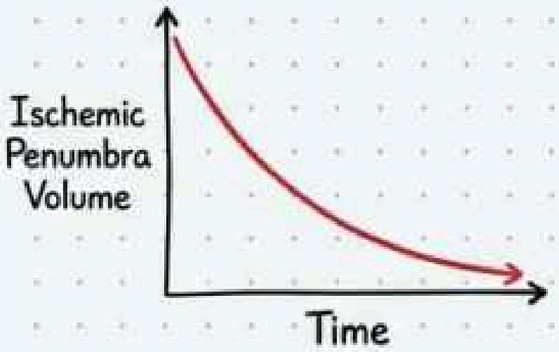
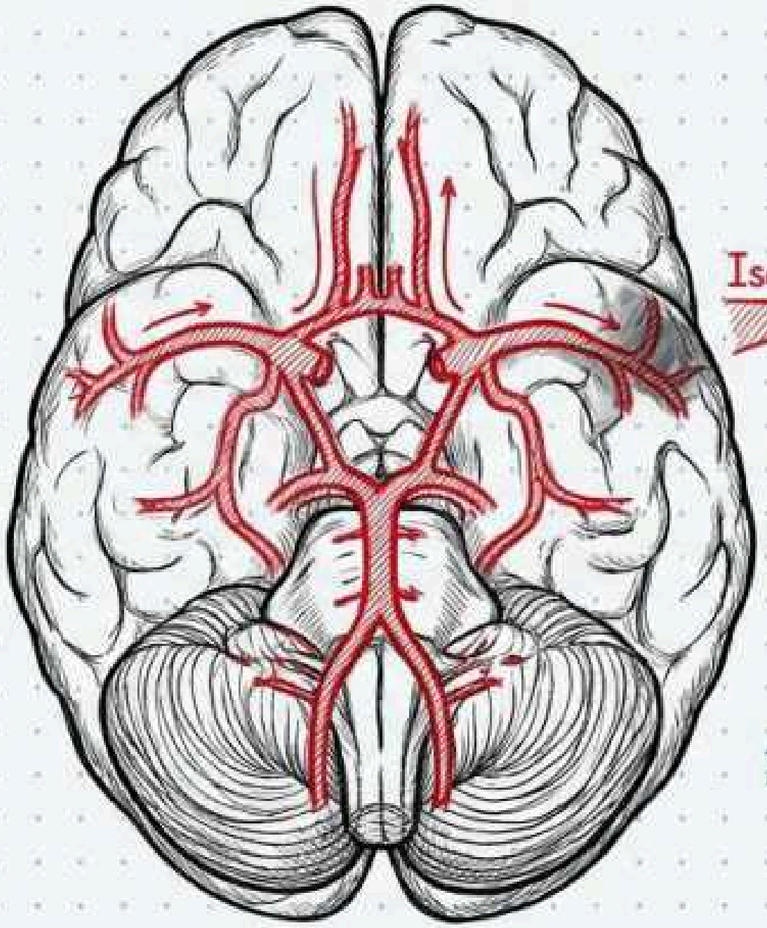
Lecture 2: Stroke

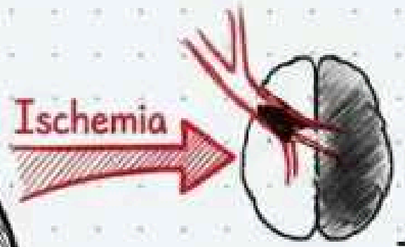
$$CBF = \frac{CPP}{CVR}$$

CPP: Cerebral Perfusion Pressure (CPP)

CVR: Cerebrovascular Resistance (CVR)

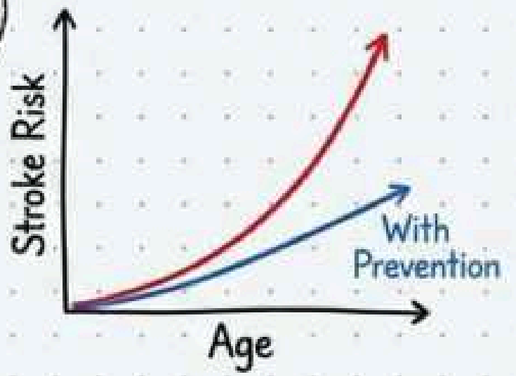






Stroke Incidence

≈ 200 per 100,000/yr (USA)

