Acute stroke treatments

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Session plan

- Management of acute ischaemic strokes
  - Thrombolysis in acute ischaemic stroke
  - Carotid Endarterectomy
- Management of acute haemorrhagic strokes (Primary intracerebral haemorrhages)
  - Hypertension
  - Secondary to Oral anticoagulants
- Intracranial cavity and ICP
- Decompressive hemicraniectomy
- Suboccipital decompression craniectomy
Learning objectives:

- Identify acute treatments for ischaemic and haemorrhagic strokes
- List stroke thrombolysis inclusion and exclusion criteria
- Have the knowledge to rapid access patients for potential thrombolysis
- Describe how rtPA therapy works, its side-effects and complications
- Devise appropriate nursing care for patients after thrombolysis
- Understand the need for vascular imaging and carotid endarterectomy
- List the aetiology for primary intracerebral haemorrhages
- Devise appropriate nursing care for patients with haemorrhagic strokes
- Understand Intracranial pressure, most common herniations and recognise its signs and symptoms
- Devise appropriate nursing care for patients post-decompressive craniectomy
- Be aware of current research and ongoing trials

Acute ischaemic strokes
The objective is to avoid lesion enlargement
Thrombolysis in acute ischaemic stroke

- Thrombo = Clot (fibrin + platelet)

- Lysis = Dissolve
Thrombolysis in acute ischaemic stroke

Alteplase

- Recombinant tissue plasminogen activator (r-tPA) – a protein
- Thrombolytic agent
Thrombolysis in acute ischaemic stroke

Conversion of plaminogen to plasmin

Plasmin breaks down fibrin in clot

Breaks up thrombus

Blood flow through blocked vessel
Thrombolysis in acute ischaemic stroke

- The NINDS trials (1995): **within 3 hours of onset**
- ECASS III (2008): benefit in giving **up to 4.5 hours of onset**
- IST-3 (2012): confirmed benefits of prior trials for **up to 4.5 hours of onset**; advised thrombolysis **aged over 80 years old**
- ECASS IV (ongoing): 4.5 to 9 hours symptom onset or unknown time window (eg wake-up strokes)
Thrombolysis in acute ischaemic stroke

**Modified Rankin Score**

For 1 patient to have an excellent outcome NNT:

- 5 patients within 1.5hrs
- 9 patients between 1.5 – 3hrs
- 15 patients between 3 – 4.5hrs
Thrombolysis in acute ischaemic stroke

**Mortality**

- 11.9% mortality rate in the placebo vs 13.9% mortality rate in the alteplase group up to 6 hours of ictus
- Significant increase in mortality after 4.5 hours of symptom onset
# Thrombolysis in acute ischaemic stroke

*Intracerebral haemorrhage*

<table>
<thead>
<tr>
<th>Number of patients</th>
<th>Parenchymal haemorrhage type 2, n/N (%)</th>
<th>Odds ratio* (95% CI)</th>
<th>p value</th>
<th>All intracerebral haemorrhage (%)</th>
<th>Odds ratio† (95% CI)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Placebo</td>
<td>Alteplase</td>
<td>Placebo</td>
<td>Alteplase</td>
<td>Placebo</td>
<td>Alteplase</td>
</tr>
<tr>
<td>0-90 min</td>
<td>312</td>
<td>0/151</td>
<td>5/161 (3.1%)</td>
<td>-‡</td>
<td>44/151</td>
<td>57/161</td>
</tr>
<tr>
<td>91-180 min</td>
<td>618</td>
<td>3/315</td>
<td>17/303 (5.6%)</td>
<td>8.23 (2.39-28.32)†</td>
<td>104/315</td>
<td>104/303</td>
</tr>
<tr>
<td>181-270 min</td>
<td>1620</td>
<td>10/811</td>
<td>35/809 (4.3%)</td>
<td>3.61 (1.76-7.38)†</td>
<td>175/811</td>
<td>245/809</td>
</tr>
<tr>
<td>181-270 min (excluding EPITHET† data)</td>
<td>1589</td>
<td>10/794 (1.3%)</td>
<td>33/795 (4.2%)</td>
<td>3.41 (1.66-7.02)†</td>
<td>175/794</td>
<td>243/795</td>
</tr>
<tr>
<td>271-360 min</td>
<td>1118</td>
<td>5/542</td>
<td>39/576 (6.8%)</td>
<td>4.32 (2.84-18.29)†</td>
<td>118/542</td>
<td>196/576</td>
</tr>
<tr>
<td>271-360 min (excluding EPITHET† data)</td>
<td>1051</td>
<td>5/512 (1.0%)</td>
<td>37/539 (6.9%)</td>
<td>7.26 (2.72-18.2)†</td>
<td>116/512</td>
<td>192/539</td>
</tr>
<tr>
<td>0-360 min</td>
<td>3670</td>
<td>18/1820</td>
<td>96/1850 (5.2%)</td>
<td>5.37 (3.22-8.95)†</td>
<td>441/1820</td>
<td>602/1850</td>
</tr>
<tr>
<td>0-360 min (excluding EPITHET† data)</td>
<td>3570</td>
<td>18/1772 (1.0%)</td>
<td>92/1798 (5.1%)</td>
<td>5.17 (3.09-8.04)†</td>
<td>439/1772</td>
<td>596/1798</td>
</tr>
</tbody>
</table>

