Learning Pack: Neurology

Comments/feedback to mehrengise.cooper@nhs.net (TPD)

CONTENT:

Lumbar puncture - Communication

Facilitator: Consultant Participants: Level 1-3 trainees

Instruction for participants:

- Group discussion: What are the contraindications to LP?
- Role play: Choose someone to play the role of a parent of a child with suspected meningitis. Assume there are no contraindications to LP in this scenario. Role play taking the consent for LP, addressing the parental concerns including possible complications (10 minutes)
- Group discussion: What is the role of imaging in preparing for LP? Can neuroimaging (CT scan, MRI scan or ultrasound) rule out raised intracranial pressure to allow for a lumbar puncture to be safely performed?

After completing the activities, see next page for notes

Contraindications to LP

It is important that children and young people with suspected bacterial meningitis have a lumbar puncture as soon as possible, but only when it is safe to do so. Contraindications to lumbar puncture include:

- signs suggesting raised intracranial pressure:
  - reduced or fluctuating level of consciousness (Glasgow Coma Scale score less than 9 or a drop of 3 or more)
  - age-relative bradycardia and hypertension
  - focal neurological signs
  - abnormal posture or posturing
  - unequal, dilated or poorly responsive pupils
  - papilloedema
  - abnormal 'doll's eye' movements
  - tense, bulging fontanelle
- shock
- extensive or spreading purpura
- convulsions until stabilised
- coagulation abnormalities:
  - coagulation results (if obtained) outside the normal range
  - platelet count below 100×10^9/litre
  - receiving anticoagulant therapy
- superficial infection at the lumbar puncture site
- respiratory insufficiency (lumbar puncture is considered to have a high risk of precipitating respiratory failure in the presence of respiratory insufficiency).

Source: NICE CG102

Consent for LP:

The following information may be helpful:

- Explain that precautions will be taken to prevent iatrogenic infection.
- The spinal cord cannot be injured (the needle enters below it).
- The body replaces the small amount of fluid removed within 36 hours.
- The rationale for testing CSF: this may be to rule out infection, or to find out more information about an underlying condition.
- Sedation / general anaesthetic / local anaesthetic (or a combination) may be used.

Complications of the procedure include:

- Failure of the procedure / dry tap.
- Child is too restless to proceed.
- Blood staining of the CSF affecting results.
- Headache (settles within 48 hours)
- Small amount of swelling/pain where the needle went in.

Group discussion: What is the role of imaging in preparing for LP?

- CT or MRI scan can suggest blockage or impairment of the cerebrospinal fluid pathways e.g. by blood, pus, tumour or coning; in which case LP should not be performed without consultant discussion.
- However a normal CT scan does not exclude raised intracranial pressure and should not influence the decision to perform a lumbar puncture if other contraindications are present
- **The decision to perform a lumbar puncture in a child with a decreased conscious level should be made by a consultant paediatrician who has examined the child**

Resources:

NICE guideline – bacterial meningitis (CG102)
https://www.nice.org.uk/guidance/cg102/

Thompson C, Kneen R, Riordan A et al. Encephalitis in children. Arch Dis Child 2012;97:150–161. URL: https://adc.bmj.com/content/97/2/150

Royal College of Paediatrics and Child Health. Decreased Conscious Level, The Management of a Child with a Decreased Conscious Level: A Nationally Developed Evidence-Based Guideline for Hospital Practitioners. 2005 URL: https://www.rcpch.ac.uk/resources/management-children-young-people-acute-decrease-conscious-level-clinical-guideline

New diagnosis of epilepsy - Group learning session

Facilitator: Consultant Participants: Level 1-3

Instructions for Facilitator: Chair discussion of case
(see participant questions below)

Instructions for participants:
Read the case and work together through the discussion points (20 mins).

Case:
A GP phones for advice regarding a 12 year old girl with a first suspected seizure. There are no previous medical problems. The episode occurred at home yesterday. She was playing computer games at home with her older brother who describes sudden onset of tonic clonic jerking affecting all four limbs with complete loss of consciousness. There was no colour change. The episode self-resolved at 2 minutes and was followed by 30 minutes of post-ictal drowsiness. She is now back to her normal self and completely asymptomatic.