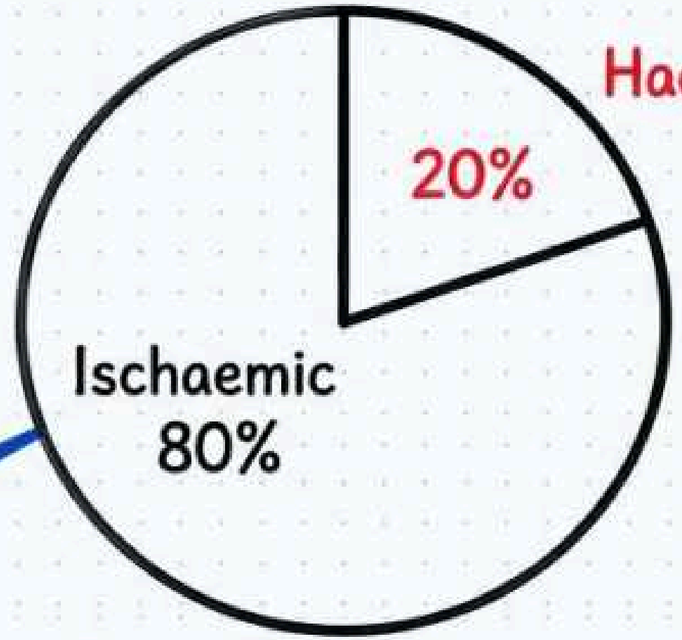


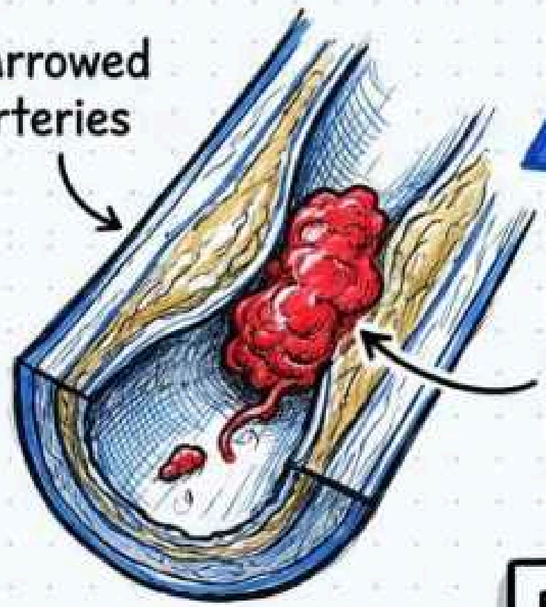
Reperfusion → Recovery

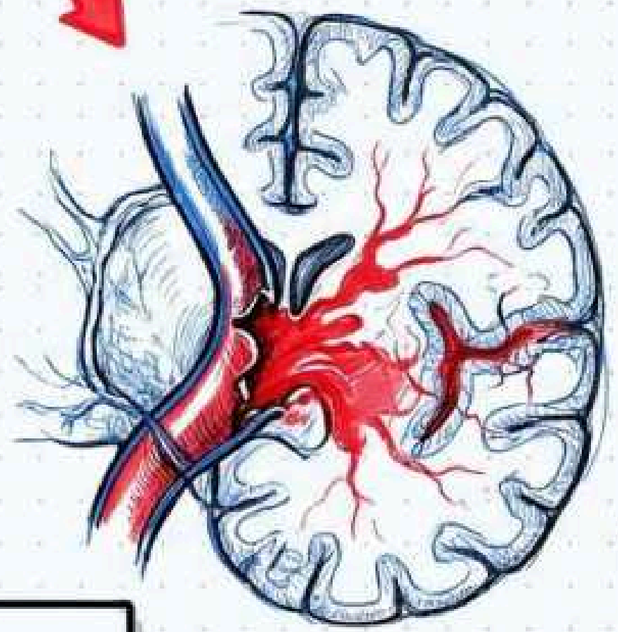
A clinical pathway from pathology to prevention.

Pathology and Origins of Stroke

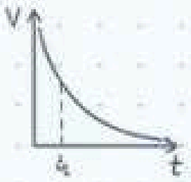
¶ 2.1

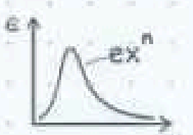


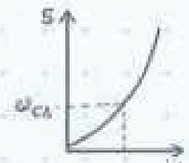


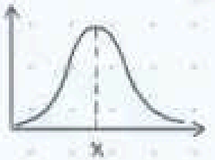


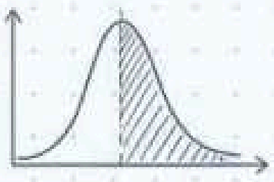
Definition: Sudden loss of brain function caused by interruption of blood supply.
A leading cause of death and disability worldwide.