*Odds ratio adjusted for stroke onset to start of treatment (OTT), National Institutes of Health Stroke Scale (NIHSS) score at baseline (0-7, 8-14, 15-18, >18), age, and diastolic blood pressure (<70, 71-90, >90 mm Hg).†Odds ratio adjusted for OTT, NIHSS score at baseline (0-7, 8-14, 15-18, >18), diastolic blood pressure (<70, 71-90, >90 mm Hg), premorbid extension, and previous stroke.‡Not evaluable due to absence of events in control group.

Table 4: Intracerebral haemorrhage by OTT interval
Thrombolysis in acute ischaemic stroke

**Inclusion criteria**

- Clinical presentation of a stroke
- Neurological deficit not improving
- Onset of symptoms less than 4.5 hrs (BAO ≤ 12 hours)
- Age ≥ 18
- No haemorrhage or early ischaemic changes on brain imaging
- No contraindications

- Up to 20% of stroke patients are eligible for thrombolysis
- Only 12% receive treatment
Thrombolysis in acute ischaemic stroke

**Exclusion criteria**

- **BP persistently > 185/110**
- Any evidence of active bleeding
- Severe sudden onset headache at onset of symptoms (suggestive of SAH)
- Previous stroke, serious head injury, GI or urinary tract haemorrhage, surgery or significant trauma in the last 3 months
- Neoplasm with increased bleeding risk
- Previous history of spontaneous ICH, pancreatitis, oesophageal varices, active hepatitis, portal hypertension or liver cirrhosis
- AVM or aortic aneurysm
- LP within the last 10 days
- External cardiac massage or obstetric delivery within the last 10 days
- Vitamin K antagonist (eg Warfarin or Phenindione) and INR > 1.7; DOACs
- Unfractioned heparin within the last 24 hours and APTT abnormal
- **Treatment dose LMWH within the last 48 hours**
- Known (or strongly suspected) iron deficient anaemia, thrombocytopenia or platelet defect
Thrombolysis in acute ischaemic stroke

**Rapid Assessment**

- History of symptoms and onset time – “is this a stroke?”
- Past medical history
- ABCD assessment – treat if necessary
- NIHSS score
- Baseline neurological observations: Vital signs, Glasgow Coma Scale, Glucose
- Bloods (FBC, U&E, Lipids, LFTs, Coagulation, Group & Save)
- Bedside INR (if on Warfarin)
- 2 x large bore Peripheral cannulas
- Brain imaging
Re-check neurological observations

Severe Hypertension

- Labetalol 10-20mg IV bolus every 10 min (max 300mg)
- Labetalol infusion 2-8 mg/min
- GTN infusion 50mg in 50mls, 1 to 10 ml/hr
Thrombolysis in acute ischaemic stroke

Treatment

- Consent
- Establish patient weight and calculate dose: 0.9mg/Kg (max 90mg)
- Prepare and Administer medication
  - Insert transfer cannula vertically in the solvent vial on a flat surface
  - Turn over the powder vial and the rubber stopper of this vial will pierce the solvent vial in an upright position
  - When the 2 vials are connected by the transfer cannula, turned them over
  - 10% bolus (over 1-2min)
  - 90% infusion (over 1 hr) via an infusion pump

Example:

Eg. 70 kg
0.9 mg ----- 1 Kg
X ----- 70kg  x = 0.9 x 70 = 63 mg (ml)

10% of 63 = 6.3 or 6 mg (ml)
90% of 63 = 57mg (ml)
Thrombolysis in acute ischaemic stroke

