Stroke → interrupted blood flow to the brain

- **Ischemic**: blocking of cerebral blood vessel → infarction (tissue death due to lack of blood flow)
  - atherosclerosis: accumulated lipid deposits in large cerebral/extracerebral
  - embolism: clot clog vessels (smaller) in the brain.
  - occlusion: occlusion of small cerebral vessels.
  - arterial dissection: tear.
- **Haemorrhage**: blood leakage
  - intracerebral → hypertension, (cause)
  - subarachnoid
    - epidural
    - subdural
    - subarachnoid

  } aneurysm / AVM (ballooning of blood vessel) → cause pressure
  - brain shift
  - increased pressure

Schizophrenia → onset in adolescence

Syndrome (obj):
- reduced hippocampal + surrounding
- thinning cortex + cingulum (connecting tracks) } fronto-hippocampal, fronto-temporal.
- reduced efficiency in info transmission

Symptom (subj):
- thought disorder, speech disorder
- auditory hallucinations
- passivity phenomenon (feel some factor is not under their control).

} white matter changes.
- changes in connectivity tract

Illness trajectory:
- white matter change
- reduction in corpus callosum
- CA1 reduction (onset) → all regions of hippocampus reduced
- reduction in brain networks integration.

Precision Psychiatry:
- prediction model
- bio understanding
- personalized treatment

Prosthetic
- cortical (brain)
- peripheral
  - motor (LMN)
  - sensory (sublesional implant)
- visceral
  - pelvic
  - tibial

} target control internal organs: anus, vagina, bladder

recording and stimulating
- each cell respond to a specific type of stimuli
- some cells → intention, others → execution
- even change working memory

electrical stimulation can

Diseases

Parkinson's Disease

Symptoms: Tremor, rigidity

Syndrome: many dopamine-producing neurons die (substantia nigra)
↓
overproduction of acetylcholine (in basal ganglia)
↓
impaired mobility

- early onset – genetic link
- damaged mitochondria
- exposure to toxins (MPTP)
- head injury

Treatment: L-Dopa (precursor to dopamine is injected)
- Deep Brain Stimulation (to quiet misfiring neurons)

MPTP toxin creates indistinguishable symptoms

LMN lesion – polio, ALS

Prion Diseases

TRANSMISSIBLE
- Kuru, CJD } humans.
- BSE (mad cow disease)
- Scrapie (in sheep and goat)

Cause: - acquired infection – diet, medical instruments
- genetic

Symptoms: - drunkish (have trouble standing up) → dementia
- no problem w/ movement, but with control
- increased aggression.
- have incubation time (diverse)

CJD – codon 129 (Met/Met most susceptible)
– mostly sporadic.

Kuru – transmission through cannibalism.

Prion (PrP)
- aggregated protein
- Protein only (no nucleus)
- unaffected by UV
- disease caused by misfolding of protein (more rich in β-sheets than α-helix)
  PrP^{sc} / PrP^{c}

↓ signalling protein

sporadic sCJD is age-related
vCJD targets younger

CJD strains differ by glycosylation
- # sites
- weight of carbs.

• FFI – codon 129 & 178
- FFI – Met (asparagine)
- fCJD – Val (asparagine)

BSE ⟷ (very similar variant) vCJD
↓
how did it jump from cow to human?
many similarity between human & cow PrP.

Diagnosing
- Immunohistochemistry: uses antibody that binds to PrP^{sc} (post-mortem)
- Immunoassay: uses enzyme that breaks PrP^{c} + marked antibody
- bioassay.

Alzheimer
- Amnesia
- Aphasia
- Apraxia
- Agnosia.

(most common dementia)

- Diff vs MCI (moderate cognitive impairment)
  only seen after the initial decline
- Down Syndrome (trisomy 21) has earlier onset of AD
- Memory affected:
- long-term (recent)

MCI: onset of dementia
- ↳ not severe enough yet to affect daily activity
- → most recent memory is lost
- ↳ does not always lead to dementia.

AD starts similar to MCI, but there is a rapid decline in memory, leading to aphasia or even anxious / aggressive → delusional personality change

Causes
- Gene: presenilin, Aβ, trisomy 21, ApoE4
- lifestyle unhealthy, stress, fatigue, sleep deprivation

Progression: hippocampus → cerebral cortex (shrinkage)
- shrinkage in ventricles,

cell level:
- insoluble deposits of Aβ plaque – damage synapse, block receptors
- tangles of tau proteins due to accumulation of phosphate groups – disintegration of microtubule

Diagnosis:
- lumbar puncture (whether SF contains Aβ)
- MRI (look for shrinkage)
- FDG-PET (glucose) or PIB-PET (tracer binds to Aβ)

Syndrome: death of cholinergic neurons.
↳ treatment:

Alzheimer didn't affect cerebellum.

