Arterial Blood Flow to CNS

approximately ____ % of what goes wrong within the skull that produces neurological deficits is vascular related

why so important?

Blood Flow to Spinal cord

suppose there's an occlusion of anterior spinal artery in mid-cervical region - “______________ syndrome”

Effects:
1) loss of ______________________ sensation below lesion
2) _____________ paralysis at level of injury
3) _____________ paralysis below level of injury
Blood Flow to Brain

*ophthalmic artery* (OA)
*anterior choroidal artery* (AChrA)
*posterior communicating artery* (PCommA)
*anterior cerebral artery* (ACA)
*middle cerebral artery* (MCA)
*anterior communicating artery* (ACommA)

anterior (ASpA) and posterior (PSpA) spinal arteries
*posterior inferior cerebellar artery* (PICA)
*basilar artery* (BA)
*anterior inferior cerebellar artery* (AICA) and
*superior cerebellar artery* (SCA)
*posterior cerebral artery* (PCA)
Blood Flow to Brain

problems

primary effect of neurovascular problem:
reduction of blood to a specific region of the brain

normal perfusion of brain: 55 ml / 100 grams tissue / min

reduced perfusion of 20 ml / 100 gm / min: neurons can survive for a time, but have difficulty firing impulses

perfusion of 10 ml / 100 gm / min for more than five minutes results in cell death and necrosis of affected region

- core
- penumbra

stroke

4th leading cause of deaths  135,000 deaths / year (US)
second leading cause of adult disability
795,000 strokes in US (610,00 first; 185,000 second or more)
7,000,000 stroke survivors in US

kinds of strokes

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Blood Flow to Brain bleeding strokes

location of bleeding

1) extracerebral
can be named in relation to layer of meninges that cover brain

epidural hemorrhage (lens-shaped)

subdural hemorrhage (crescent-shaped)

subarachnoid hemorrhage

MRI scan of head side view

MRI scan of head top view

MRI scan of head front view

2) intracerebral
in brain ventricles in brain tissue itself

drawing of skull, meninges and brain
some causes of hemorrhagic strokes

1) arteriovenous malformation  congenital malformation
tangled nest of blood vessels between arteries and veins in a region
dangerous
1) “steal” blood
2) fragile

2) tear in an artery or a vein
outpocketing of wall in an artery
an example: aneurysms

often where arteries branch
more common toward front of brain
potential of rupturing
Blood Flow to Brain problems

ischemic strokes

some causes

1) arterial blood pressure is too low

2) blockage of blood vessel

thrombotic

a) thrombus (blood clot) forms around plaque in a blood vessel

b) due to constriction of artery

c) inflammation of vessel wall
some causes

2) blockage of blood vessel

by an embolism - material travels to an artery, lodges in its lumen and limits blood flow

material - clump of bacterial cells, cancer cells, air, bone marrow fat from a broken bone
- most commonly, a blood clot

blood clots for embolic strokes can originate anywhere in the cardiovascular system; most originate in the heart

heart attacks, congestive heart failure, heart surgery

heart valve problems, atrial fibrillation

ischemic strokes may be preceded by one or more TIAs (transient ischemic attack)

a stroke-like event duration of minutes or hours

a warning that an ischemic stroke may be in the offing
reestablish blood flow
  limit brain damage, reduce area of penumbra improve clinical outcome

in some cases, there is reperfusion injury

  leukocytes activated
    inflammation
    oxidative damage
    platelet and complement activation
    secondary ischemia
    breakdown of blood brain barrier
    hyperfusion and brain edema
Meninges

a major contribution

layers

dura mater
  - outermost layer
  - tough, fibrous tissue
  - outer layer associated with the periosteum
  - inner layer associated with arachnoid
  - at places, inner and outer layers split and form dural venous sinuses
  - dural reflections (dural septa)

sensation

blood supply

arachnoid

pia mater

very thin membrane located directly on the surface of the brain and spinal cord
follows contours and extends down into sulci
covers small vessels that lie on the brain’s surface

pia arachnoid

dural sinus

dura
arachnoid
subarachnoid space
pia

brain

from figure 4-6
Meninges
hemorrhage in and around dura
in potential spaces

epidural hematoma
meningeal artery damage
venous sinus damage

subdural hematoma
vein damage

figure 4-14

figure 4-16
Blood-Brain Barrier
components and structures

outside the CNS

extracerebral capillary

arachnoid cells

choroidal capillary in subarachnoid space

pial cells
ependymal cells

CNS tissue

ventricles

intracerebral capillaries

glial cells

function

endothelial cell

blood

ion channels, pumps and transporters
circumventricular organs
fenestrated capillaries
contact with CSF
sensory function
secretory function

figure 6-29

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figure 6-30
Cerebrospinal Fluid

formation
in choroid plexus

composition
comparable to plasma ...
not an ultrafiltrate of plasma
cells
proteins

location
most
remainder

volume
150 ml

rate of production
350 microliters / minute

functions
support
cushioning

CNS weight:
CNS weigh in CSF:
extracellular environment
transport
Cerebrospinal Fluid circulation

lateral ventricle

third ventricle

fourth ventricle

openings lateral medial

central canal enters

reabsorption via arachnoid villi into venous sinuses

venous sinus

endothelial lining of sinus

dura

arachnoid

figure 4-12

CSF pressure venous pressure

figure 4-6
Venous Sinuses

circulation into venous sinuses

orbit

cavernous sinus

straight sinus

superior sagittal sinus

inferior sagittal sinus

transvers sinus

sigmoid sinus

internal jugular vein

meningitis inflammation

viral meningitis

common causative agents

bacterial meningitis

common causative agents

Streptococcus pneumoniae

Neisseria meningitidis

Haemophilus influenzae type b (Hib)

spinal tap

viral meningitis

bacterial meningitis

CSF appearance

cell count

protein content

glucose

pressure
meningitis

bacterial meningitis
treatment

fungal meningitis

(encephalitis)