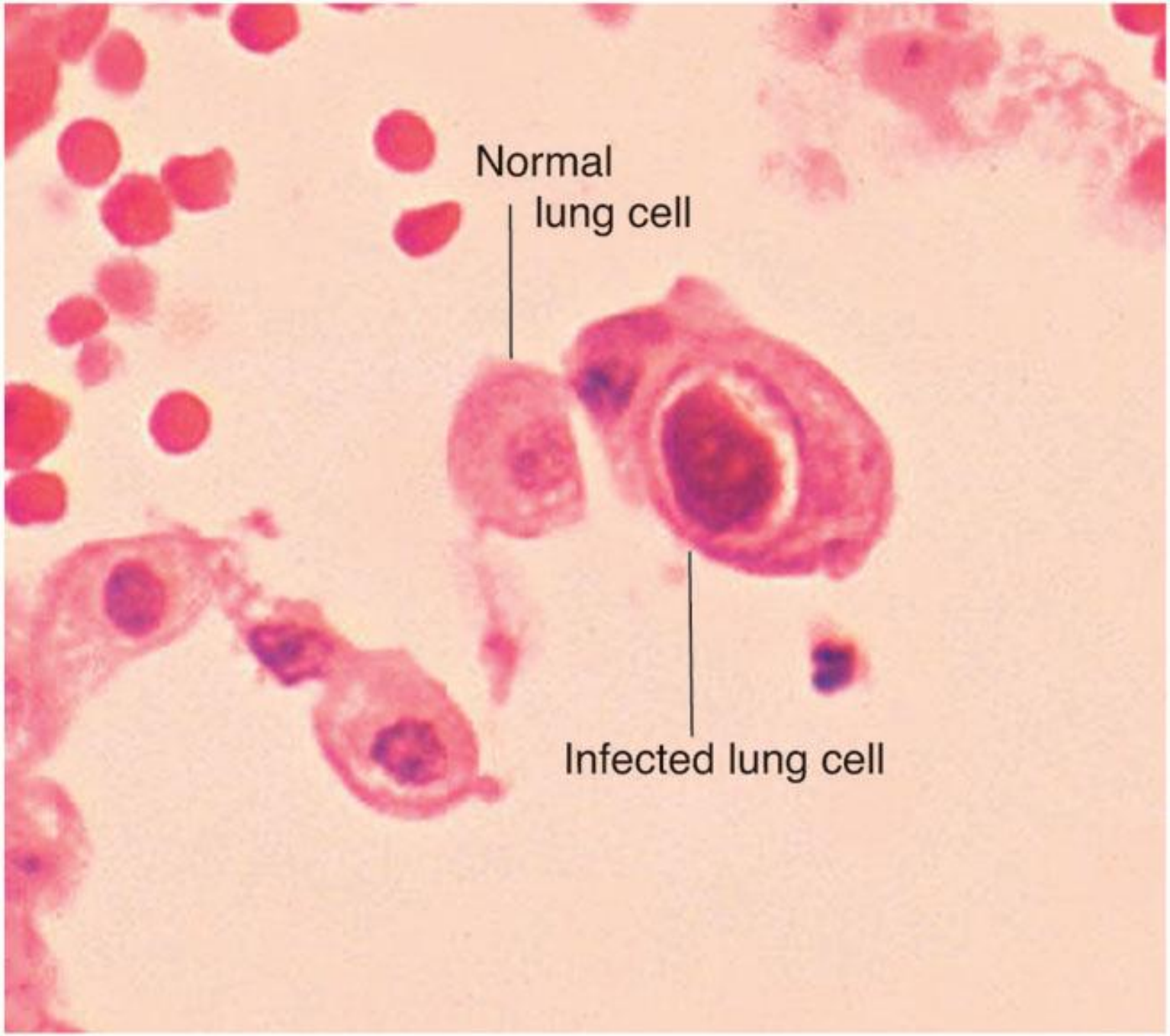
Cytomegalovirus (CMV)

- produce giant cells with nuclear & cytoplasmic inclusions
- transmitted in saliva, respiratory mucus, milk, urine, semen, cervical secretions & feces
- commonly latent in various tissues
- most infections are asymptomatic
- 3 groups develop a more virulent form of disease: fetuses, newborns, immunodeficient adults