**Treatment**

- Monitor side-effects/complications and treat
  - Allergic rash
  - Bronchospasm
  - Severe Hypotension
  - Anaphylactic reaction
  - Bleeding/ICH (including bruises, gingival oozing)
- Stop rtPA if severe hypotension, bronchospasm, anaphylactic shock

- ABCD
- Chlorpheniramine 10mg IV
- Hydrocortisone 200mg IV
- Salbutamol 2.5 – 5 mg
- Adrenaline 0.5mg im (0.5 ml of 1:1000)
- Fluid challenge
Thrombolysis in acute ischaemic stroke

Treatment

- Repeat brain imaging if ICH is suspected
- NIHSS at 2, 24, 48 and 72 hours
- Neurological observations as per local policy (Glasgow Coma Scale, pupil assessment, limb power, NEWS)
  - 15 min for 2 hours
  - 30 min for 6 hours
  - 1 hrly for 16 hours
- Monitor for signs/symptoms of raised ICP
- Know the clinical syndrome and monitor for lesion extension
- Continuous cardiac monitoring
- Maintain BP < 185/110 (Vs Enchanted B arm trial)
Transfer to HASU

- Continue treatment plan and local protocol
- Flush the entire IV line at the end of the infusion
- Avoid all treatments/procedures with associated risk of bleeding
- Repeat Brain imaging at 24 hours → antiplatelet therapy
Do all stroke patients have carotid dopplers?

A – Yes

B – No
Why?

- Is it an ischaemic stroke?
- Is it an anterior circulation ischaemic stroke?
- Will the person be a candidate for carotid endarterectomy?
  - Pre-morbid mRS
  - Co-morbidities
Vascular imaging for anterior circulation

- Right common carotid artery
- Left common carotid artery
- Right subclavian artery
- Left subclavian artery
- Brachiocephalic artery
- Arch of aorta
- Descending aorta
- Heart

Internal carotid artery
External carotid artery
Common carotid artery
Carotid Artery
Carotid Endarterectomy

- Surgical procedure under local or general anaesthesia
- Aims to remove atherosclerotic plaque in the arteries
- Reduces the risk of stroke or death
- Optimise BP, cholesterol levels, diabetes, lifestyle advice, antiplatelet treatment pre and post CEA
- Considered for patients with **symptomatic** carotid artery stenosis (50-99%) within 1 week
  - In post-thrombolysis patients wait 72 hours
Symptomatic ICA stenosis

- 54 years old male
- HPc: At 2pm sudden onset of RUL weakness and word finding difficulty
- At 4pm, presented as a thrombolysis call.
- On Examination, NIHSS 0
- CT head: Nil acute infarct. No bleed
- Clinical impression: L MCA TIA
- C. Dopplers: L ICA 65-75%
Acute haemorrhagic stroke
Acute haemorrhagic stroke

Primary Intracerebral haemorrhage

- Hypertension
- AVM or aneurysms
- Intracerebral tumours
- Haematological disorders
SBP reduction to < 140 mmHg within 1 hour and during 7 days

**Systolic BP control**
Median (IQR) time to treatment, hr - intensive 4 (3-5), standard 5 (3-7)

<table>
<thead>
<tr>
<th>Intensive group to target (&lt;140mmHg)</th>
<th>Systolic BP time trends</th>
</tr>
</thead>
<tbody>
<tr>
<td>452 (33%) at 1 hour</td>
<td>1 hour - Δ14 mmHg (P&lt;0.0001)</td>
</tr>
<tr>
<td>731 (53%) at 6 hours</td>
<td>6 hour - Δ14 mmHg (P&lt;0.0001)</td>
</tr>
</tbody>
</table>

**Key secondary outcome**
Ordinal shift in mRS scores (0-6)

Odds ratio 0.87 (95%CI 0.77 to 1.00); P=0.04
Management of hypertension

**INTERACT 2 Trial**

- Early BP control
- Target SBP < 140 mmHg
- Sustained BP control
If on Warfarin:

1) Reverse anticoagulation with Vitamin K and prothrombin complex concentrate (PCC) - Octaplex

2) Initiate Octaplex 1ml/min for 5 minutes → 2-3 mls/min after

3) Check INR 30 min post-treatment

If on Dabigatran:

Reverse anticoagulation with Idarucizumab (FDA approved)

Patients with PICH who develop hydrocephalus should be considered for surgical intervention or insertion of an EVD
Management acute haemorrhagic stroke