There are no other abnormal movements reported, no vacant episodes and no previous medical history. The GP is happy that the patient is clinically well and has given the relevant advice regarding risk avoidance and what to do in the event of future episodes. The GP has carried out an ECG, which is normal.

Discussion points:
- Does this patient need to be seen by a paediatrician with expertise in epilepsy? If so, when?
- Two weeks later the child has another episode with similar features and duration. The family would like to start an antiepileptic medication. What should be offered and discussed in view of the patient's age and sex?
- What is the risk of SUDEP for this patient?

After completing the activities, see next page for notes

Does this patient need to be seen by a paediatrician with expertise in epilepsy? If so, when?

NICE guideline on diagnosis and management of epilepsy (CG137) recommends all children and young people with a recent onset suspected seizure should be seen urgently (within 2 weeks) by a paediatrician with training and expertise in epilepsy.

The family would like to start an antiepileptic medication. What should be offered and discussed in view of the patient's age and sex?

- The decision to initiate AED therapy should be taken between the child, young person or adult, their family and the specialist after a full discussion of the risks and benefits of treatment. This discussion should take into account details of the person's epilepsy syndrome, prognosis and lifestyle (NICE CG137).
- Treatment with AED therapy is generally recommended after a second epileptic seizure (NICE CG137).
- When possible, choose which AED to offer on the basis of the presenting epilepsy syndrome. If the epilepsy syndrome is not clear at presentation, base the decision on the presenting seizure type(s) (NICE CG137).
- Do not offer sodium valproate to women and girls of childbearing potential (including young girls who are likely to need treatment into their childbearing years), unless other options are ineffective or not tolerated and the pregnancy prevention programme is in place (NICE CG137).
- Lamotrigine should be offered as a first-line treatment for newly diagnosed generalised tonic-clonic seizures, where sodium valproate is contraindicated (NICE CG137).
- Consider carbamazepine or oxcarbazepine, but be aware of the risk of exacerbating myoclonic or absence seizures (NICE CG137).
- Discuss the importance of adherence to the treatment plan, whatever AED is chosen

SUDEP

SUDEP is a rare but critically important complication of epilepsy in children and young people. Children with epilepsy have a fivefold higher risk of dying than the general population in the first 15-20 years after diagnosis.

Mechanisms are poorly understood but include apnoea and cardiac arrhythymia. ‘Symptomatic’ epilepsy (epilepsy occurring as a symptom of an underlying problem e.g. hypoxic brain injury, infection, structural brain malformation, metabolic disorder) is associated with a 20-fold increased risk of mortality compared to other epilepsy types. Children who are otherwise healthy, with uncomplicated epilepsy responsive to one medication, are at very low risk.

Resources:

Epilepsies: diagnosis and management
http://www.nice.org.uk/guidance/cg137

Callenbach PMC, Westendorp RGJ, Geerts AT et al. Mortality risk in children with epilepsy: the Dutch study of epilepsy in childhood. Pediatrics. 2001. 107:1259-1263. URL: https://pediatrics.aappublications.org/content/107/6/1259

Morse and Kothare. Pediatric SUDEP. Pediatric Neurology. 2016; 57:7-16. URL: https://www.pedneur.com/article/S0887-8994(16)00030-8/fulltext

Epilepsy Action www.epilepsy.org.uk

Status epilepticus - Group learning session

Facilitator: Consultant Participants: Level 1-3

Instruction for participants:

- Review the APLS guideline for management of status epilepticus (5 minutes)
- Read and discuss the attached paper 'Levetiracetam versus phenytoin for second-line treatment of paediatric convulsive status epilepticus (EcLiPSE): a multicentre, open-label, randomised trial'. (30 minutes)
- Imagine you are in charge of producing the next APLS guideline for status epilepticus. Do you think this paper should change our practice? (10 minutes)

Paper: Free download at:
https://www.thelancet.com/action/showPdf?pii=S0140-6736%2819%2930724-X

Levetiracetam versus phenytoin for second-line treatment of paediatric convulsive status epilepticus (EcLiPSE): a multicentre, open-label, randomised trial

