UKSF Conference 4th December 2018
Nurse Training Session

Early physiological changes and actions

Clare Gordon & Cath Curley 4th December 2018
Aims & Objectives

• Understanding of:
  – Acute cerebral imaging
  – Early ischaemic changes

• Current evidence & recommendations for:
  – Mechanical thrombectomy
  – Intracerebral haemorrhage

• Case studies / sharing experiences
Part 1 – Acute cerebral pathophysiology and imaging

Clare Gordon
Introduction

Imaging
• Normal CT
• Perfusion CT
• Standard MRI
• DWI MRI

Acute Pathophysiology
• Cerebral blood flow
• Ischaemic penumbra
• Cytotoxic & vasogenic oedema
• Mass effect
1. Non-contrast CT

- Determines tissue density

<table>
<thead>
<tr>
<th>Hyperdense (most dense)</th>
<th>Isodense</th>
<th>Hypodense (least dense)</th>
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</thead>
<tbody>
<tr>
<td>White</td>
<td>Grey</td>
<td>Dark grey</td>
</tr>
</tbody>
</table>
| Bone, calcium deposits, fresh blood | Cerebral tissue, sub-acute blood (1 week post bleed) | Cerebral oedema, fat, chronic blood > 2 weeks post bleed  
Predictive for Irreversible ischemia |

- Shows haemorrhage immediately
- Acute ischaemia not easily visible
- Post fossa less visible due to bone artefact

Acute ischaemia CT signs (<24hrs)

- Loss of grey-white matter differentiation/insular ribbon sign
- Effacement of cortical sulci
- Hyperdense artery sign

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Acute ischaemic signs

1. Loss of grey-white matter differentiation & sulci effacement

2. Hyperdense sign
   - Thrombus in MCA/basilar tip/vertebral artery
   - Develops within 90 mins

A. Atherothrombosis
   - Cardiac or artery to artery

B. Embolic

Tomsick T et al. (1996) AJNR. 17 (1) 79-85

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Sub-acute ischaemia (24hrs-5 days)

CT signs

- Hypoattenuation and well-defined margins.
- Mass effect & risk of herniation
Sub-acute CT pathophysiology
A 64-year-old man presenting with headache and acute aphasia.

CT perfusion

B. Cerebral Blood Flow

C. Cerebral Blood Volume

D. Mean Transit Time

CBV/CBF

CT perfusion pathophysiology

• Ischaemic area has both ↓ CBF and CBV.
  – ↓ total CBV is a specific indicator for irreversible ischemia or infarct.
  – Severe reduction (<30% CBF) marker for irreversible damage.

• Penumbra shows CBF with normal to ↑ CBV


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Standard MRI

- Determines hydrogen protons in tissues to produce images of different densities.
- Superior for detection of ischaemia in brainstem, cerebellum, small structures of the brain, & very small infarcts (Jaunch et al 2013).
- Detects sub-acute vasogenic oedema & sub-acute stroke.
MR infarct or haemorrhage?
MR Diffusion imaging

- Detects infarct within minutes after onset (FLAIR takes hours)
- Visualises cytotoxic oedema
- Improves stroke detection from 50% to >95%
- Advantages for detection of stroke mimics
- Increases door to needle by 10 mins.
- 1 in 5 wake up stroke
- WAKE-UP trial (2018)
  - N=503 placebo v rt-PA
  - DWI-flair mismatch


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Summary

• Early cytotoxic and later vasogenic oedema main pathophysiological changes.
• CT or MR perfusion imaging visualises ischaemic penumbra.
• MR DWI offers new options for stroke of unknown onset, determining cause of stroke and increasing accuracy of diagnosis.
Part 2 – Intra-arterial Thrombectomy
Catherine Curley
Aims & Objectives

• Evidence for IAT
• Procedure
• Post IAT care
• Case Study
Why IAT?

• IV-rtPA <30% recanalization in large vessel and basilar artery (Bhatia, R. *Stroke* 2010;41:2254–80)

• 9 positive RCTs established it as treatment for large vessel anterior circulation infarcts <6 hrs

• Limited evidence for basilar artery occlusion

• Approved by NICE in 2016
HERMES collaboration

**Lancet 2016; 387:1723-31**

- Meta-analysis of 5 RCTs
- **n=1287**
- Significant reduced disability at 90 days
- Reduced disability by at least 1 on MRS NNT=2.6
- No change in mortality or ICH risk compared to control