- Haematoma expansion common (25% of ICH)
- Intensive BP control is effective
- **TICH 2 Trial**: Tranexamic acid (an antifibrinolytic drug) vs placebo within 8 hours
- A meta-analysis of the only 2 trials of TA in traumatic ICH showed a significant reduction in post-traumatic intracranial bleeding
Intracranial cavity and ICP

- Layers (meninges): dura, arachnoid and pia
- Brain tissue – 80%
- Blood – 10%
- Cerebrospinal fluid (CSF) – 10%
Intracranial cavity and ICP

- 3 compartments
  - 2 Supratentorial – falx cerebri
  - 1 Infratentorial

When oedema/mass occurs within a compartment, the brain shifts from a compartment of high pressure to one of a lesser pressure.
Most common herniations:

- Subfalcine herniation (3)
- Descending transtentorial herniation (1)
- Posterior fossa herniations
  - Tonsilar (6)
  - Ascending transtentorial (5)
Subfalcine herniation

- **Subfalcine herniation (3)**
  - midline shift
  - Headache
  - contralateral leg weakness
  - possible hydrocephalus
  - Can progress to central herniation (2)

Eg. Malignant MCA infarct/space-occupying lesion (8%) - 80% mortality rate
Descending transtentorial herniation

- Descending transtentorial herniation (1)
  - CN III (oculomotor) compression – ipsilateral dilated pupil
  - Midbrain compression (hemiparesis, reduced consciousness, BP, HR, RR)
  - Ipsilateral PCA occlusion
  - May advance to central herniation (2)
Posterior fossa herniation

- Cerebellum, midbrain, pons, medulla
- 3rd to 12th CN impairment
- 4th ventricle - CSF obstruction - hydrocephalus
Signs and symptoms of intracranial pressure

- Restlessness
- Headache
- Nausea and/or vomiting
- Photophobia
- Reduce GCS (or effort)
- Increase focal neurology
- Seizure
- Increased BP with associated Bradicardia (*Cushing 1900*)
- Meningism (*neck stiffness, headache and photophobia*)
- Changes in the pupil size and reaction of the pupils to light
- **Think about the clinical syndrome!**
Within 72-92 hours

Surgical procedure under GA

Aim to relieve increased ICP as result of oedema of cerebral tissue caused by large cerebral hemisphere lesion, or space-occupying lesion

Removes part of the skull and opens the dura Brain herniates outwards
Traditional conservative management: sedation, hyperventilation, barbiturates and osmotic therapy (no evidence from RCTs)

VERSUS DHC
### Decompressive hemicraniectomy

**SR and meta-analysis of 6 of RCTs (314)**

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>DHC</th>
<th>Control</th>
<th>Peto Odds Ratio</th>
<th>Peto Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Events</td>
<td>Total</td>
<td>Events</td>
<td>Total</td>
</tr>
<tr>
<td><strong>5.1.1 Age &lt; 60 years</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESTINY 2007</td>
<td>3</td>
<td>17</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>DECIMAL 2007</td>
<td>5</td>
<td>20</td>
<td>14</td>
<td>18</td>
</tr>
<tr>
<td>HAMLET 2009</td>
<td>7</td>
<td>32</td>
<td>19</td>
<td>32</td>
</tr>
<tr>
<td>Zhao 2012</td>
<td>1</td>
<td>8</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td>77</td>
<td>78</td>
<td>50.0%</td>
<td>0.17 [0.09, 0.33]</td>
</tr>
<tr>
<td><strong>Total events</strong></td>
<td>16</td>
<td>48</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Heterogeneity:</strong> Chi² = 0.74, df = 3 (P = 0.66); I² = 0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Test for overall effect:</strong> Z = 5.35 (P &lt; 0.0001)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| **5.1.2 Age > 60 years** |           |       |       |       |        |                    |      |
| Zhao 2012            | 3        | 16     | 9      | 13    | 9.6%   | 0.13 [0.03, 0.58] | 2012 |
| DESTINY II 2014      | 20       | 47     | 47     | 62    | 34.1%  | 0.25 [0.11, 0.54] | 2014 |
| **Subtotal (95% CI)** | 63     | 75     | 43.7%  | 0.22 [0.11, 0.43] |      |
| **Total events**     | 23     | 56     |       |       |        |                    |      |
| **Heterogeneity:** Chi² = 0.54, df = 1 (P = 0.48); I² = 0%  |
| **Test for overall effect:** Z = 4.37 (P < 0.0001) |

| **5.1.3 Unclear** |           |       |       |       |        |                    |      |
| Szalay 2012         | 6        | 11     | 12     | 13    | 6.2%   | 0.15 [0.02, 0.89] | 2012 |
| **Subtotal (95% CI)** | 11     | 13     | 6.2%  | 0.19 [0.02, 0.89] |      |
| **Total events**    | 6       | 12     |       |       |        |                    |      |
| **Heterogeneity:** Not applicable  |
| **Test for overall effect:** Z = 2.08 (P = 0.04) |