*Mark D Lyttle, Naomi E A Rainford, Carrol Gamble, Shrouk Messahel, Amy Humphreys, Helen Hickey, Kerry Woolfall, Louise Roper, Joanne Noblet, Elizabeth D Lee, Sarah Potter, Paul Tate, Anand Iyer, Vicki Evans, Richard E Appleton, with support of Paediatric Emergency Research in the United Kingdom & Ireland (PERUKI) collaborative**

APLS: Next page

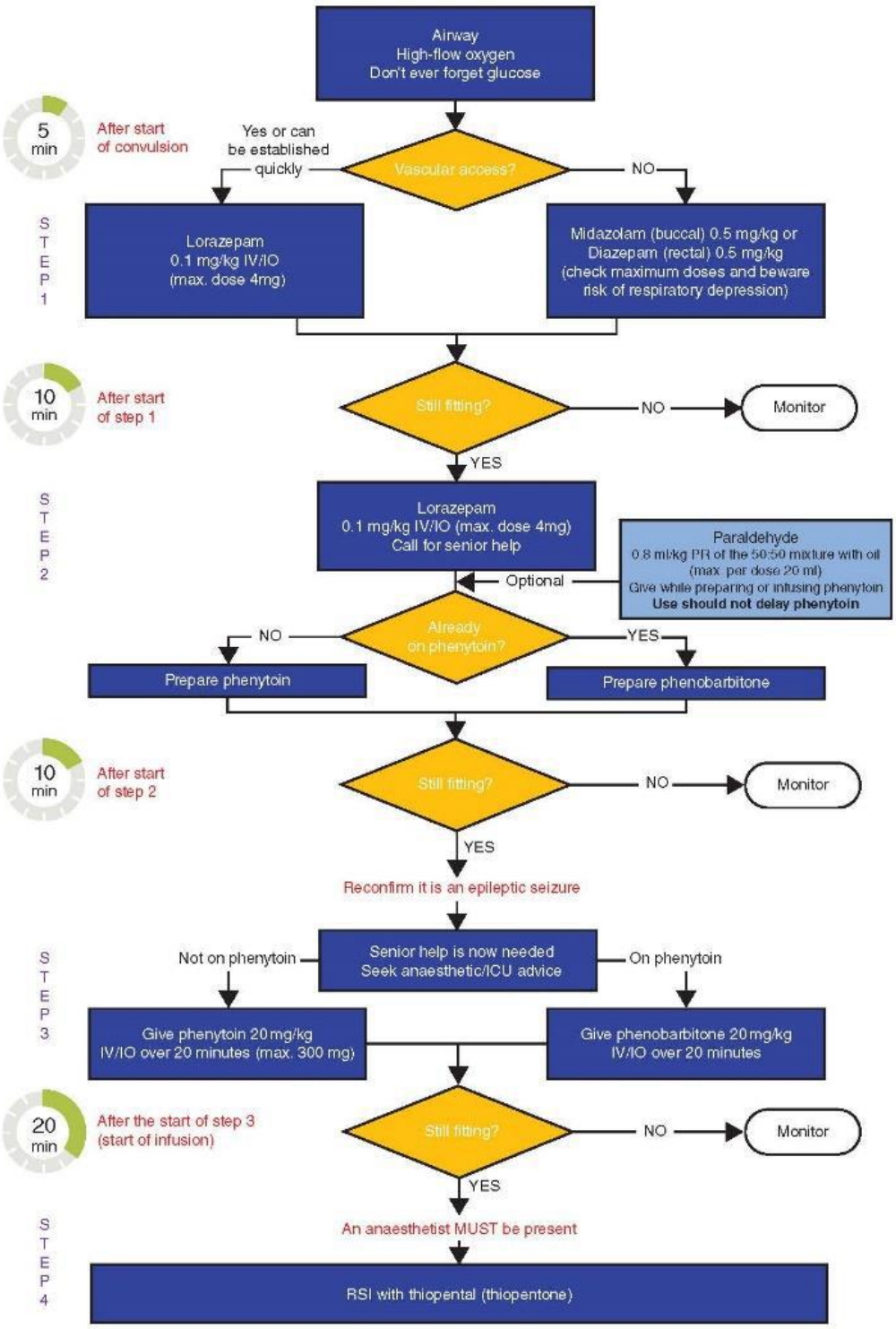

Figure 9.1 Status epilepticus algorithm. [ICU, intensive care unit; RSI, rapid sequence induction]

Acute admission with seizures - Group Learning

A 12 year old girl develops a generalised tonic clonic seizure while at school. The ambulance is called and her seizure terminates with PR diazepam given by the paramedics at about 10 mins from seizure onset. She is transferred to the district general hospital.