$\tau = RC$

$\frac{d[A]}{dt} = -k[A]$

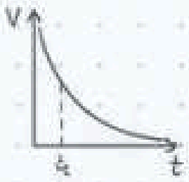
$P(E) = \int f(x)\,dx$

$\sigma^2 = \frac{\sum (x_i - \mu)^2}{N}$

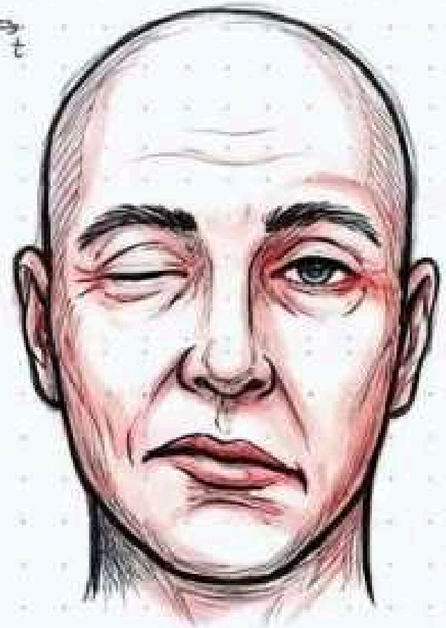
Clinical Presentation and FAST Recognition

¶ 2.2

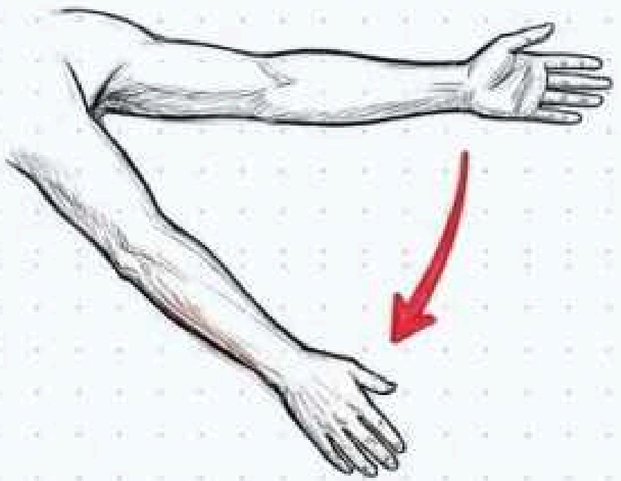
$\tau = RC$



F (Face)



A (Arms)



S (Speech)



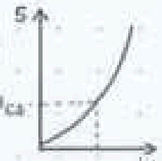
T (Time)

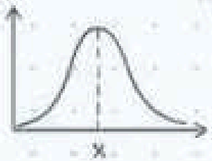
$\frac{d[A]}{dt} = -k[A]$





Time to call emergency services





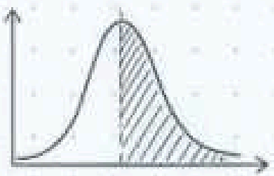
Symptoms depend on the specific brain area affected. Additional presentations: sudden loss of vision, loss of balance, or sudden confusion.

$\tau = RC$

$\frac{d[A]}{dt} = -k[A]$

$P(E) = \int f(x)\,dx$

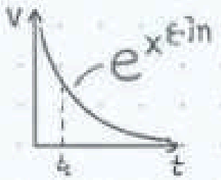
$\sigma^2 = \frac{\sum (x_i - \mu)^2}{N}$



