Diagnostic Imaging Pathways - Paediatric, Seizure

Population Covered By The Guidance

This pathway provides guidance on imaging children with unexplained seizures.

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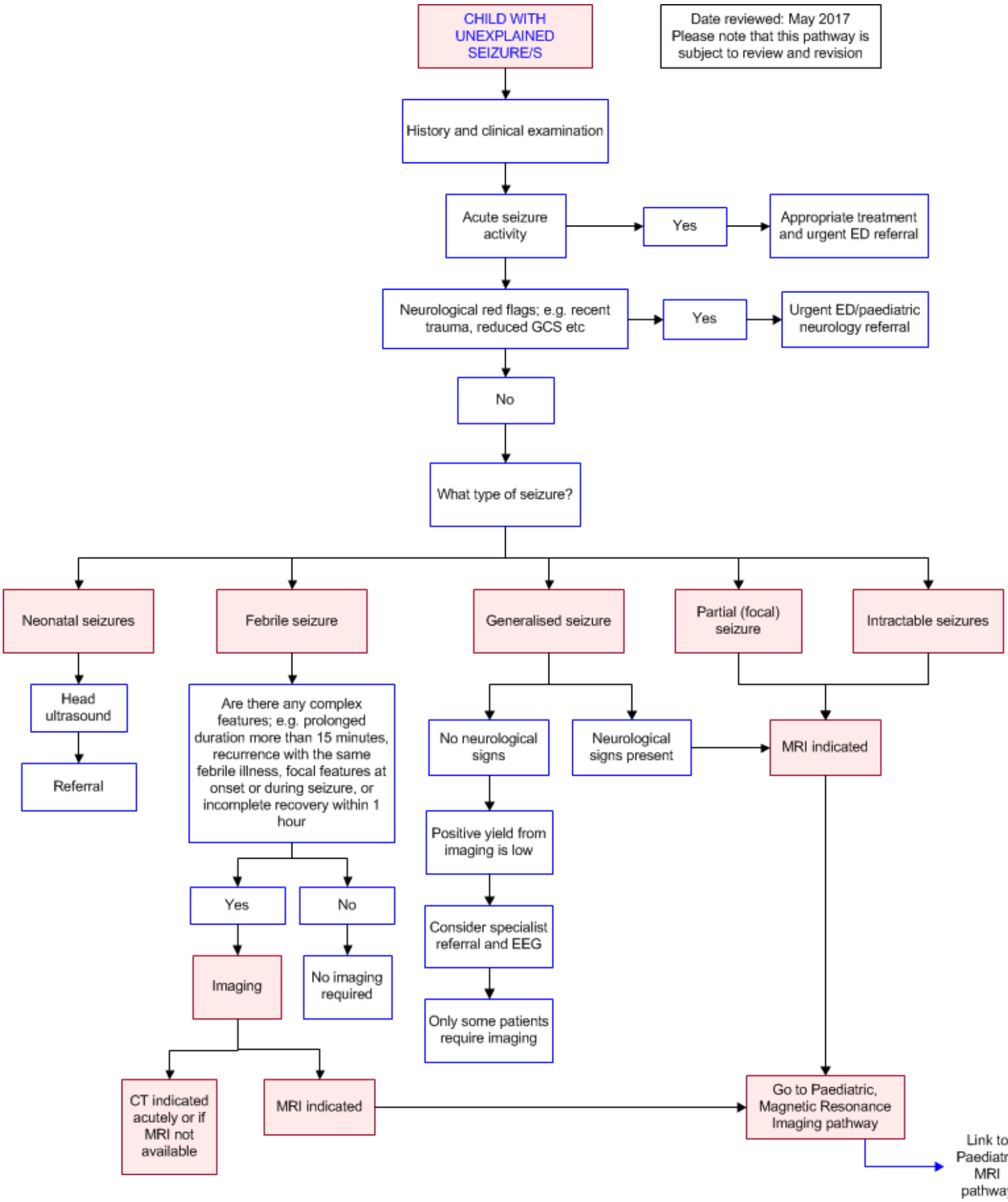
Quick User Guide

Move the mouse cursor over the PINK text boxes inside the flow chart to bring up a pop up box with salient points.
Clicking on the PINK text box will bring up the full text.
The relative radiation level (RRL) of each imaging investigation is displayed in the pop up box.

SYMBOL	RRL	EFFECTIVE DOSE RANGE
	None	0
	Minimal	< 1 millisieverts
	Low	1-5 mSv
	Medium	5-10 mSv
	High	>10 mSv

Pathway Diagram



Seizures

- A seizure is defined as “a transient occurrence of signs and/or symptoms due to abnormal excessive or synchronous neuronal activity in the brain” 1, 2
- Epilepsy is a condition of recurrent seizure activity over a prolonged period with no obvious precipitants.
- Numerous seizure and epilepsy classification systems are available and a widely referenced model was put forth by the International League against Epilepsy (ILAE). 3, 4 Although there are several classification systems present of which many are contended, it is well known that seizures in childhood vary significantly from adults and there are several well recognised epileptic disorders unique to infancy and early childhood. Recognising the syndromes and specific forms of seizures is paramount to administer a tailored management plan
- Apart from acute post-traumatic causes, MRI when available is the imaging modality of choice when feasible owing to its lack of ionising radiation, excellent soft tissue and contrast resolution and versatility but may need general anaesthesia in a significant number of children 5