Parents report she has been suffering from headaches in the last week. No fever. No rash. No photophobia. No past medical history. No regular medications. No family history of seizures/ neurological conditions.

Bedside observations including blood pressure are normal. CT head is performed and is reported as normal. She is moved to the general paediatric ward.

Discussion Part 1:

- **What is the differential diagnosis at this point?**
- **What further investigations should be performed?**

After discussing your response to these questions as a group, proceed to the next page

Differential diagnosis:

- Meningo-encephalitis – viral, bacterial, autoimmune
- First onset of primary generalized epilepsy
- Toxins – recreational drug use?
- Electrolyte disturbance and metabolic disorders
- Vascular – early arterial ischaemic stroke, vasculitis, cerebral venous sinus thrombosis
- Non-epileptic attack disorder

Initial investigation results:

- Bloods: U&E, bone profile, FBC, LFTs and inflammatory markers normal.
- CSF: WBC 30, RBC<0, protein and glucose normal, viral PCR negative, CSF culture negative
- MRI head with contrast, diffusion-weighted imaging and MRA/MRV: normal
- ECG: normal
- EEG: background activity showing generalised slow waves

Progress in hospital:

The patient is commenced on antimicrobial treatment (ceftriaxone, aciclovir and clarithromycin). She goes on to have further generalised tonic-clonic seizures every day requiring IV lorazepam to terminate. Over the next few days, she becomes very agitated and is screaming on the ward. She seems to be talking to herself although her speech is not clear. She has not slept properly in the last few nights. Between seizures you observe frequent, restless, purposeless movements of the tongue, face and upper limbs (dyskinesia).

She has a further generalised tonic clonic seizure which does not terminate with 2 doses of IV lorazepam and IV phenytoin. She is transferred to PICU.

<u>Discussion Part 2:</u>

- **What is the single most important investigation to now confirm the diagnosis?**
- **What treatments should be considered?**
- **What additional investigations should be arranged?**

After discussing your responses, proceed to the next page

Single most important investigation:
CSF and serum NMDA receptor antibodies

Treatments to consider:
- First-line immunotherapy: IV methylprednisolone, IV Immunoglobulin, plasma exchange
- Second-line immunotherapy: rituximab
- Maintenance anti-epileptic treatment
- Antipsychotics, sedatives

Additional investigations:
- Screen for tumours, beginning with US abdomen and pelvis (?ovarian teratoma)
- CSF oligoclonal bands

Notes:
Autoimmune encephalitis should be suspected in patients with subacute onset (rapid progression of less than 3 months) of working memory deficits (short-term memory loss), altered mental status, or psychiatric symptoms, in combination with at least one of the following:
• New focal CNS findings
• Seizures not explained by a previously known seizure disorder
• CSF pleocytosis (WBC > 5)
• MRI features suggestive of encephalitis

Abnormal background activity on EEG can be very useful in discriminating encephalopathy from primary psychiatric illness.

The most frequent cause of autoimmune encephalitis in children and young adults is NMDA receptor antibody encephalitis (also known as anti-NMDA encephalitis), in which antibodies bind to the NMDA receptor in the brain, causing a characteristic clinical syndrome including cognitive and memory dysfunction, prominent psychiatric symptoms with behavioural disturbance, seizures and movement disorder. In adolescent females an ovarian teratoma can be the triggering event. Half of patients require admission to intensive care. MRI is usually normal. Diagnosis is confirmed by

detecting the NMDAR antibody in the blood or CSF. The antibody result can take days to weeks to come back, so treatment must not be delayed while awaiting the result, as early initiation of immunotherapy significantly improves the chance of good outcome. Despite the severity of the acute illness, most adolescent patients eventually make a full recovery.