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Implementation in UK

- PISTE trial demonstrated safety in UK (Keith W Muir et al. *J Neurol Neurosurg Psychiatry* 2017;88:38-44).
- Modelling suggests around 10% of all stroke admissions in the UK (around 9500 patients) would be eligible for IAT annually. (Evans M.B. *Practical Neurology* 2017;17:252-265).
- Currently two centres offer 24hr IAT, most working hours only.
If there is a proximal thromboembolic occlusion of the middle cerebral artery (a), the stent retriever is run past the intra-arterial thrombus in a microcatheter (b). When the microcatheter is retracted, the stent retriever is pushed out and released inside the thrombus. After a few minutes, the stent expands into the thrombus so that the mesh of the stent hooks into the thrombus (c). The expanded stent, together with the whole thrombus, is then removed into a larger catheter (d).
Plain CT scan of head (a) and prethrombectomy (b) and post-thrombectomy (c, e, f) digital subtraction angiograms in a 58-year-old man with a short history of visual symptoms and vertigo followed by a rapid drop in conscious level.

Matthew R B Evans et al. Pract Neurol 2017;17:252-265
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Devices

- 1\textsuperscript{st} generation devices (Merci retriever) increased re-canalisation but improved outcomes for stroke patients was not proven.
- 2\textsuperscript{nd} generation (Solitaire and Trevo) devices achieved significant higher perfusion rates and better patient outcome, lower ICH rates.


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Criteria for IAT

1. Decision to proceed with IAT made by a stroke physician along with a neuro interventionalist at a specialist centre.

2. Documented large vessel anterior circulation occlusion (CTA).

3. Significant clinical deficit at time of treatment >NIHSS above 5 or a lower score that is functionally significant to patient.

4. Treatment with IV thrombolysis within 4.5 hours.
Criteria for IAT

5. Lack of extensive early ischaemic changes (ASPECTS score of more than 5).

6. Pre stroke functional status and lack of serious co-morbidities indicating potential to benefit (age 80 and above is not a contraindication to treatment).

7. Delivered within 6 hours of stroke onset. *(NICE proposed update: up to 24hrs)*
- 6-24 hour time window including wake up strokes.
- NIHSS above 10
- Pre morbid mRS 0-1
- ICA/MCA M1 occlusion
- CT/MR perfusion salvageable brain

DAWN trial investigators (2018) NEJM 378: 11-21
IV rt-PA Time *still is brain*


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Complications

• Direct device related vascular injury
• Vessel perforation 1.6% (ICH, subarachnoid haemorrhage, arterial dissection)
• Stent retriever detachment 2-3%
Post intervention care

• Undertaken in major neurointerventional centres with a well functioning HASU

• Blood pressure – limited evidence for after IAT. Advise usual post stroke care

• Anti-thrombotics – not started until repeat scan. Dependent on whether stent is deployed.

• Continue to investigate cause of stroke.
Case study

- 75 year old female, normally fit and well
- Pre-morbid mRS 0
- New onset right sided weakness at 09.00
- NIHSS 17
- Thrombolysis commenced at 11am
- CTA-total occlusion of left MCA
- 11.30 NIHSS 17
- Discuss the information you would give patient and relatives in regards to possible IAT and transfer to a specialist centre?
Part 3 – Acute management of ICH

Catherine Curley
Primary Intracerebral Haemorrhage (PICH) Background

• Accounts for 20% of all strokes
• Affects 2 million people in the world per year (Krishnamurthi R.V. Lancet Glob Health 2013; 1: e259–81)
• One in 3 people die within the first month of onset (van Asch C.J. Lancet Neurol 2010; 9: 167–76)
• Organised stroke care associated with more favourable trends in survival (Cordinnier et al. Lancet 2018; 392: 1257–68)
The growing burden of ICH

High income countries:
- Case fatality 30-40% at 1 month
- Only 20% regain independence
- No change in incidence over last 30 years
- Changing profile: older, ↑antithrombotics

Low and middle income countries:
- 80% of incident cases
- Higher mortality rates
- 86% of DALYs lost

Age-standardized mortality rates in 2010

Early recognition

• Difficult to differentiate from acute ischaemic stroke from bedside
• Rapidly progressive neurological symptoms
• Headache
• Vomiting
• Seizures
• Reduced consciousness
• Early neuroimaging
Causes

- 15% underlying vascular lesion e.g. Arteriovenous malformation
- 80% hypertension and amyloid angiopathy
- 5% other cause e.g. vasculitis, infective endocarditis, severe clotting deficiency, PRES, haemorrhagic transformation
- 15% are associated with anticoagulation treatment
ICH – different in acute phase

