- low birth weight babies/ adult with suppressed cell mediated immunity (AIDS) often exposure to bird/bat droppings or certain soils
- cause: cryptococcus neoformans and coccidioides immitis
- crypt. neof.
    - slow development - days or weeks
    - capsulated yeast visible in CSF stained with india ink ad can be cultured.
    - treatment - long course high dose intravenous anti fungals
        - e.g. amphotericin B and flucytosine combination

CNS 2

protozoal meningitis/encephalitis
- very rare rapid onset, usually fatal.
- cause of primary amoebic menigocephalits
- free living amoeba lives in stagnant freshwater and lakes
- enters nose usually during swimming then travels to meninges
    - Route of infection -> nasal passages -> olfactory tract -> meningitis
- naegleria amoeba can infect healthy individuals
- drug treatment for protozoal meningitis sometimes available
- but rarely successful

acanthamoeba and balamuthia spp.
- these are widespread in environment
- enter host through skin or respiratory tract
- only infect immunocompromised and cause chronic CNS condition = Granulomas Amoebic Encephalitis
- usually not visible in CSF samples, but can be seen in brain biopsies
- drug treatment not successful
- rare/fatal

viral meningitis
- most common cause
- milder disease than bacterial
- symptoms include headaches fever photophobia
- seasonal disease, mainly enterovirus group (polio, coxsackie, echo)
- CSF for viral ('aseptic')
    - high lymphocytes (T cells)
    - high monocytes
    - moderately high protein
    - normal glucose
    - clear and no bacterial growth
- PCR specific for each virus = diagnosis - amplifies DNA or RNA
- few antiviral drugs, usually recover w/o

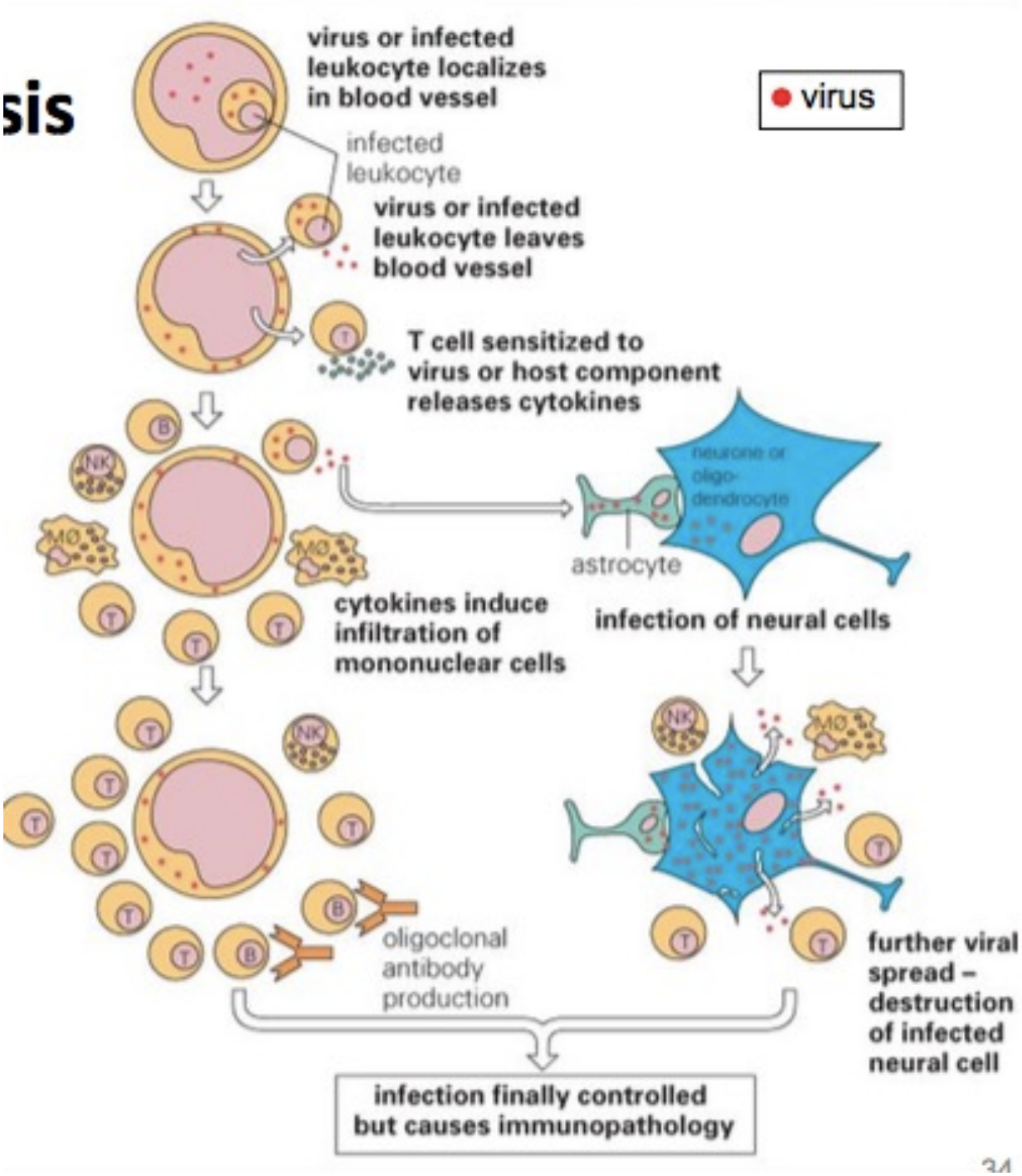
CNS diseases that infect brain
- encephalitis = inflammation of brain
- encephalopathy = disease or disorder of brain
- parasitic brain infection
- brain abscess
- bacterial toxins

encephalitis
- caused mainly by viruses
- also caused by others

viral enceph.
- substance of brain infected with virus, not just lining (such as in meningitis)
- patents show abnormal behaviour seizures, altered consciousness, nausea, vomiting fever
- caused by viruses such as
    - herpes
    - enterovirus (polio)