Resources:

What is Anti-NMDA Encephalitis:
https://www.youtube.com/watch?v=Jf9QH7ax26w

Graus et al. A clinical approach to diagnosis of autoimmune encephalitis. Lancet Neurol 2016; 15(4): 391-404.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5066574/

Dalmau J, Armangue T, Planaguma J et al. An update on anti-NMDA receptor encephalitis for neurologists and psychiatrists: mechanisms and model. Lancet Neurol 2019;18:1045-57. URL:
https://www.thelancet.com/article/S1474-4422(19)30244-3/fulltext

Wright S, Hacohen S, Jacobson L, Agrawal S, Gupta R, Philip S, Smith M, Lim M, Wassmer E, Vincent A. N-methyl-D-aspartate receptor antibody-mediated neurological disease: results of a UK-based surveillance study in children. Arch Dis Child. 2015 Jun; 100(6): 521–526.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4453622/

Stroke – Group Learning

The paediatric team is called to A&E Resus as the paramedics are bringing in Sarah who is a 10 year old girl who is 'FAST positive'. She was at school when she suddenly developed right sided arm and leg weakness, right facial droop and slurred speech although she is alert. She has no past medical history and she is not on any regular medications.

Part 1 discussions:

- **What should you do when the patient arrives?**
- **What are your differentials?**
- **How urgently should you perform the investigations?**

CT head and angiogram is performed and shows an acute clot in the left middle cerebral artery.

Part 2 discussions:

- **What should you do? How quickly should this be done?**

Part 3 discussions:

- **If Sarah has history of sickle cell disease, how would the management change?**

Resources:

Poster summary of RCPCH Stroke in Childhood
https://www.rcpch.ac.uk/sites/default/files/2018-04/2017_stroke_in_childhood_-_pathway_poster.pdf

Full RCPCH Stroke in Childhood Guidelines:
https://www.rcpch.ac.uk/sites/default/files/2019-04/Stroke%20guideline%2008.04.19.pdf

Part 1:

- As per Stroke in Childhood poster
- ABCDE management
- Rule out hypoglycaemia
- Calculate NIHSS score
- CT head + angiogram within 1hr of admission

Part 2:

- Consider thrombolysis (tPA) as per Stroke in Childhood poster
- Consider referral for thrombectomy
- If not suitable for thrombolysis or thrombectomy, commence aspirin 5mg/kg

Part 3:

- Discuss with haematologist
- Consider exchange transfusion

Headache - Group Learning Session:

Facilitator: Consultant Participants: SHO, SpRs

Instructions for Facilitator: Chair discussion of case
(see participant questions below)

Instructions for participants:
Read through case below and work through the following discussion points (20 mins):

- What, if any, is the most appropriate initial investigation for this child?
- What are the 'red flag' signs and symptoms that should prompt arrangement of neuroimaging in the A&E department for a child presenting with headache?

Case:
A previously well 11 year old boy presents to A&E with a two week history of headache occurring most days. Pain is in the suboccipital area bilaterally and radiates down into the neck. He describes the pain as continuous pressure. Severity is 5/10; he is able to mobilise around the house during episodes, which last up to 2-3 hours, but is distracted from his usual activities. Episodes usually occur in the evening but do not wake him from sleep. There is no history of nausea, vomiting, fever or rash. There is no history of foreign travel. He had a similar episode two months ago but is otherwise well.

On examination the patient is fully alert and oriented, and complaining of headache. Blood pressure is 102/62, HR 114, RR 22, T37.4. Fundoscopy is normal although he complains of pain when the light is shone into the eye. There is no cranial bruit. Neck extension and rotation are painless but neck flexion causes pain. The posterior aspect of the neck and shoulders are tender to palpation. The rest of the neurological examination is normal.

After discussing your response to these questions as a group, proceed to the next page

What, if any, is the most appropriate initial investigation for this child?

- No investigations are required
- This child meets the ICHD-3 criteria for episodic tension type headache with pericranial muscle tenderness, which requires at least two of the following:
    - Bilateral location
    - Pressing or tightening (non-pulsating) quality
    - Mild or moderate intensity
    - Not aggravated by routine physical activity such as walking or climbing stairs

  And both of the following:
    - No nausea or vomiting
    - No more than one of photophobia or phonophobia
- Diagnosis is on the basis of clinical assessment; investigations are not required in the absence of features suggestive of raised intracranial pressure, space occupying lesion or infection

What are the red flags for imaging in A&E?