Aging

factors: - education
- healthy lifestyle
- social occupational

- accumulated dead cells
- decrease in metabolism
- sensory
- motor control
- brain size & weight
- # of neurons
- atherosclerosis, stroke > blood flow
- brain synaptic organization
- plaques
- tangles

Genetics: ApoE 2/? → longevity genes
ApoE4 → risky

Lifestyle:
- restricted calorie
- cardio training
- active social involvement
- positive emotional bias

Temp

- bio: thermoreceptors (skin, ↳ΔT)
  - hot: less, deeper
  - cold: more, closer to skin
  - travels → same pathway as pain (spinothalamic tract (lateral))
- rep:
  - input from both warm & cool
  - activate localized part of the brain → (pleasant) insular / (unpleasant) cingulate cortex
  - comfort depends on the body's condition

Thermoregulation
- centers → reticular formation (brainstem) ↔ sleep cycle; primary sensory cortex; thalamus
- → do not require consciousness; no cerebral cortex needed
- state ↔ Thermal Comfort

Thermal Comfort: humidity, radiant heat, clothing, metabolic heat (personal), air temp, air movement

- Individual Factors
- Societal Factors: urban heat island

Pain

nociceptors (everywhere except brain) — activation threshold — travels → spinothalamic tract — project to → primary sensory cortex

Pain Matrix
- insula
- cingulate cortex
- primary sensory cortex

Processing area

def. Pain: unpleasant — verbal, cage (?) — associated ↕ tissue damage (synonymous)

here injury: chemical, mechanical (inflammation peptide)

- headache
  - primary (stress/tension, migraine)
  - secondary (symptoms of another health disorder)
- fibromyalgia (widespread pain amplification)
- neuropathic pain (diseases on somatosensory)

Biological: similar brain region (pain)

Psychological:
- Behaviour: overreact / avoidance
- Cognition: interpreting pain
- Attention: direction
- Emotions: placebo, nocebo

Cultural:

Pain behaviours
- facial expression
- verbalizing / moaning
- FACS (Facial Action Coding System)
- (influenced by: cultural beliefs — suppress (East Asia); upbringing; social values; gender, age)

rest & attention should be given in moderation

coping style → attitudes of taking pain medication

Sleep

- increased melatonin
- slower breathing, metabolism, heart rate, lower core body temp

Sleepiness:
- circadian rhythm (wake drive)
- sleep drive

feel sleepy when there is the largest gap between S and C.

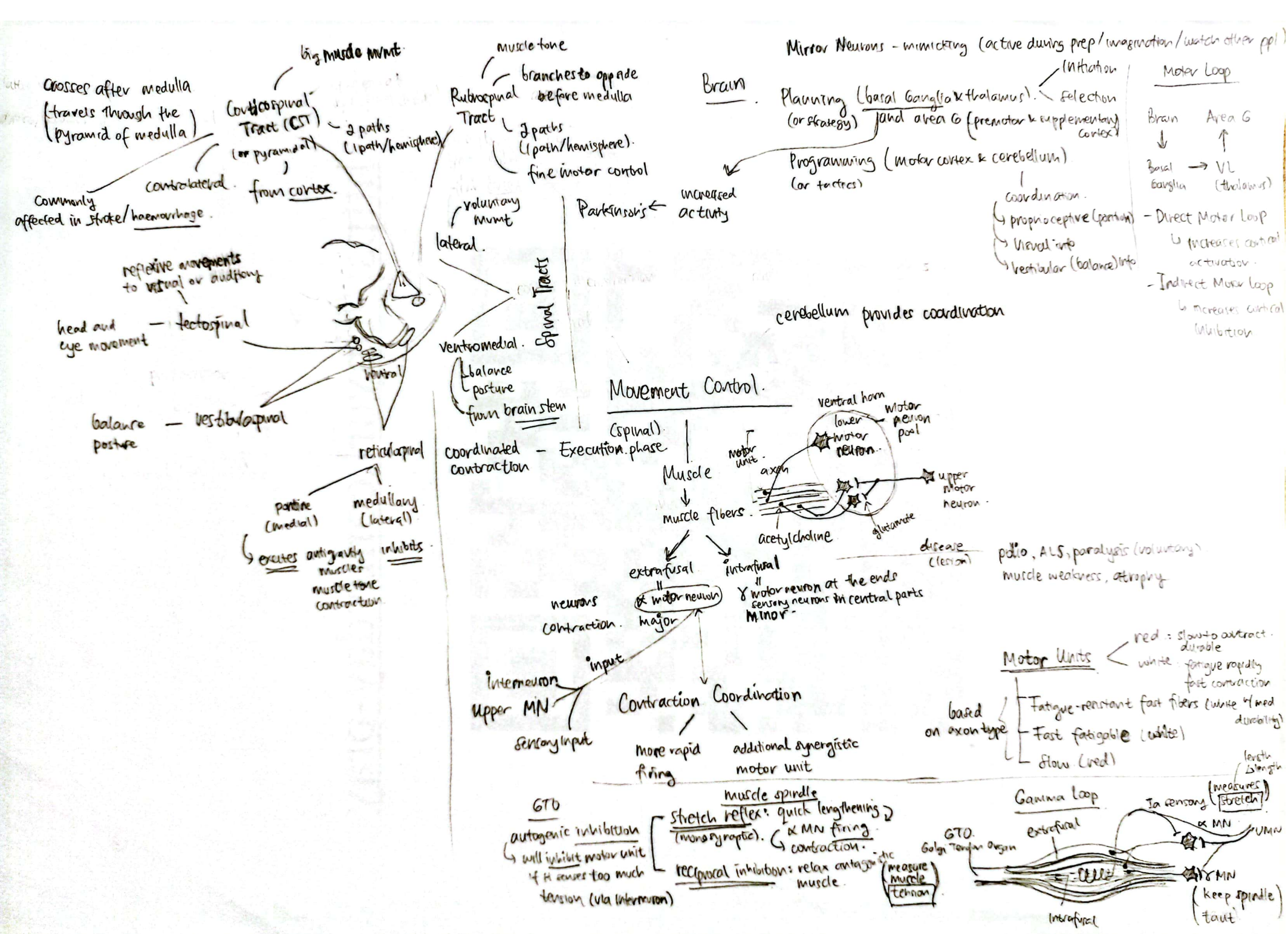
SCN cells (suprachiasmatic nucleus) → circadian clock ← light (w/o light, sleep time gets later) — intensity matters more than color; external
- ← food consumption
- ← physical activity
- ← melatonin secretion (by pineal gland) is suppressed by light
- ← genes & age (rare e.g. DEC2) → might impact duration + timing

