Imaging in Pediatric Stroke

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indication → differential diagnosis and management issues → protocol → interpretive strategy → impression
focal neurologic deficit: hemiparesis
hypotonia
seizure
premature sidedness
visual deficits
differential diagnosis: infarct
CNS malformation
neoplasm
metabolic disorder
management issues:

1. exclude hemorrhage
2. confirm clinical diagnosis
3. determine extent, location
4. determine vessel patency
5. cerebral perfusion

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management issues:
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PROTOCOL
US
CT
MRI

infarct
hemorrhage: important triage tool in thrombolysis
confirm dgx: may detect infarct in first 6-8 hours
extent, may underestimate c/w DWI
CTA
CT perfusion
gold standard for venography
de facto modality of choice for herniation, edema: ER, ICU
CT at 300 mA is 60 mSv
background radiation is 3.6 mSv

10 CTs to a 10 yo ~ 10% life time risk, 1 Sv to 10 yo, 10% life time cancer risk
1/10,000 cancer morality risk for 10 year olds foreach CT

ICRP, 1991 analysis
Brenner DJ. Pedatr Radiol 2002 32: 228-231
susceptibility: hemorrhage

DWI: confirm diagnosis, extent

MRA: patency

MR perfusion: mismatch, territory at risk

T1

T2

FLAIR

consider:

MRV
venous thromboses and infarcts
venous sinus thrombosis, venous infarct

6 yo girl, seizure
venous sinus thrombosis, venous infarct

6 yo girl, seizure
venous sinus thrombosis, venous infarct

6 yo girl, seizure
venous sinus thrombosis, venous infarct
6 yo girl, seizure
venous sinus thrombosis, venous infarct

6 yo girl, seizure, 8 months later
deep venous thrombosis

10 day old girl, former 36 weeker
deep venous thrombosis
10 day old girl, former 36 weeker
deep venous thrombosis

10 day old girl, former 36 weeker
deep venous thrombosis

10 day old girl, former 36 weeker
arterial infarcts
R MCA infarct
6 yo girl, left hemiparesis
R MCA infarct
6 yo girl, left hemiparesis
R MCA infarct

6 yo girl, left hemiparesis
left MCA infarct and MCA stenosis

14 yo girl, right hemiparesis
left MCA infarct and MCA stenosis

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left MCA infarct and MCA stenosis

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left MCA infarct and MCA stenosis

14 yo girl, right hemiparesis
left MCA infarct and MCA stenosis

14 yo girl, right hemiparesis
L MCA infarct

3 yo boy, seizure
L MCA infarct, likely in utero

3 yo boy, seizure
left thalamocapsular infarct
14 yo boy, R hemiplegia and hemihyposthesia sudden onset
left thalamocapsular infarct
14 yo boy, R hemiplegia and hemihypesthesia sudden onset
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left thalamocapsular infarct

14 yo boy, R hemiplegia and hemihypesthesia sudden onset
R thalamic infarcts
16 year old new onset gait instability
hemorrhages and hemorrhagic infarcts
cerebellar hemorrhage
16 yo boy, hemophilia
cerebellar hemorrhage
16 yo boy, hemophilia, 2 months later
infarct mimics
infarct?

5 year old girl, seizure
infarct?
5 year old girl, seizure
infarct?

5 year old girl, seizure
infarct?

5 year old girl, seizure
infarct?
5 year old girl, seizure
infarct?

5 year old girl, seizure
infarct?

5 year old girl, seizure
ecitotoxic unilateral cortical necrosis
hypoglycemia, AEFCSE
5 year old girl, seizure
? stroke
3 year old girl, L sided weakness
3 year old girl, L sided weakness
3 year old girl, L sided weakness
stroke
3 year old girl, L sided weakness
complex I deficiency
3 year old girl, L sided weakness
imaging in pediatric stroke

• GOALS OF NEUROIMAGING
  – hemorrhage: CT, susceptibility
  – confirmation of diagnosis: infarct mimics
  – extent and location
  – vessel patency: CTA, MRA
  – regional perfusion: MR perfusion, CTP
• CT: important modality in the imaging of stroke
  – gold standard for venography
• MRI
  – DWI/ADC detects stroke within hours of ictus
DWI
http://www.tbrhsc.com/patient_information/media_releases/new_MRI_scanners.asp
http://hsc.uwe.ac.uk/radscience/MRI/MRI_Physics.pdf
RF pulse applied
• What is diffusion weighted imaging?
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• What is diffusion weighted imaging?

\[ t = 5 \text{ millisec} \]
• What is diffusion weighted imaging?

\[ t = 10 \text{ millisec} \]
• What is diffusion weighted imaging?

\[ t = 20 \text{ millisec} \]
• What is diffusion weighted imaging?

t= 30 millisec
• What is diffusion weighted imaging?

\[ d^2 = 6Dt \]

\[ t = 30 \text{ millisec} \]
\[ d^2 = 6D t \]
signal loss $\alpha d$

$d^2 = 6Dt$
\[ b = n \left( \gamma \delta G \right)^2 \left( \Delta - \delta/3 \right) \]
Background

\[ b = n (\gamma \delta G)^2 (\Delta - \delta/3) \]
applications

- classic application: stroke
applications

- classic Application to Stroke
Proton MR signal of the in the human brain. We are able to see the water peak and the fat/lipid peak, because these molecules are most abundant in the human body. However,
MR spectroscopy

Metabolites

Water suppressed

PPM

NAA

Cho

Cr

Cr2

5 4 3 2 1

PPM

Dr. Eva Rata, Guidline for reading MR spectroscopy, MGH, 2006
MRS

- NAA: 2 ppm, neuronal density and viability, necrosis
- Creatine: 3 ppm, metabolic marker, ATP reservoir
- Choline: 3.2 ppm, cell membranes, myelin, marker for membrane turnover, leukodystrophies, hypercellularity/tumor
- Lactate: 1.3 ppm, marker of anaerobic metabolism, hypoxia, infarct, mitochondrial disease, tumor
• things to do next time
• US physics slide
• CT physics slide