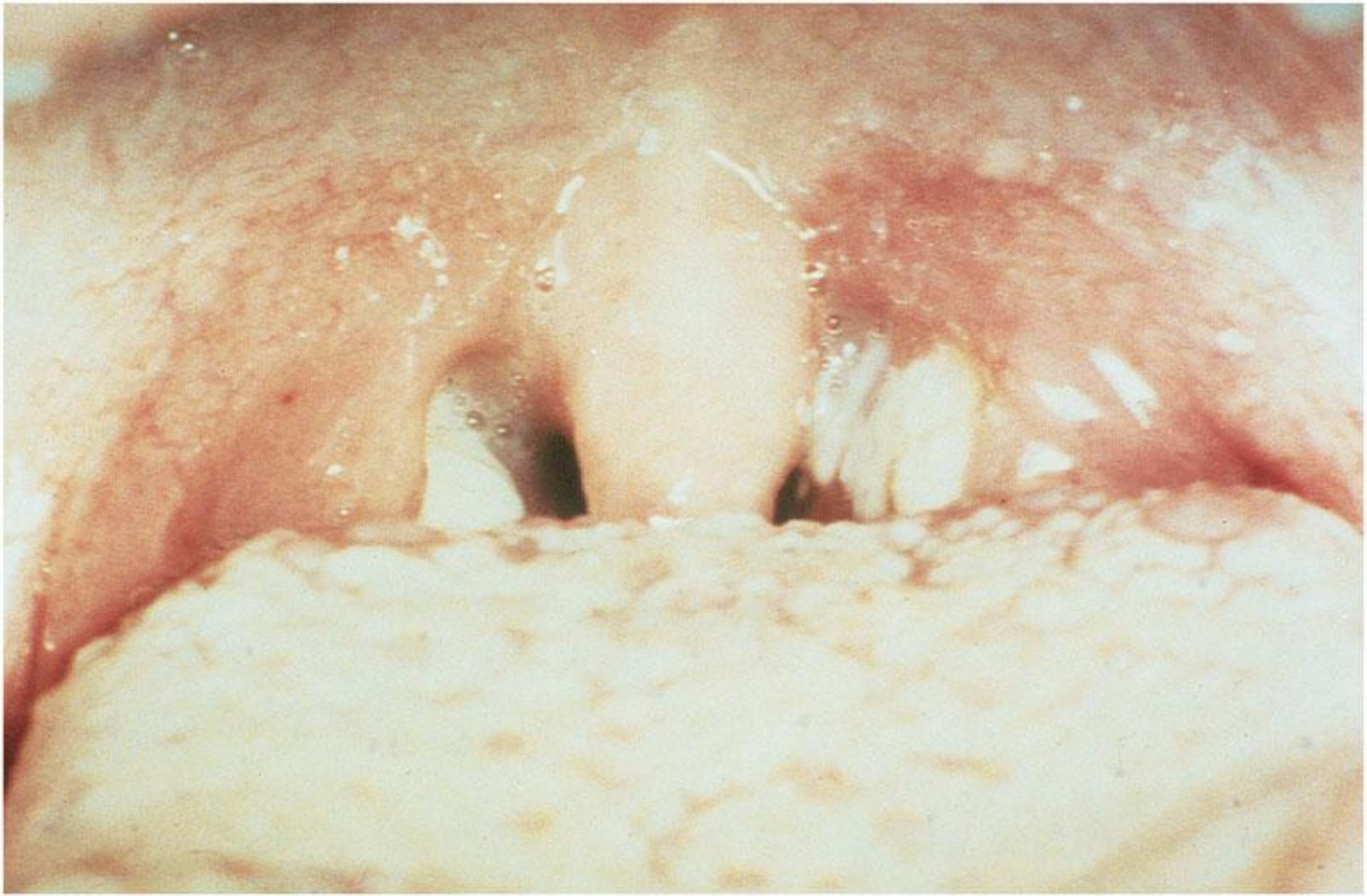


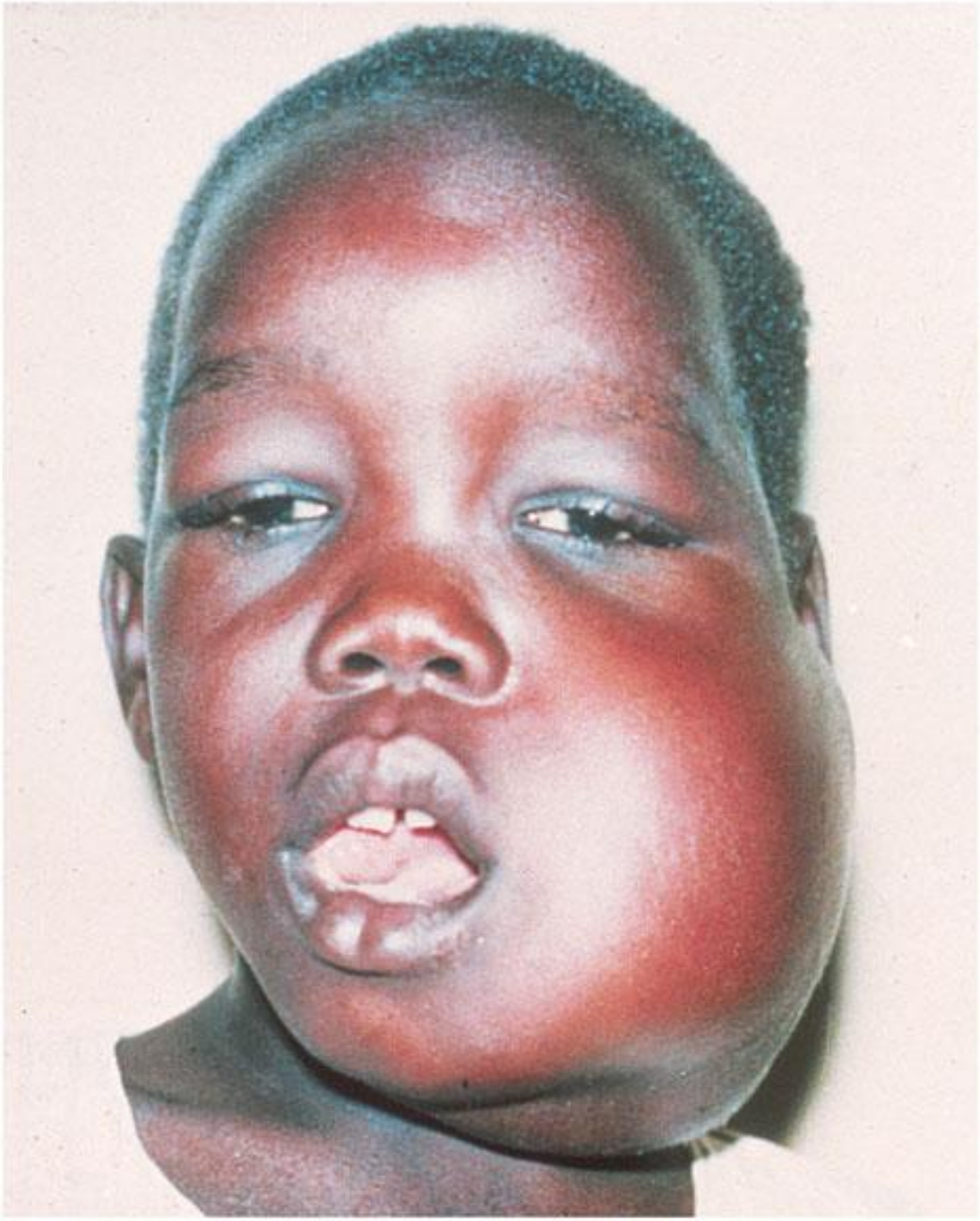
CMV

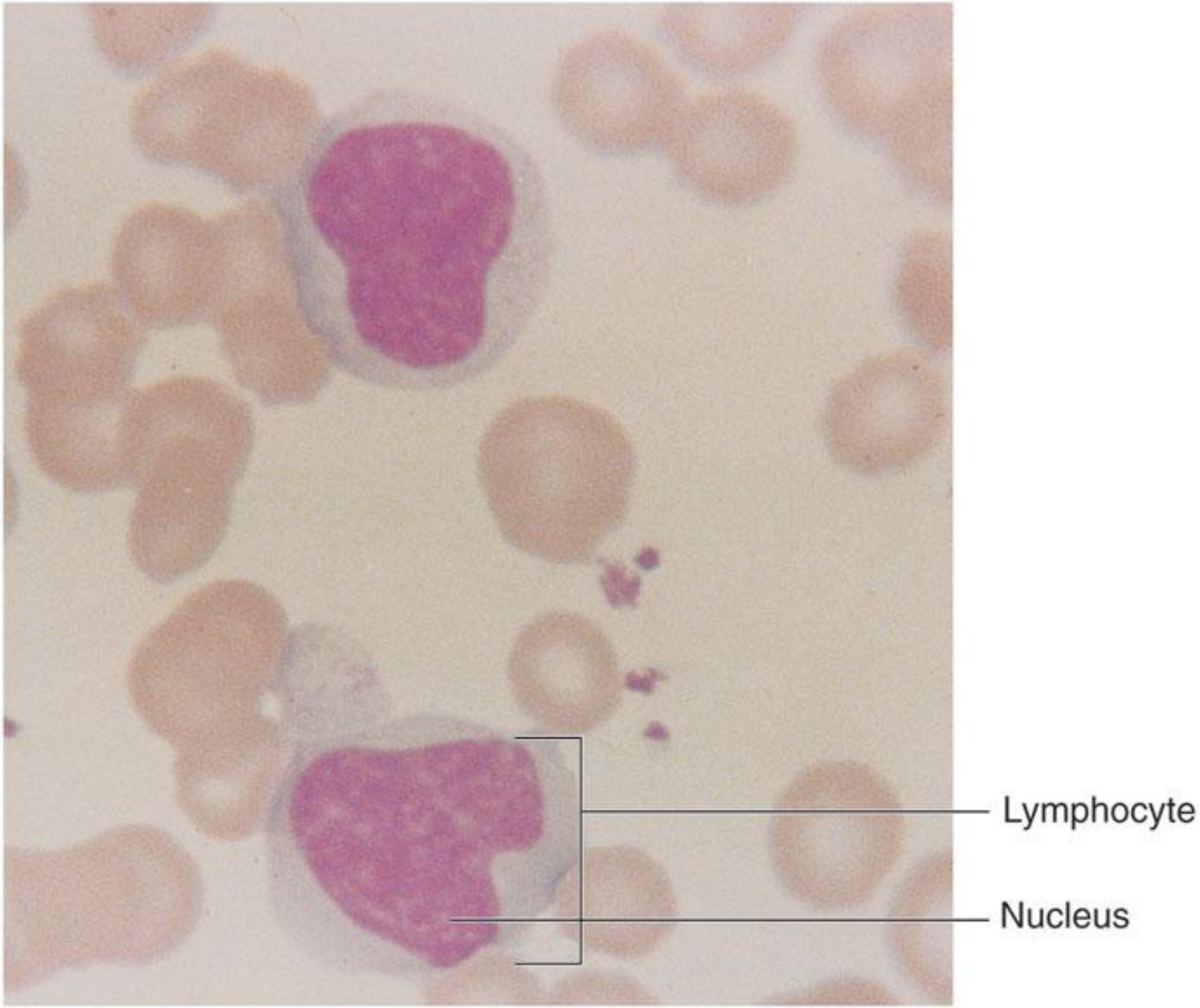
- newborns may exhibit enlarged liver & spleen, jaundice, capillary bleeding microcephaly, & ocular inflammation, may be fatal
  - Babies who survive develop neurological sequelae; hearing, visual disturbances & mental retardation
- perinatal CMV infection – mostly asymptomatic, or pneumonitis, & a mononucleosis-like syndrome
- AIDS patients – CMV mononucleosis, disseminated CMV, retinitis,
- transplant patients - pneumonitis, hepatitis, myocarditis, meningoencephalitis
- treatment: ganciclovir, valvcyclovir, foscarnet