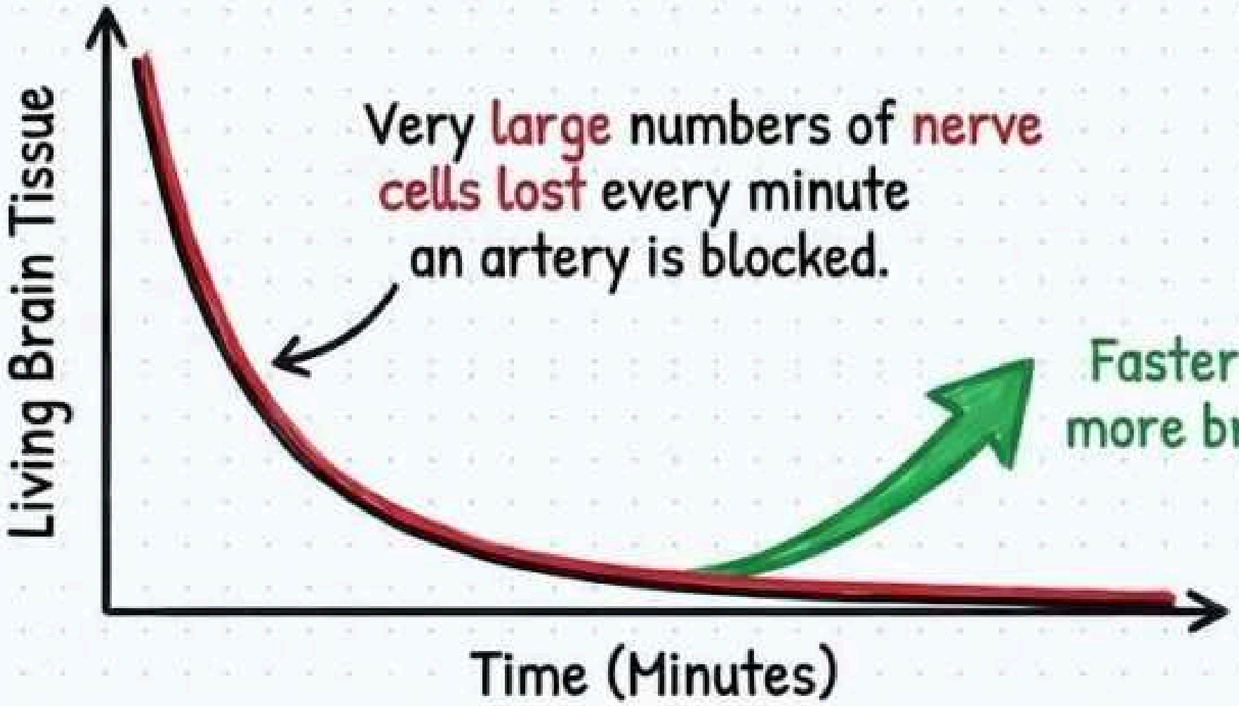
The Pathophysiology of Urgency

¶ 2.3

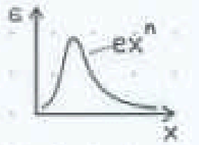
$\tau = RC$

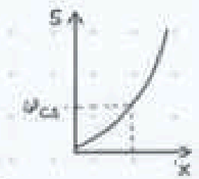


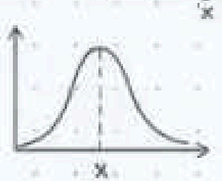
TIME = BRAIN



$\frac{d[A]}{dt} = -k[A]$







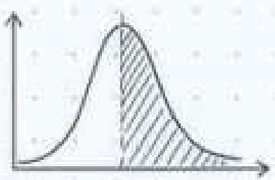
Urgency level: Treated as an absolute emergency on par with a heart attack.