Neuroimaging may be required in children with headache and one or more of the following:

- Not meeting diagnostic criteria for one of the primary headache disorders
- Abnormal neurological examination
- Rapidly progressing subacute headache
- New headache in an immunosuppressed child
- First or worst headache
- Systemic symptoms
- History of seizures
- Headaches awakening the child from sleep
- Intractable vomiting

<u>Resources:</u>

Kacperski et al. The optimal management of headaches in children and adolescents. Ther Adv Neurol Disord. 2016 Jan; 9(1): 53-68.

URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4710107/

Headache Classification Committee of the international Headahce Society (HIS). The International Classification of Headache Disorders, 3rd edition. Cephalagia 2013; 33:629. URL: https://ichd-3.org/wp-content/uploads/2018/01/The-International-Classification-of-Headache-Disorders-3rd-Edition-2018.pdf

Head Smart Early Diagnosis of Brain Tumours
https://www.headsmart.org.uk/

Neurofibromatosis Type 1 - Communication

Facilitator: Consultant Participants: Level 1-3 trainees

Case:

George is a 6 year old child referred to the general paediatric clinic. The GP has noticed George has 8 café au lait macules measuring over 0.5cm and axillary freckling. The GP suspects he may have Neurofibromatosis Type 1. There is no family history of NF1. The mother is currently 18 weeks pregnant.

Candidate Instructions

Please discuss with George's mother about the possible diagnosis of Neurofibromatosis Type 1 and the further management required.

Role Player Instructions:

George's mother has read about NF1 on the internet and would like to know:

- What further investigations does he need?
- Should George have a genetic test to confirm the diagnosis?
- What are the chances of the unborn child developing NF1?
- What follow up will George require?

Further Discussion:

- Diagnostic criteria for NF1 – does George need a genetic test for diagnosis?
- The role of the MDT in managing NF1 patients
- Referral criteria for the National Neurofibromatosis Service

Resources:

GOSH information sheet for health professionals
https://tinyurl.com/y965wd9m
Neurofibromatosis Type 1 Review Guidelines from Nerve Tumours UK
https://nervetumours.org.uk/images/downloads/NF1_Review_Guidelines_v2.pdf
Miller DT, Freendenberg D, Schorry E et al. Health Supervision for Children With Neurofibromatosis Type 1. Paediatrics. 2019: e20190660.
https://pediatrics.aappublications.org/content/pediatrics/143/5/e20190660.full.pdf American guidelines for NF1 with good explanation of the topic

Infantile Spasms - Lightning Teaching

Deliver a lightning teaching session on Infantile Spasms and Treatment

Resources:

West Syndrome (Infantile Spasms) information page from Epilepsy Action
https://www.epilepsy.org.uk/info/syndromes/west-syndrome-infantile-spasms

O'Callaghan FJK, Edwards SW, Alber FD. Vigabatrin with hormonal treatment versus hormonal treatment alone (ICISS) for infantile spasm: 18-month outcome of an open-label, randomized controlled trial. Lancet Child Adolesc Health. 2018; 2:715-25.
https://www.thelancet.com/journals/lanchi/article/PIIS2352-4642(18)30244-X/fulltext

Head injury and Safeguarding - Lightning Teaching & Group Discussion:

Deliver a lightning teaching on NICE head injury guidelines:
Discuss the immediate management of head injury in the A&E department.
Discuss what aspects of the history should raise safeguarding concerns in a case of head injury.

Resources:

NICE guidelines on head injury https://www.nice.org.uk/guidance/cg176

Paediatric FOMAed: Neuroprotective strategies for traumatic brain injury https://www.paediatricfoam.com/2019/09/neuroprotective-strategies-in-tbi/

Araki T, Yokota H, Morita A. Pediatric Trauamtic Brain Injury: Characteristic Features, Diagnosis and Management. Neurol Med Chir (Tokyo). 2017; 57(2):82-93. URL; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5341344/

Joyce T, Huecker MR. Pediatric Abusive Head Trauma (Shaken Baby Syndrome). 2019. https://www.ncbi.nlm.nih.gov/books/NBK499836/