Epstein-Barr Virus (EBV)

- infects lymphoid tissue & salivary glands
- transmission – direct oral contact & contamination with saliva
- by mid-life 90-95% of all people are infected
- causes **mononucleosis** – sore throat, high fever, cervical lymphadenopathy
- 30-50 day incubation
- most cases asymptomatic
- **Burkitt's lymphoma** associated with chronic coninfections with malaria, etc
- **nasopharyngeal carcinoma** in Chinese & African men







Human Herpes Virus 6 (HHV-6)

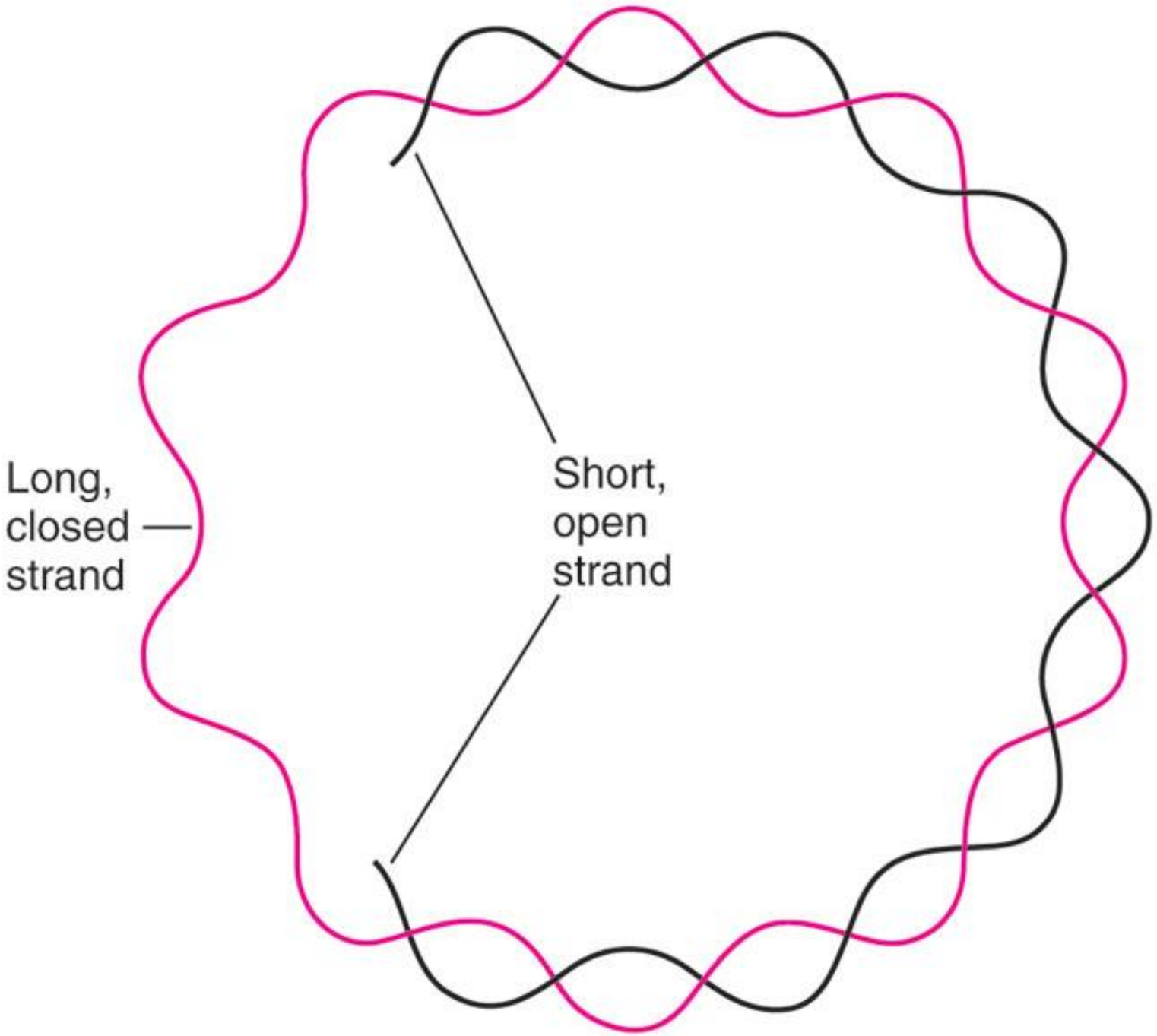
- T-lymphotropic virus
- transmitted by close contact
- very common –95% prevalent
- causes roseola, an acute febrile disease in babies 2-12 months
- begins with fever, followed by a faint maculopapular rash
- usually self-limited
- adults may get mono-like symptoms, lymphadenopathy, hepatitis
- over 70% of MS patients show signs of infection
- can cause encephalitis, cancer