older adults:
- slower to sleep
- more often to be awaken (noise) — cause microarousals & increase blood pressure — intermittent; hypertension and stroke risk

Light: more light in the evening ⇒ later sleep

Sleep onset: peripheral heat dissipation

Stages of Sleep:
- Awake
- NREM
  - I
  - II: spindle & K-complex
  - III, IV (deep sleep): slow waves → clears Aβ, consolidate memory
- REM: similar to NREM I (EEG) → emotional regulation


big muscle mvmt
Corticospinal Tract (CST)
(or pyramidal)
2 paths (1 path/hemisphere)
from cortex
contralateral
crosses after medulla (travels through the pyramid of medulla)
commonly affected in stroke/haemorrhage
muscle tone
Rubrospinal Tract
2 paths (1 path/hemisphere)
fine motor control
branches to opposite before medulla
Brain
Planning (basal ganglia & thalamus) (or strategy)
and area 6 (premotor & supplementary cortex)
Initiation
selection
Programming (motor cortex & cerebellum) (or tactics)
Parkinsson's ← increased activity
Mirror Neurons - mimicking (active during prep/imagination/watch other ppl)
Motor Loop
Brain → Basal Ganglia → VL (thalamus) → Area 6
- Direct Motor Loop
↳ increases cortical activation
- Indirect Motor Loop
↳ increases cortical inhibition
coordination
↳ proprioceptive (position)
↳ visual info
↳ vestibular (balance) info
cerebellum provides coordination
voluntary mvmt
lateral
Spinal Tracts
ventromedial
balance
posture
from brain stem
reflexive movements to visual or auditory
head and eye movement — tectospinal
balance posture — vestibulospinal
reticulospinal
pontine (medial)
medullary (lateral)
excites antigravity muscles muscle tone contraction
inhibits
Movement Control
coordinated contraction — Execution phase (spinal)
Muscle
muscle fibers
motor unit
ventral horn
lower motor neuron
motor neuron pool
axon
upper motor neuron
acetylcholine
glutamate
disease (lesion)
polio, ALS, paralysis (voluntary) muscle weakness, atrophy
extrafusal
intrafusal
α motor neuron
γ motor neuron at the ends
sensory neurons in central parts
neurons contraction
major
minor
input
interneuron
upper MN
sensory input
Contraction
Coordination
more rapid firing
additional synergistic motor unit
Motor Units
red : slow to contract durable
white : fatigue rapidly fast contraction
based on axon type
Fatigue-resistant fast fibers (white & red durability)
Fast fatigable (white)
slow (red)
GTO
autogenic inhibition
↳ will inhibit motor unit if it senses too much tension (via interneuron)
muscle spindle
stretch reflex: quick lengthening (monosynaptic). ↳ α MN firing ↳ contraction.
reciprocal inhibition: relax antagonistic muscle
(measure muscle tension)
Gamma Loop
GTO
Golgi Tendon Organ
extrafusal
Ia sensory (measures stretch)
length Δlength
α MN
UMN
γ MN
(keep spindle taut)
intrafusal