ICH is a space occupying lesion

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Blood pressure management

- Multiple factors contribute to HPTN including stress of acute event and prior peaks in SBP
- Elevated SBP is defined as >140 mm hg
- Is modifiable and associated with haematoma growth and poor recovery
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<tr>
<th>Target SBP – intensive group</th>
<th>INTERACT2</th>
<th>ATACH-II</th>
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<tbody>
<tr>
<td></td>
<td>&lt; 140 mmHg by 1 h&lt;br&gt;stop if &lt; 130 mmHg</td>
<td>110-139 by 2 h</td>
</tr>
<tr>
<td>Target SBP – standard group</td>
<td>&lt; 180 mmHg&lt;br&gt;target 160/90 (AHA 2010)</td>
<td>140-179 by 2 h</td>
</tr>
<tr>
<td>Agents used</td>
<td>α-blocker (urapadil) – 32.5%&lt;br&gt;Ca$^{2+}$ channel blocker – 16.2%&lt;br&gt;Nitroglycerin – 14.9%&lt;br&gt;α/β blocker (labetalol) – 14.4%&lt;br&gt;Diuretics – 12.4%&lt;br&gt;Nitroprusside 12.1%&lt;br&gt;Others – 12%</td>
<td><strong>First line</strong>: nicardipine&lt;br&gt;<strong>Second line</strong>: Labetolol&lt;br&gt;Urapadil&lt;br&gt;Diltiazem</td>
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| SBP achieved with treatment | **Mean at 1 h:**  
150 mmHg (intensive)  
164 mmHg (standard) | **Mean minimum 0-2 h:**  
129 mmHg (intensive)  
141 mmHg (standard) |
| Primary outcome          | mRS 4-6  
52.0% (I) vs 55.6% (S) (p=0.06) | mRS 4-6  
38.7% (I) vs 37.7% (S) (p=0.72) |
| Secondary outcomes       | **Ordinal shift: 0.87 (0.77–1.00) p=0.04**  
EQ5D: 0.60 (I) vs 0.55 (S); p=0.002  
SAEs: 23.3% (I) vs 23.6% (S) | Ordinal shift: 1.07 (p=0.56)  
EQ5D: 0.7 (I) vs 0.7 (S); p=0.47  
Renal AEs: 9% (I) vs 4% (S) p=0.002 |

Outcome

• Overall evidence is reasonably strong to recommend intensive BP lowering (Target systolic BP 130-140 mm Hg within 6 hours of onset).

• May improve functional outcome.

• More research is needed to assess the effects of this treatment in certain subgroups.
Neurosurgery for ICH

• Infratentorial ICH
  – Risk of brainstem compression, herniation syndromes, hydrocephalus
  – Procedures – EVD / posterior fossa decompression / haematoma evacuation

• Supratentorial ICH
  – Early haematoma evacuation in the stable patient
  – Haematoma evacuation in the deteriorating patient
  – External ventricular drainage for hydrocephalus
Early haematoma evacuation in the stable patient

Mendelow et al. (2013) *Lancet* 382:397–408

Minimally invasive surgery
Acute Bundle of Care for ICH (ABC-ICH) project

**Design:** Single centre quality improvement project and evaluation

**Site:** Salford Royal Hospital, Greater Manchester, UK

**Aim:** 10 percentage point reduction in 30-day case fatality after admission with acute ICH by the end of 2016.

**Methods:**
- Model for Improvement used to conduct QI project
- Improvement phase: June 2015 – June 2016
- Data entered in QI registry from Jun 2013 – Jan 2017
- All spontaneous ICH included (excluded traumatic ICH, haemorrhagic transformation)
**Aim:** By Dec 2016, 10 percentage point reduction in 30-day case fatality after admission to Salford with acute ICH

- **Anticoagulants:** Recognition as emergency
  - Fast reversal

- **Blood pressure:**
  - Intensive BP lowering
  - Early enteral treatment

- **Neurosurgery:**
  - Timely, focused referrals
  - ICH MDT meetings

- **Supportive care:**
  - Improved access to critical care
  - Reduction in DNR orders
Kaplan-Meier analysis

Pre-QI project commencement:
- 381 cases admitted
- 30-day case fatality = 33.9%

Post-QI project commencement:
- 449 cases admitted
- 30-day case fatality = 23.4%

Logrank test: \( p=0.001 \)
Case study

• 65 year old, PMH hypertension controlled with Amlodipine 5mg OD, independently mobile, sudden onset headache and drowsiness at 13.00.
• Admitted to ED at 14.30, CT shows intracerebral haemorrhage in left basal ganglia
• Patient sat up at 15.00 and vomited without nausea
• How would you manage the blood pressure and what is the stroke nursing role within this?
• What do you need to consider?
Acknowledgements

• University of Manchester: Dr Adrian Parry Jones