- **HHV-7** is closely related to HHV-6 causes similar diseases

- **Kaposi's sarcoma**-associated virus or **HHV-8** is linked with common tumor of AIDS patients, also may be involved in multiple myeloma

Hepadnaviruses

- enveloped DNA viruses
- never been grown in tissue culture
- unusual genome containing both double & single stranded DNA
- tropism for liver
- **Hepatitis B** virus causes hepatitis & can be a factor in liver cancer
- other members cause hepatitis in woodchucks, ground squirrels, & Peking ducks



Viral hepatitis

- hepatitis – an inflammatory disease of liver cells that may result from several viruses
- interferes with liver's excretion of bile pigments, bilirubin accumulates in blood & tissues causing jaundice, a yellow tinge in skin & eyes
- caused by 3 principal viruses

TABLE 24.3

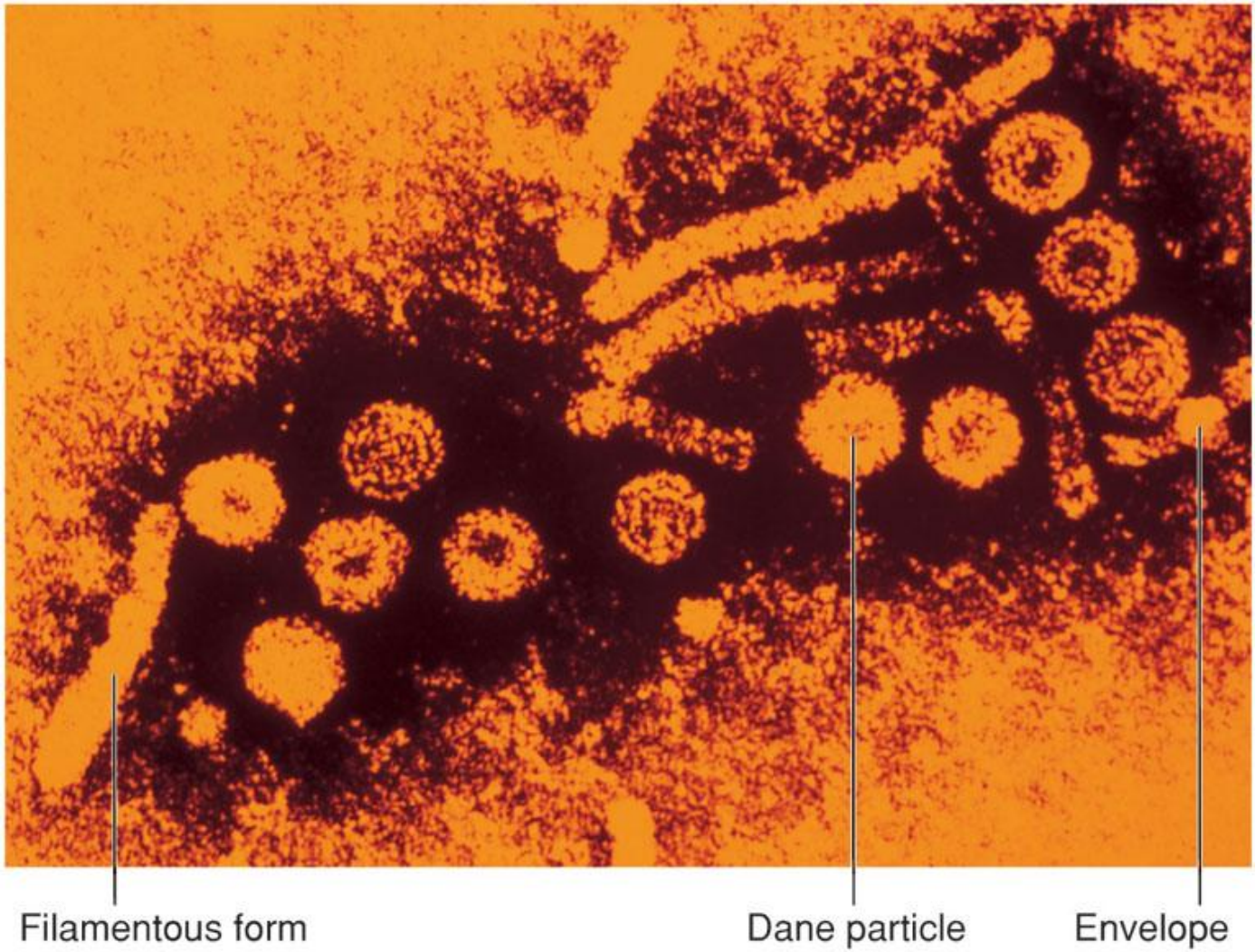
Principal Morphological and Pathologic Features of the Major Hepatitis Viruses