**DHC versus medical treatment: death at 12 months**

**DHC versus medical treatment: mRS 4-5 at 12 months**
Refer to neurosurgery within 24 hours of symptom onset and treat within 48 hours if:

- Pre-morbid mRS < 2
- Clinical diagnosis of MCA syndrome
- NIHSS > 15
- Decrease in the level of consciousness to a score of 1 or more on NIHSS 1a
- At least 50% of the MCA territory in brain imaging
Suboccipital decompressive craniectomy

- Is effective for cerebellar infarction
- EVD and Craniectomy
- EVD increased mortality because of upward herniation
Decompressive hemicraniectomy – nursing care

Complications:

- Herniation
- Site infection
- Contralateral haematoma
- High risk of fall and injury
- Sinking skin flap syndrome: depression, headache, behaviour changes, seizure
- Hydrocephalus
Decompressive hemicraniectomy – nursing care

Nursing Care Priorities

Potential for development of elevated ICP, cerebral edema, effusion, hematoma and other neurologic deterioration:

Neurologic monitoring
- Fluctuation of neurologic status may indicate subclinical seizures
- Declining neurologic status may indicate development of edema, effusion or hematoma
- Continued assessment of ICP
- Assessment every shift for skin flap turgor

Potential for development of Syndrome of Trophined, seizures and/or hydrocephalus

Neurologic monitoring
- Personality changes
- Acute or insidious decreased level of consciousness
- Neurologic change associated with position change, dehydration

Potential for infection

Dressing, skin and wound monitored frequently

Potential for neurologic deterioration due to pressure placed on cerebrum during positioning or mobilization

Avoid pressure on skin flap site, turn side-back-side while positioning head with pillows and towels to prevent tension or pressure

Mobilization
- Consultation with prosthetic service to fit helmet when mobilized
- Use helmet with any mobilization out of bed
- High risk for fall and injury
- Consult with social work, neuropsychology, and other available services for cognitive evaluation

Care coordination

- Neurosurgical follow up frequently, including cranioplasty plan
- Family training for monitoring of complications

Livesay and Moser (2014)
Suboccipital decompressive craniectomy

- 57 y.o male
- Hpc: 4pm acute onset dizziness + vomiting. Lasted 2 hours then settled. 8pm symptoms returned.
- Went to bed. 2am woke up, vomiting + room spinning
- LAS arrival: noted RUL + RLL weakness
- Examination in ED: nystagmus, R facial droop, RUL, RLL weakness. GCS 15/15
- CT – old R basal ganglia infarct. Nil acute DWI MRI – bilateral cerebellar infarcts
- CTA – Thrombus in R VA
- 8:30am: drop GCS (E3 V5 M6), ataxia, worsened dysarthria, R CN VI palsy, upper airway noises, tachypnea
- Impression: Posterior fossa malignant swelling 2nd bilateral cerebellar infarcts and hydrocephalus
- 11am (just before intubation): Noted L sided weakness
- **Plan:** 1) R frontal EVD for posterior fossa decompression
  2) Posterior fossa decompression
46 y.o lady

- Lives with mother, no children. Works in a pub
- PMHx: smoker
- At 7:00am, mother heard a noise upstairs and thought it was her daughter but doesn’t go upstairs to check. Mother found daughter 1 hour later, on the floor, unable to move. Mother calls 999
- Paramedics arrived on scene and took patient to the nearest HASU, alerting ED
- ED alerted Stroke team
- Stroke team met patient in ED
Case study

- Patient arrives in ED at 9:00am
- GCS 14/15, E3 V4 M6, dysarthria, left facial droop
- LUL, severe weakness (power 1/5)
- LLL, no response (power 0/5)
- Left homonymous hemianopia
- Right gaze preference
- NIHSS 16
- Blood Pressure 150/70 HR 75 SR SaO2 98% in Air RR 15 T 36.5°C blood sugar 6.5 mmol/L
Is this patient eligible for rt-PA?
References


Thank you!

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