    - paramyxoviruses (mumps)
    - rhabdoviruses (rabies)
    - arboviruses
    - retrovirus (HIV)
- general pathogenesis:

- clinical features
    - fever, headache seizure
    - signs of meningitis (stiff neck, photophobia)
    - altered conscious state
    - focal neurological signs - depending on where virus is located
        - e.g. loss muscle control, aphasia
- management
    - exclude other causes for symptoms
    - HSV therapy (acyclovir eg zovirax) before identification
        - this is effective for HSV viruses
    - supported by restricting fluid to lower pressure in brain, using anti-seizure medication and ventilation



ENCEPHALITIS: HERPES SIMPLEX VIRUS

- most common cause
- remains latent in dorsal root ganglion and reactivated by stress/illness
    - dorsal root ganglion -> travel up nerves to CNS -> encephalitis
- neonates can get during delivery if mother has active lesions
- disease usually caused by HSV1
    - common cold sore
    - usually virus reactivation in trigeminal ganglia
    - vary rare that HSV encephalitis is primary infections
- 50% of HSV encephalitis occurs in people over 50
- skin or mucosal active lesions may/may not be present
- infects temporal lobe - speech, understanding
- diagnosis
    - CSF increased lymphocytes, red blood cells
    - imaging: CT EEG MRI of temp lobe
    - PCR on CSF
- treatment - acyclovir before diagnoisis.
- untreated - very high mort. rate (70%), if survive have severe complications

ENCEPHALITIS: ENTEROVIRUS

poliovirus

- common cause before vaccine
- rare now
- 1-4 days fever, sore throat, meningeal symptoms then encephalitis affecting motor neurons, paralysis
- three serotypes - most common serotype 1

enterovirus 71

- cause outbreaks of hand foot mouth disease (location of lesions)
- mild disease in young children - affect immunocompromised
- outbrain in taiwan 1998 - 405 patients, most under 5
- complications rare but sever cases brainstem involvement wiht poss. permanent damage
- no vaccine

ENCEPHALITIS: PARAMYXOVIRUS

mumps virus

- 10% mumps cases, 10 days after parotitis (inflammation of salivary gland)
- may also cause enceph. usually complete recovery but rarely deafness may occur
- asymptomatic invasion of CSF- increased white cell count in CSF
- can occur without parotitis
- vaccine available part of MMR vaccine

Nipah virus

- zoonotic, aerosol from pigs
- infection from ingesting palm sap and human-human transmission
- 1998 in malaysia lots died inc. pigs
- likely reservoir: fruit bats, pigs eat droppings
- related to hendra virus

Hendra virus

- 39 outbreaks in QLD/NSW lots horses dead
- transmission from horses to humans - not often
- bats reservoir
- vaccine for horses

ENCEPHALITIS: RHABDOVIRUS

Rabies virus

- infected saliva of dogs, fox, skunk, raccoons, bats but can infect all warm blooded animals
- disease course varies depending on host but almost always fatal
- one human death every 15 min
- dogs may have virus in saliva before symptoms
- tranmission to humans via bite
- unvaccinated dogs = cause of transmission - much less since vaccination
- AUS and UK exclude by quarantine
- clinical features:
  - slow incubation 4-13 weeks to 6 months
  - delay as virus travels up peripheral nerves -> CNS -> Enceph.
  - no immunological response can be detected
    - can possibly immunise infected patients post-exposure with human rabies immunoglobulin as well as give rabies vaccine to induce active immunity
  - if untreated, goes to brain, spread cell to cell with few cytopathic effects
  - dysfunction of limbic system, behaviour aggressive
  - goes to rest of body - salivary glands
  - sore throat, headache, fever, muscle convulsions, death by cardiac or respiratory arrest
  - rarely survive untreated
- diagnosis:
  - tests using saliva, serum, spinal fluid, skin biopsy of nape of neck
  - detect viral antigen using immunoflourescance
  - detect antbiodies
  - detect viral RNA in saliva by reverse transcriptase PCR
  - post mortem:
- prevention and treatment:
  - rabies vaccination
  - if bitten, clean wound determine if biting animal is rabid
  - administer human rabies immunoglobulin - passive immunity
  - administer vaccine (killed virus) - active immunity

ENCEPHALITIS: RHABDOVIRUS

Australian Bat Lyssavirus

- very similar to rabies
- zoonotic
- early symptoms = flu like,
- 3 human cases recorded
  - 1996 - woman bitten trying to remove fox from child. 2 years later died
  - 1996 - animal carer bitten by bat died within 8 weeks
  - 2013 - boy died, bitten or scratched
- prevention
  - avoid handling bats
- treatment: same as for rabies, rabies immunoglobulin and vaccine

ENCEPHALITIS: ARBOVIRUS

- mosquito vector, vertebrate reservoir (birds)
- outbreaks can be controlled by protective clothing, insect repellant and mosquito eradication
- flaviviridae viruses
  - zikka: uganda
  - west nile (temp/trop) regions
  - dengue
  - murray valley
- togaviridae family - ross river and barmah, japanese encephalitis