Property/Diseases	HAV	HBV	HCV
Biology			
Nucleic acid	RNA	DNA	RNA
Size	27 nm	42 nm	Various
Protein coat	−	+	+
Cell culture	+	−	−
Envelope	−	+	+
Synonyms	Infectious hepatitis, yellow jaundice	Serum hepatitis	Post-transfusional hepatitis
Epidemiology	Endemic and epidemic	Endemic	Endemic
Reservoir	Active infections	Chronic carrier	Chronic carrier
Transmission	Oral-fecal; water- or food-borne	Overt inoculation from blood, serum; close contact	Inoculation from blood, serum; intimate contact
Incubation Period	2–7 weeks	1–6 months	2–8 weeks
Symptoms	Fever, GI tract disorder	Fever, rash, arthritis	Similar to HBV
Jaundice	1 in 10	Common	Common
Onset/Duration	Acute, short	Gradual, chronic	Acute to chronic
Complications	Uncommon	Chronic active hepatitis, hepatic cancer	Chronic inflammation, cirrhosis
Availability of Vaccine	+	+	−
Diagnostic Tests to Differentiate	+	+	+

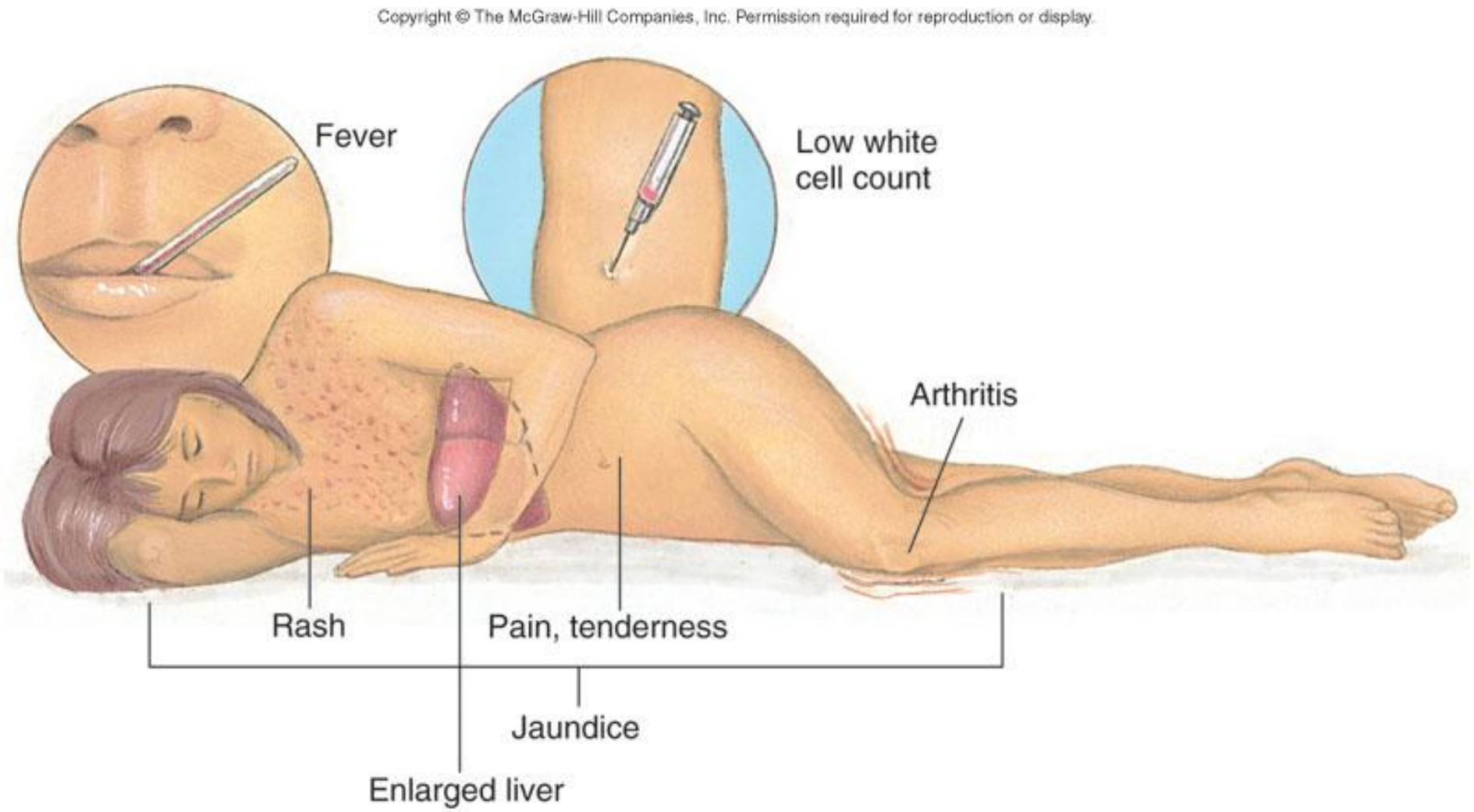
Hepatitis B virus

- multiplies exclusively in the liver, which continuously seeds blood with viruses
- 10^7 virions/mL blood
- minute amounts of blood can transmit infection
- sexually transmitted
- high incidence among homosexuals & drug addicts
- can become a chronic infection
- increases risk of liver cancer

HBV



HBV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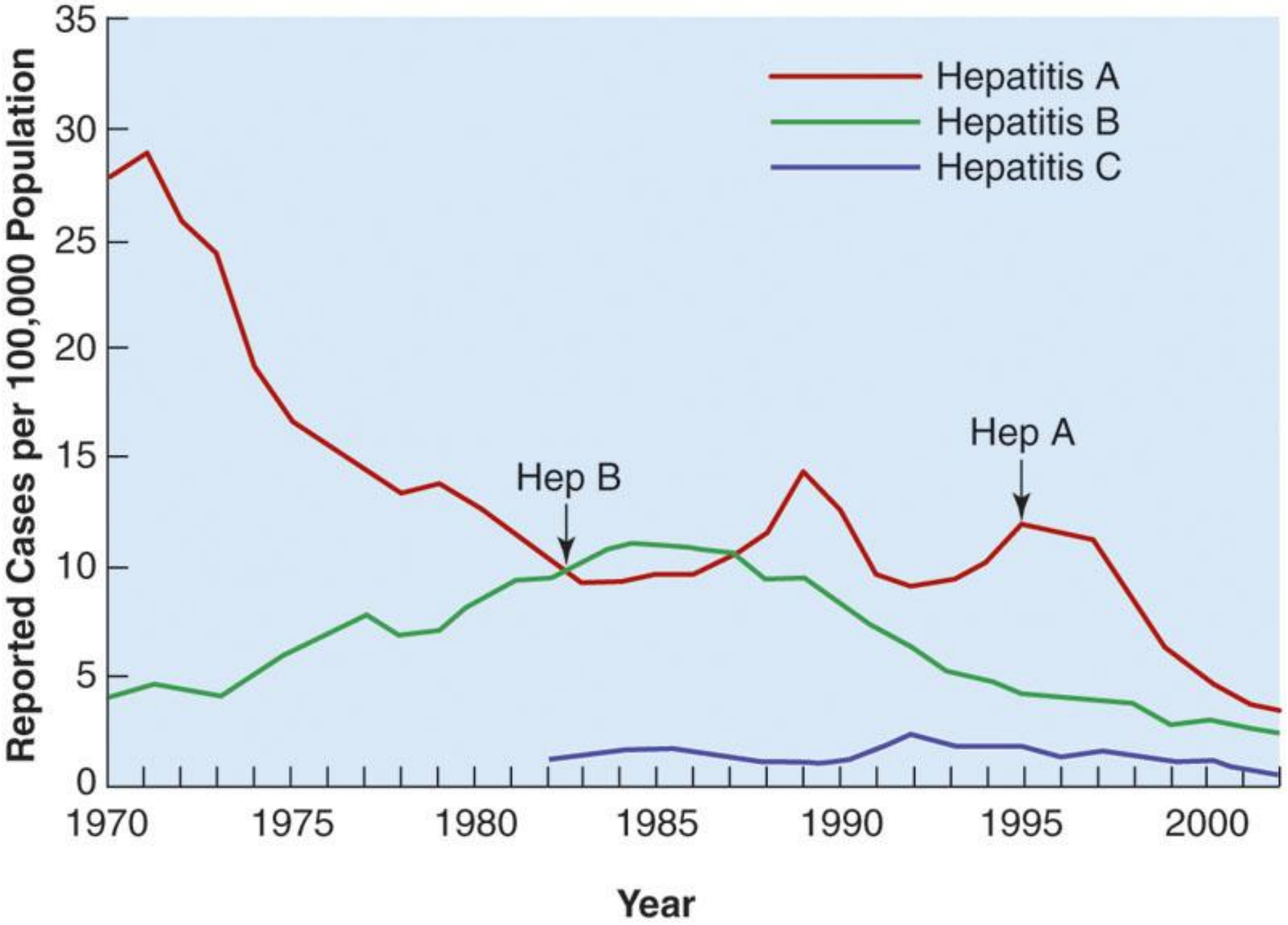
Fever
Low white cell count
Arthritis
Rash
Pain, tenderness
Jaundice
Enlarged liver

Hepatitis B virus

- chronic infection controlled with interferon
- HB immune globulin protects exposed people
- HBV vaccine – recombinant surface antigen made by yeast; given in 3 doses over 18 months