$\tau = RC$

$\frac{d[A]}{dt} = -k[A]$

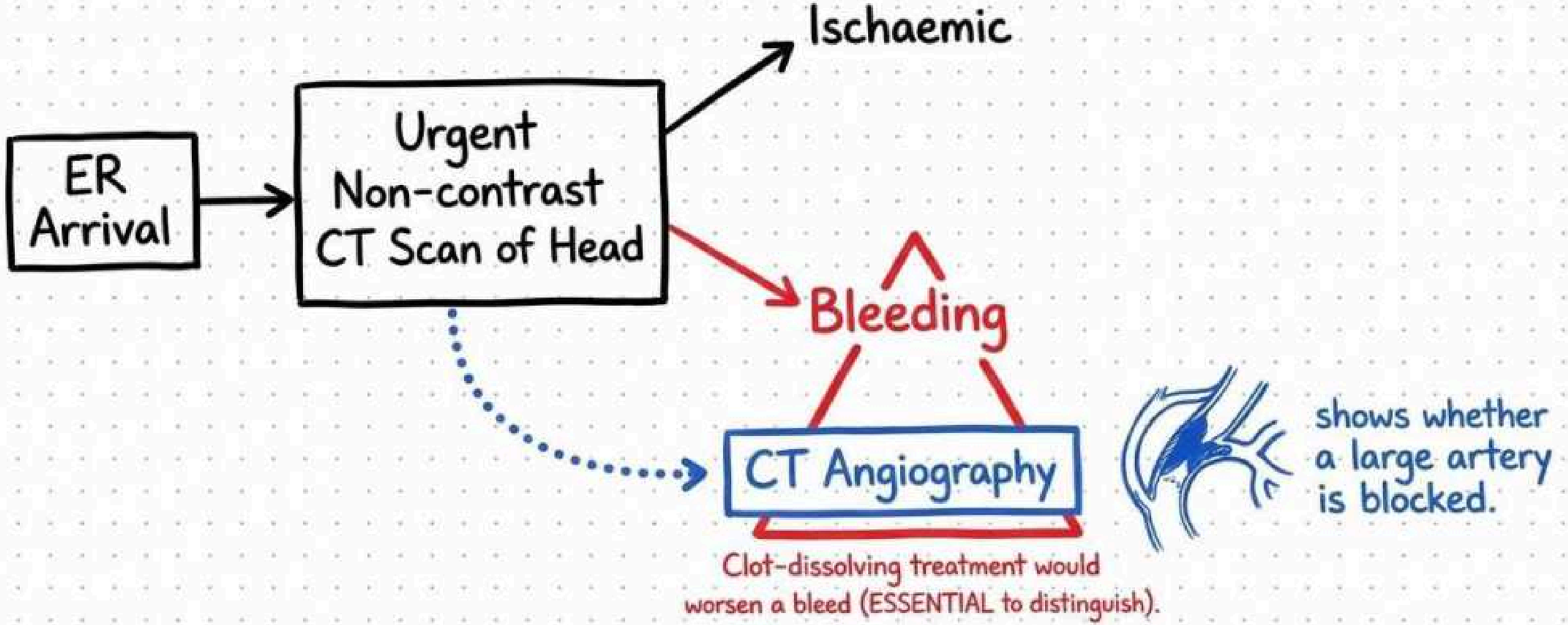
$P(E) = \int f(x)\,dx$

$\sigma^2 = \frac{\sum(x_i - \mu)^2}{N}$



Diagnostic Triage upon Hospital Arrival

¶ 2.4



Medical Reperfusion: Thrombolysis

¶ 2.5



The earlier it is given, the greater the benefit.

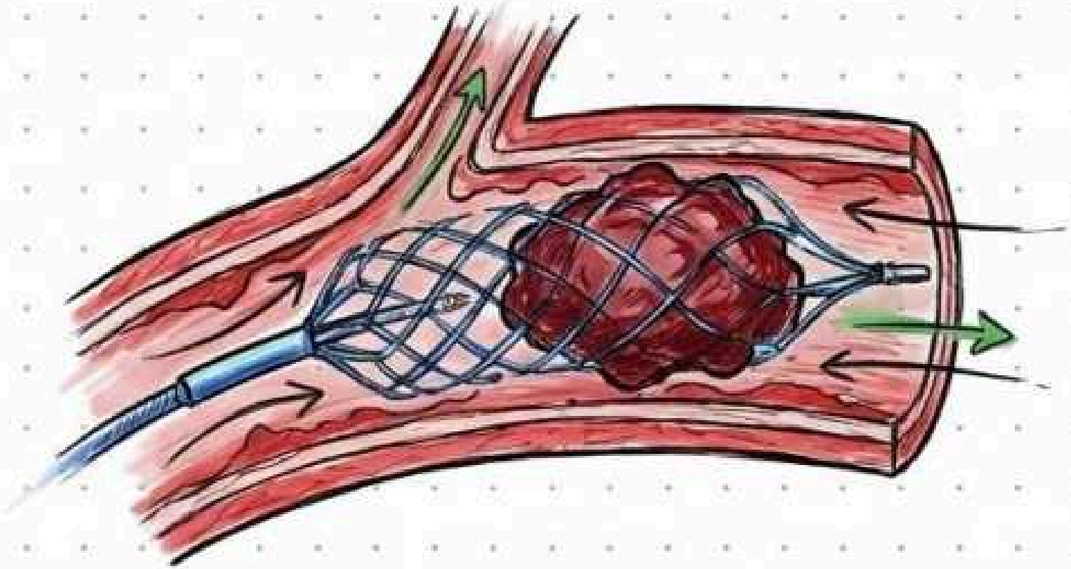
T = 0
(Symptom Onset)

4.5 Hours

Established by landmark American trial (1995).

