SOUTH WEST LONDON AND SURREY TRAUMA NETWORK REFERRAL PATHWAY FOR CHILDREN WITH SPINAL CORD INJURIES

0 hours: ASSESSMENT AND PROVISIONAL DIAGNOSIS

- Triage and management of other injuries including anaesthetic evaluation
- Baseline neurological assessment; determine level and conduct serial examinations
- CT specific area but MRI entire spine (whiplash effect on the spine makes a second spinal column injury likely); beware SCIWORA (SCI without radiological abnormality)

4 hours: CONTACT LONDON SPINAL CORD INJURY CENTRE, STANMORE

- A referral needs to be made to LSCIC, Stanmore by 4h even if the child is felt to be unsuitable for transfer to the SCIC as LSCIC, Stanmore will advise on ongoing spinal management and provide outreach specialist nurses & therapists
  - Phone 0844 892 1915 and follow instructions for Stanmore
  - Ask switchboard to bleep the Spinal Coordinator (bleep 755), on site 24 hours a day

  National online referral form (to be completed in full by transfer)
  - https://mdsas.nhs.uk/Spinal
  - Note “nww” not “www”. Username and password not required –click “new patient”

  Appropriate location for medical and surgical management agreed with LSCIC, Stanmore. Immediate management plan for SCI agreed.
  - Early referral allows earliest possible outreach assessment.

CLINICAL ADVICE WHILST AWAITING BED AT LSCIC, STANMORE

- Telephone advice on SCI management available from SCI Coordinator (bleep 755), on site 24 hours a day
  - The LSCIC Outreach team will assess the patient within 5 days

As soon as clinically appropriate: TRANSFER TO ALAN BRAY CHILDREN’S HDU

- Ensure spinal alignment maintained at all times during transfer
- Plan transfer, including accompanying medical staff, with LSCIC, Stanmore

Pan-London Paediatric Trauma Group and London Spinal Cord Injury Centre, August 2014
Thanks to Dr Danielle Hall and Dr Sakura Hingley
### The immediate management of children with Spinal Cord Injuries

**AIRWAY**
- Anaesthetic concerns: ensure neck remains in neutral position; maintain MAP, anticipate bradycardia and hypotension when intubating or suctioning, avoid succinylcholine, maintain temperature.

**BREATHING**
- SCI causes hypersecretion & hugely deceased vital capacity due to reduced intercostal/abdominal muscle function
- Nurse flat; maximum of 15 degrees if ventilated
- Hourly observation for signs of respiratory distress/fatigue
- Humidify oxygen, consider bronchodilators, early use of incentive spirometry, non-invasive ventilation etc.

**CIRCULATION**
- SCI may result in bradyarrhythmias or asystole; log rolling, repositioning and tracheal stimulation may exacerbate
  - Prescribe Atropine for the emergency treatment of bradycardia:
    - 20 microgram/kg (minimum 100 mcg, maximum 600 mcg)
    - repeated after 5 minutes if required
    - maximum 1mg in a child or 2mg in an adolescent (dosing from APLS 4th edition)
  - If prolonged or repeated bradycardia, glycopyrrolate may be better – discuss with SCIC
  - Adjust blood pressure to age
- Children with high spinal lesions above T5 are at risk of Neurogenic Shock (resulting from peripheral vasodilatation)
- Fluid resuscitate if needed but do not chase blood pressure as likely to be lower than normal parameters
- Maintenance fluids, titrated to urine output (not blood pressure), aiming for 0.5ml/kg/h

**BEWARE AUTONOMIC DYSREFLEXIA** – a rare complication that may occur after spinal shock wears off
- An emergency hypertensive crisis (approx 15-20 mmHg above baseline) secondary to sympathetic chain disruption
- Monitor for signs: relative hypertension, bradycardia, flushed face and upper extremities, stuffy nose, pounding headache, sweating, irritable crying
- Identify stimuli e.g kinked catheter, UTI, impacted bowel, pressure sore, other noxious stimuli
- Treatment:
  - Nifedipine/GTN spray/GTN tablets
  - Monitor cardiovascular signs continuously until resolution, keeping heightened awareness of repeat attack

**DISABILITY / NEUROLOGICAL ASSESSMENT**

**MOVING AND HANDLING**
- Remove from spinal board within 20 minutes
- Transfer between surfaces using a spinal board or scoop plus head blocks
- Maintain full spinal alignment, supporting body to keep neck neutral & re-check every time child is moved
- Turn every 2 hours. Guidelines on how to turn at [www.mascip.co.uk](http://www.mascip.co.uk)

**GASTROINTESTINAL & BLADDER**
- Place urinary catheter immediately and leave on free drainage
- NBM initially but start feeds when bowel sounds return following discussion with NSIC, Stoke Mandeville
- Commence a PPI and bowel regime

**SKIN : RED MARKS ARE SIGNIFICANT!**
- Complete Waterlow Score: [http://www.judy-waterlow.co.uk/waterlow_score.htm](http://www.judy-waterlow.co.uk/waterlow_score.htm)
- Review all pressure areas including areas of splints, plaster casts and orthoses

**THROMBOEMBOLIC PHENOMENA**
- Mechanical prophylaxis (TED or pneumatic compression stockings)
- Consider prophylactic low molecular weight heparin in children over 13

**SURGERY**
- Low velocity injury with facet joint dislocation: reduction in less than 4 hours is indicated
- Advice from the on-call consultant at NSIC is available on a consultant to consultant basis
### Muscle Function Grading

- 0 = total paralysis
- 1 = palpable muscle contraction
- 2 = active movement, full range of motion (ROM) with gravity eliminated
- 3 = active movement, ROM against gravity
- 4 = active movement, full ROM against gravity and moderate resistance in a muscle-specific position
- 5 = (normal) active movement, full ROM against gravity and full resistance in a functional muscle position expected from an otherwise uninvolved person

### Sensory Grading

- 0 = absent
- 1 = altered, either decreased or increased sensation
- 2 = normal
- NT = not testable (due to immobilization, severe pain, etc.)