Papovaviruses

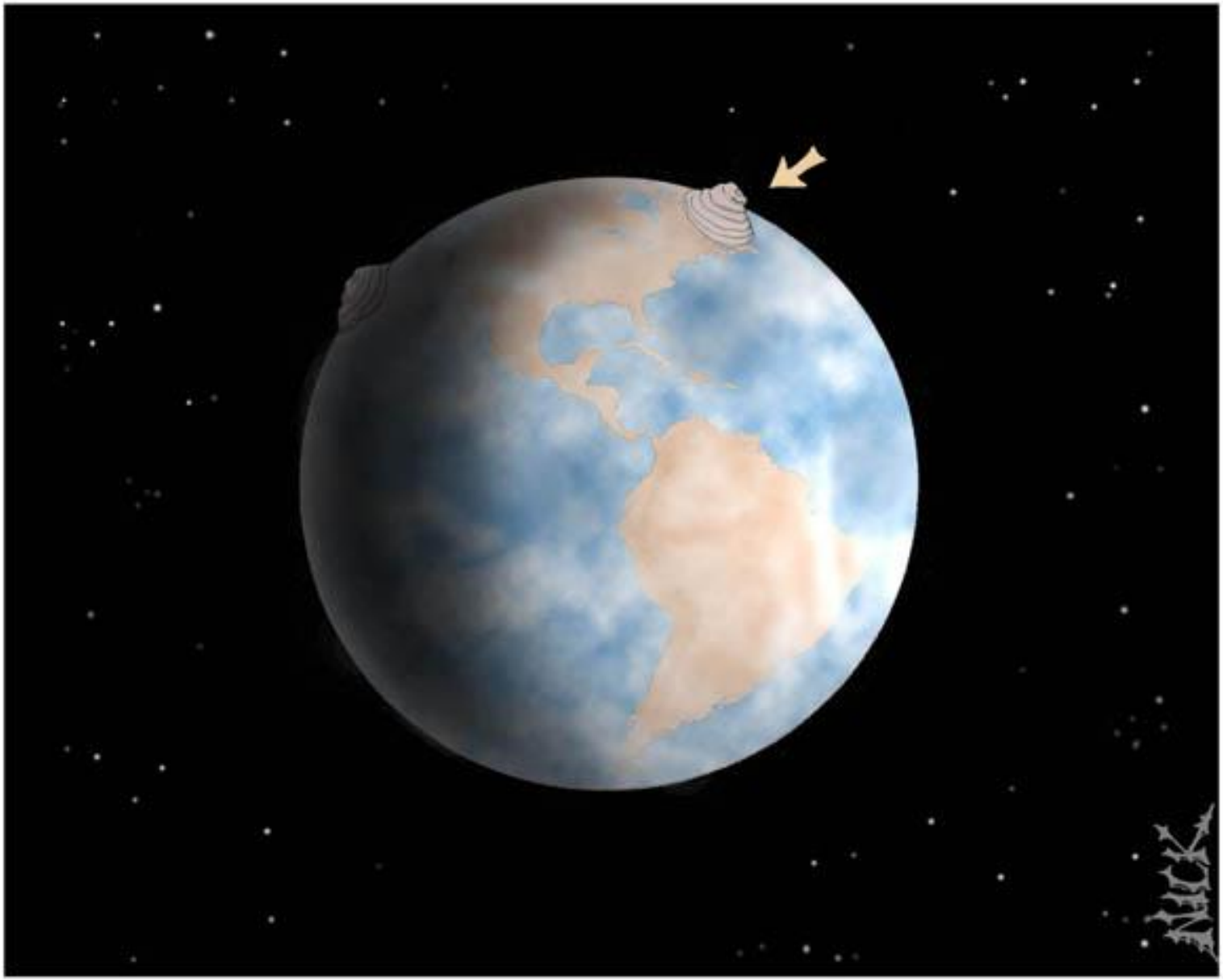
- **Pa**pillomavirus
- **Po**lyomavirus
- Simian **va**cuolating virus
- 2 subtypes
  - Papillomavirus
  - Polyomavirus
- small nonenveloped icosahedra dsDNA

Papillomavirus

- papilloma – benign, squamous epithelial growth, wart
  - Neuraminidase (NA) – hydrolyzes mucus & assists viral budding & release
- caused by 40 different strains of **HPV**
- common seed warts – on fingers, etc
- plantar warts – on soles of feet
- genital warts – prevalent STD
- transmissible through direct contact or contaminated fomites
- Incubation – 2 weeks – more than a year

(a)

(b)



The Second World Wart.

Genital warts

- most common STD in US
- over 6 M new cases each year
- 30 M carriers of one of the 5 types of **HPV** associated with genital warts
- strong association with cervical & penile cancer – type 16 & 18
- podophyllin chemical treatment, cauterization, freezing, laser surgery, immunotherapy

Polyomaviruses

- induce tumors
- JC & BK viruses
- common throughout the world
- majority of infections are asymptomatic or mild
- not much is known
- BK infection in renal transplants causes complications in urinary function
- Progressive multifocal leukoencephalopathy (PML) is an uncommon fatal infection by JC

"Doorknob OK?"