Surgical Reperfusion: Mechanical Thrombectomy

¶ 2.6



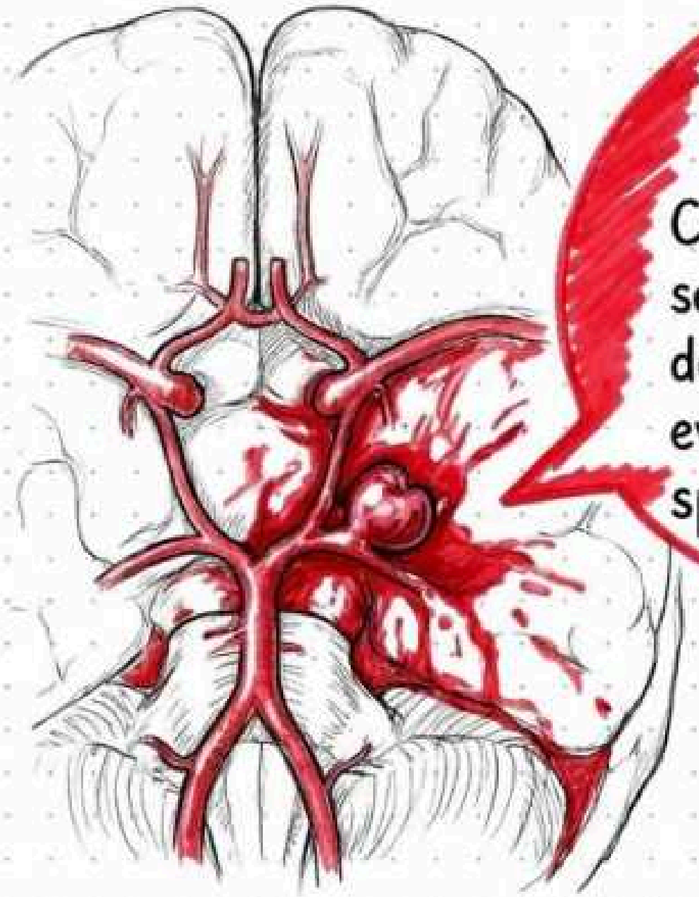
Can benefit selected patients up to 24 hrs when imaging shows salvageable brain tissue.

24 Hours

Trials published in 2015 showed greatly improved outcomes for large artery clots.