### Non Key Muscle Functions (optional)

May be used to assign a motor level to differentiate AIS B vs. C.

<table>
<thead>
<tr>
<th>Movement</th>
<th>Root level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder: Flexion, extension, abduction, adduction, internal and external rotation</td>
<td>C6</td>
</tr>
<tr>
<td>Elbow: Supination</td>
<td></td>
</tr>
<tr>
<td>Elbow: Pronation</td>
<td>C6</td>
</tr>
<tr>
<td>Wrist: Flexion</td>
<td></td>
</tr>
<tr>
<td>Finger: Flexion at proximal joint, extension</td>
<td>C7</td>
</tr>
<tr>
<td>Thumb: Flexion and abduction in plane of thumb</td>
<td>C8</td>
</tr>
<tr>
<td>Finger: Flexion at MCP joint</td>
<td></td>
</tr>
<tr>
<td>Thumb: Opposition, adduction and abduction perpendicular to palm</td>
<td></td>
</tr>
<tr>
<td>Finger: Abduction of the index finger</td>
<td>T1</td>
</tr>
<tr>
<td>Hip: Adduction</td>
<td>L2</td>
</tr>
<tr>
<td>Hip: External rotation</td>
<td>L3</td>
</tr>
<tr>
<td>Hip: Extension, adduction, internal rotation</td>
<td>L4</td>
</tr>
<tr>
<td>Knee: Flexion</td>
<td></td>
</tr>
<tr>
<td>Ankle: Inversion and eversion</td>
<td></td>
</tr>
<tr>
<td>Toe: MP and P extension</td>
<td></td>
</tr>
<tr>
<td>Hallux and Toe: DP and PP flexion and abduction</td>
<td>L5</td>
</tr>
<tr>
<td>Hallux: Adduction</td>
<td>S1</td>
</tr>
</tbody>
</table>

### ASIA Impairment Scale (AIS)

A = Complete. No sensory or motor function is preserved in the sacral segments S4-5.

B = Sensory Incomplete. Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-5 (light touch or pin prick at S4-5 or deep pain and pressure). AND no motor function is preserved more than three levels below the motor level on either side of the body.

C = Motor Incomplete. Motor function is preserved below the neurological level, and more than half of key muscle functions below the neurological level of injury (NLI) have a muscle grade < 3 (Grades 0-2).

D = Motor Incomplete. Motor function is preserved below the neurological level, and at least half (or more) of key muscle functions below the NLI have a muscle grade ≥ 3.

E = Normal. No sensory or motor function as tested with the SNASS criteria are normal in all segments, and the patient had normal motor function in ALL segments. Someone with an initial SCI does not receive an AIS grade.

**For an individual to receive a grade of C or D, i.e., motor incomplete status, they must have either (1) voluntary and active motor function in 2 or more key muscle functions (2) 2 out of 3 key muscle functions in the lower extremities (knee flexion at 90 degrees, ankle dorsiflexion, and toe flexion) (3) or 2 out of 3 key muscle functions in the upper extremities (shoulder abduction, elbow flexion, and wrist flexion).**

### Steps in Classification

1. Determine sensory levels for right and left sides.
   - The sensory level is the most caudal, intact dermatome for both pin prick and light touch sensation.

2. Determine motor levels for right and left sides.
   - Defined by the lowest key muscle function that has a grade of at least 3 (on supine testing), providing the key muscle functions represented by segments above that level are judged to be intact (graded as 0).
   - Note: In regions where there is no motor to test, the motor level is presumed to be the same as the sensory level, i.e., testable motor function above that level is also normal.

3. Determine the neurological level of injury (NLI).
   - This refers to the most caudal segment of the cord with intact sensation and voluntary or more than minimal muscle function strength, provided that there is normal voluntary sensory and motor function distal to the level.
   - The NLI is the most caudal segment of the cord and motor levels determined in steps 1 and 2.

4. Determine whether the injury is Complete or Incomplete.
   - (i.e., absence or presence of sensory sparing)
   - A = No sensory sparing.
   - B = Some sensory sparing.
   - C = Full motor sparing.
   - D = Some motor sparing.
   - E = Normal.

5. Determine ASIA Impairment Scale (AIS) Grade:
   - Is injury Complete? If YES, AIS=A and can code TFP (lowest dermatome or myotome on each side with some preservation).
   - Is injury Motor Complete? If YES, AIS=B
     - (No=voluntary or more than minimal muscle function more than three levels below the motor level on a given side, if the patient has sensory incomplete classification)
     - Are at least half (half or more) of the key muscles below the neurological level of injury graded 3 or better?

   - If sensory and motor function is normal in all segments, AIS=E.

Note: AIS E is used in follow-up testing when an individual with a documented SCI has recovered normal function. If initial testing no deficits are found, the individual is neurologically intact; this ASIA Impairment Scale does not apply.