Neonatal Seizures

- There is a relatively higher risk of seizures in neonatal period owing to inherent low threshold to excitability of brain cells at this age and the high risk of brain injury in peri-natal period. Pre-term infants have a higher incidence of seizures than term infants 6, 7
- Hypoxic ischemic encephalopathy is the most common cause of seizure in both term and preterm infants. Intracranial haemorrhage is the second leading cause 5
- Timely and accurate diagnosis of seizures in this age group can prevent or reduce the brain damage and reduce the seizure burden 5
- Head ultrasound is the first modality of choice in a majority of these patients because of the ease of use, lack of ionising radiation and portability 5
- Magnetic Resonance Imaging can detect hypoxic ischemic encephalopathy, arterial and venous strokes, structural brain developmental abnormalities, neuro-cutaneous syndromes and inborn errors of metabolism. Diffusion imaging has added sensitivity to routine spin-echo sequences 5, 8, 9
- Computed Tomography can be useful when suspecting skull fractures or haemorrhage but involves exposing highly sensitive neonatal brain to ionising radiation 5, 8

Febrile Seizures

- Febrile seizures occur in a child of age between 3 months to 5 years and are associated to a febrile illness with no evidence of intra-cranial infection 5
- Febrile seizures are the most common type of childhood seizures 10
- Febrile seizures can be simple - lasting 15 mins, may have focal features and can recur within the next 24 hours 5
- Simple febrile seizures do not need any imaging tests other than routine lab investigations to look for the source of infection if not evident 5, 11, 12
- Complex febrile seizures occasionally have an underlying cause such as meningitis, encephalitis or underlying trauma which may benefit from an MRI or CT scan. 5, 12 The diagnostic yield of imaging tests for detecting a lesion is increased in the presence of an abnormal neurological examination or an abnormal laboratory investigation 13, 14
- Whilst MRI may provide more diagnostic information, CT may be preferable depending on age and waiting time for MRI
- There is increasing evidence that hippocampal swelling and diffusion restriction on MRI particularly

in complex febrile seizures may point to an increased likelihood of developing mesial temporal sclerosis in later life which may be another indication for imaging tests in these seizures 5

Generalised Seizures

- Generalised seizures occur when the entire cerebral cortex of both cerebral hemispheres is aberrantly excited diffusely from the onset 1
- Generalised seizures include infantile spasms, absence seizures, tonic-clonic, atonic and myoclonic seizures.
- Patients with generalised seizures and no neurological findings do not require imaging 5
- New-onset seizures with abnormal neurologic findings and recurrent seizures with varying seizure characteristics warrant neuro-imaging. Urgent neuro-imaging is advocated on the presence of post-ictal focal neurologic defects and semi-urgent neuro-imaging for cognitive and unexplained motor deficits, seizures with partial features, sinister EEG findings and children under 1 year 15
- MRI has higher diagnostic yield than CT but may require general anaesthesia in children and may not be available as freely as CT 15, 16
- When an underlying trauma is suspected, urgent CT scan should be the first choice to rule out intracranial haemorrhage which may need urgent neurosurgical intervention

Partial (Focal) Seizures

- Focal seizures occur when the aberrant neuronal discharge occurs focally from one of the cerebral cortices. Focal seizures can undergo secondary generalisation when the focal discharge spreads across rapidly to trigger a diffuse neuronal discharge and sometimes the distinction between a primary generalised seizure and secondary generalised seizure becomes very difficult from history alone 2
- Partial seizures most often result from focal structural brain abnormalities. Hence, the positive yield of neuro-imaging in seizures with focal origin is significantly higher than generalised seizures 5, 17
- MRI is considerably more sensitive than CT, particularly with subtle developmental abnormalities and small foci of haemorrhage 5, 15, 16

Intractable Seizures

- MRI is the most sensitive imaging modality for this relatively uncommon group of patients who may benefit from surgical management aimed at reducing the seizure-burden 5
- Functional brain imaging with Single-Photon Emission CT (SPECT) and Flouorine-18-2-flouro-2-deoxy-D-glucose positron emission tomography (FDG-PET) are also being used to map epileptic foci 5

Magnetic Resonance Imaging (MRI)

- Apart from acute posttraumatic causes, MRI when available is the imaging modality of choice when feasible owing to its lack of ionising radiation, excellent soft tissue and contrast resolution and versatility but may need general anaesthesia in younger children 5, 15, 16, 18
- Magnetic Resonance Imaging can detect hypoxic ischemic encephalopathy, arterial and venous strokes, structural brain developmental abnormalities, neuro-cutaneous syndromes and inborn

errors of metabolism 8, 9
- In partial seizure, MRI outweighs CT in the majority of situations and should be the preferred investigation except in children less than 2 years of age where non-accidental head injury is suspected 15, 16

Computed Tomography (CT)

- CT can be useful when suspecting skull fractures or intracranial haemorrhage but involves exposing highly sensitive neonatal brain to ionising radiation 8
- Whilst MRI may provide more diagnostic information, CT may be preferable depending on availability and need for sedation 15, 16

References

References are graded from Level I to V according to the Oxford Centre for Evidence-Based Medicine, Levels of Evidence. Download the document

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