Managing Haemorrhagic Stroke

¶ 2.7

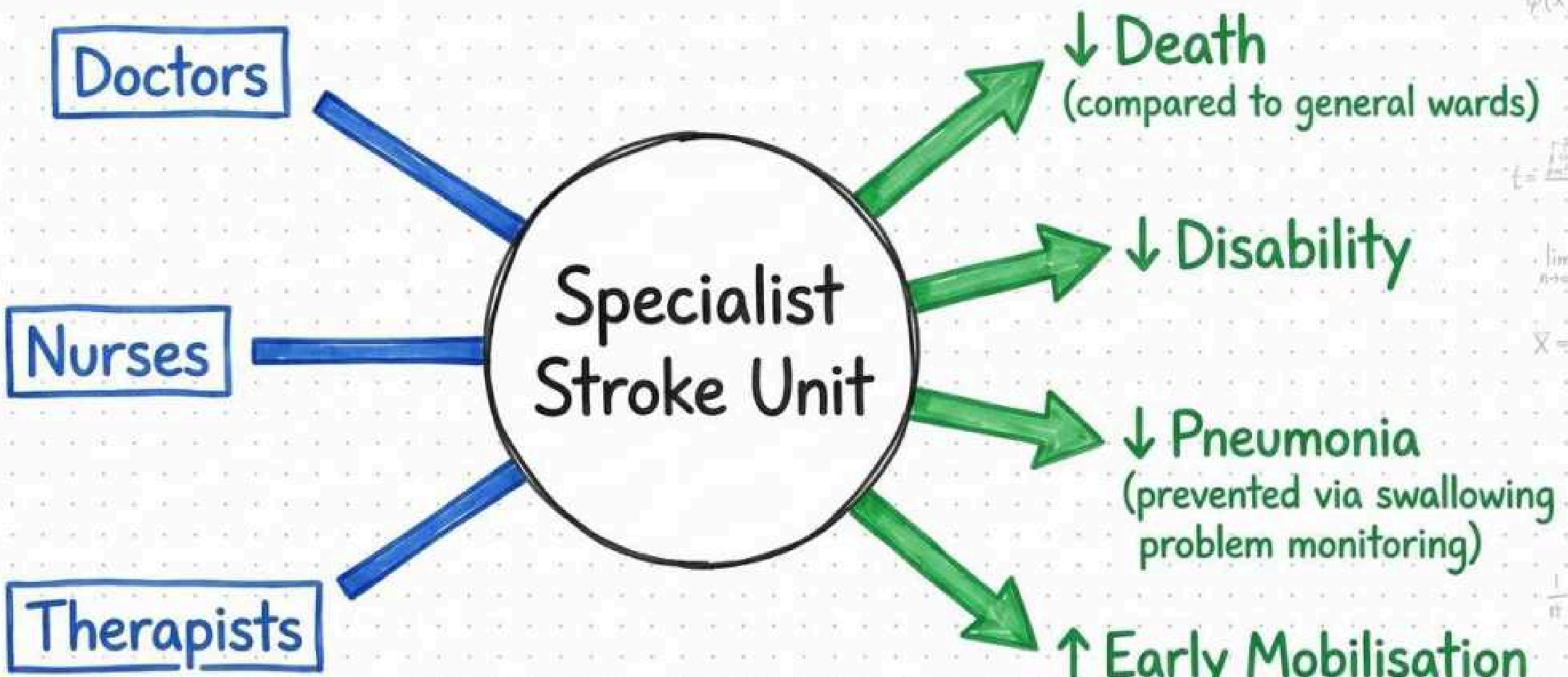


Subarachnoid Haemorrhage:
Causes sudden, extremely severe headache - often described as the worst ever. Needs urgent specialist treatment.

- [x] Control blood pressure
- [x] Reverse blood-thinning drugs
- [x] Surgery (in selected cases)

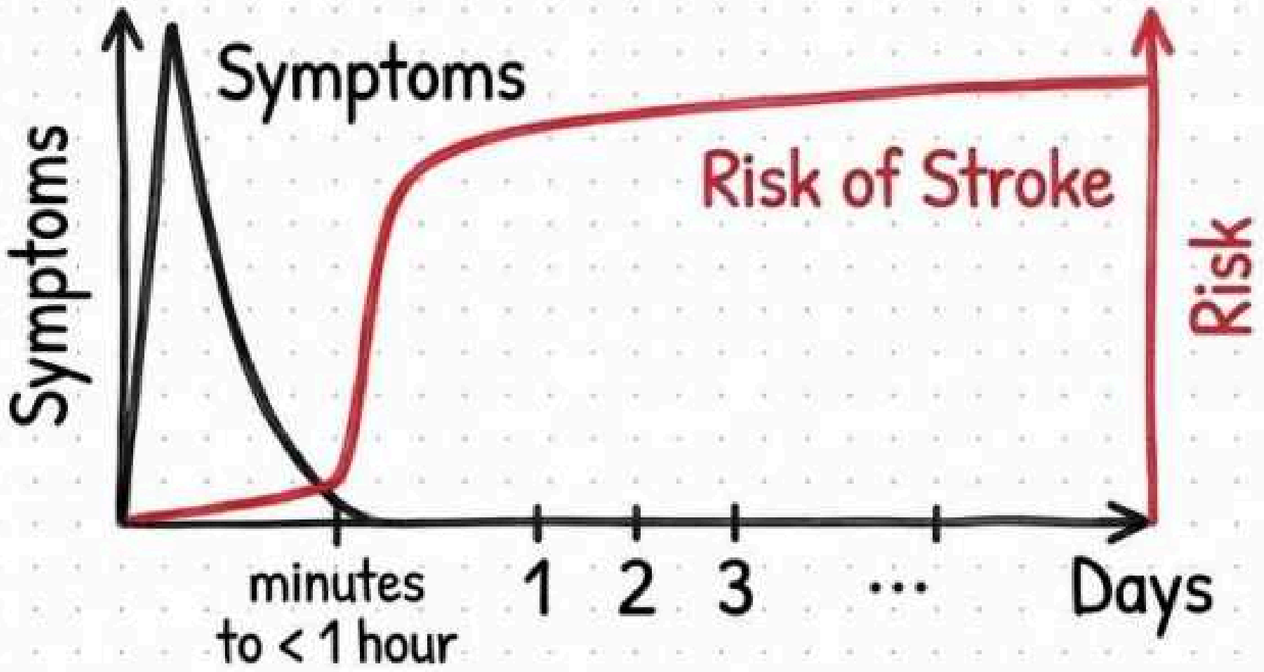
The Specialist Stroke Unit

¶ 2.8



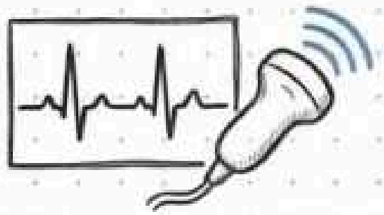
TIA: A Critical Warning Sign

¶ 2.9





Antiplatelets, Statins,
Blood Pressure meds



Investigation of
arteries and heart

Urgent assessment and treatment reduces stroke risk dramatically (EXPRESS study, Oxford 2007).

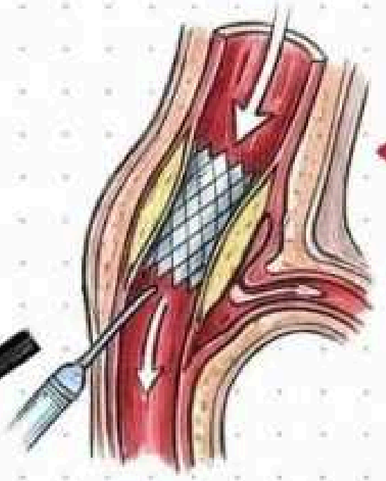
Modifiable Risk Factors & Prevention

¶2.10

High Blood Pressure

(The single most important modifiable risk factor)

- Slard
- Smoking
- Diabetes
- High Cholesterol
- Excess Alcohol
- Excess Alcohol
- Physical Inactivity
- Unhealthy Diet
- Obesity
- Atrial Fibrillation



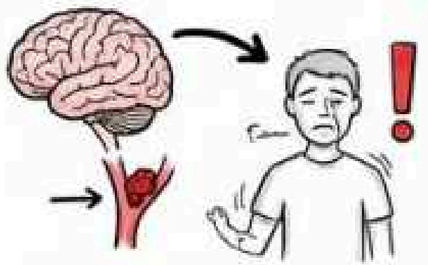
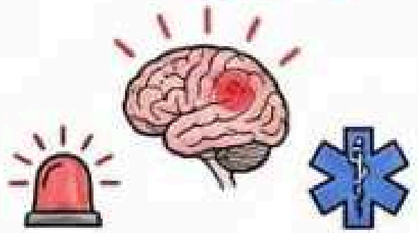
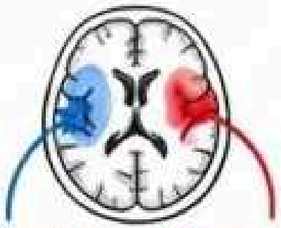
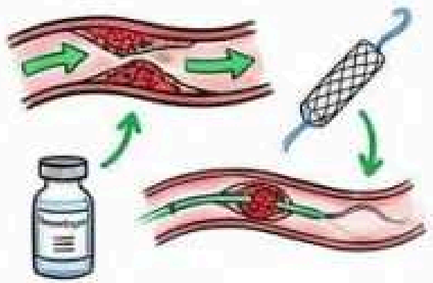
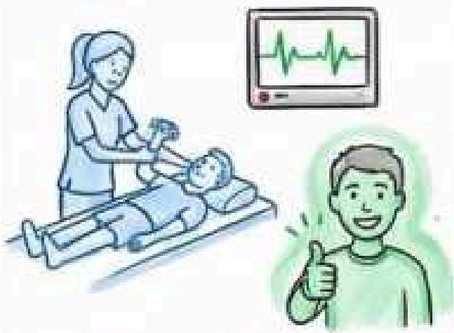
Severe narrowing of neck arteries



Anticoagulation

The Complete Clinical Pathway (Summary)

¶ 2.11

Phase 1 (Pre-event)	Phase 2 (Onset)	Phase 3 (ER)	Phase 4 (Intervention)	Phase 5 (Recovery)
Preventable Risks → TIA Warning  (Act Urgently)	 Medical Emergency  (Time is Brain)	Imaging   Ischemic stroke (clot) Hemorrhagic stroke (bleed) (Distinguish Clots vs Bleeds)	Restore Blood Flow  (Thrombolysis / Thrombectomy)	Specialist Stroke Units  (Save Lives)

Next up: Headache.