

Limited brain magnetic resonance imaging for evaluation of non-traumatic pediatric head emergencies

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fast spin echo (SSFSE) and sagittal SSFSE can be performed in under 5 min of scan time. This approach may provide more information than a non-contrast head computed tomography (CT) in non-traumatic pediatric head emergency, avoid ionizing radiation from CT scan and stratify patients who need more detailed brain MRI. Research studies are required to provide evidence for feasibility of such an approach.

Key words: Magnetic resonance imaging; Head; Brain; Pediatric head emergency; Computed tomography; Pediatric; Emergency

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Core tip: Limited brain magnetic resonance imaging (MRI) consisting of axial fluid attenuated inversion recovery, axial diffusion weighted imaging, coronal single shot fast spin echo (SSFSE) and sagittal SSFSE can be performed in under 5 min of scan time. This approach may provide more information than a non-contrast head computed tomography (CT) in non-traumatic pediatric head emergency, avoid ionizing radiation from CT scan and stratify patients who need more detailed brain MRI. Research studies are required to provide evidence for feasibility of such an approach.

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Abstract

Limited brain magnetic resonance imaging (MRI) consisting of axial fluid attenuated inversion recovery, axial diffusion weighted imaging, coronal single shot

CURRENT SITUATION

Multitude of various indications exists for non-traumatic head imaging in the emergency department among children, most common of which is headache. Other

common indications include seizures, syncope, ataxia, or a focal neurologic deficit. For many of these reasons, a non-contrast head computed tomography (CT) is often performed. While quite useful in eliminating or diagnosing life-threatening conditions, if negative, CT will not be helpful in providing a specific diagnosis. In contrast, a limited brain magnetic resonance imaging (MRI) may be more efficient, cost-effective, diagnostic and safer alternative to non-contrast head CT in non-traumatic pediatric head emergencies.

Huda *et al*^[1] estimated the organ-absorbed dose in head CT ranges from 30 mGy in neonates to 40 mGy in adults. More importantly, the effective dose for a head CT in a neonate was approximately four times higher than in an adult (0.9 mSv).

Pearce *et al*^[2] found a correlation between head CT scans and an increased risk, albeit small, for the development of leukemia and brain tumors. In concert with the ALARA principle, it is now ever more prudent to attempt to limit the use of ionizing radiation and if possible, eliminate it altogether.

CHANGING SCENARIO

Previously, accessibility and efficiency have always been touted as being reasons for performing a head CT versus a MRI. However, newer MRI technologies have developed which allow for faster image acquisition. More institutions now employ more MRI scanners running on an around the clock basis allowing for more availability in performing urgent/stat exams.

Even though MRI examinations are faster than they ever have been, they cannot currently match the speed of CT. Because of this, sedation or general anesthesia is often employed in children to obtain quality MRI examinations. In our institution, sedation or general anesthesia is typically given to children after the first few months of life to age 6-8 years. A feed and sleep technique is typically employed for infants under 1 mo of age with a swaddling and sleep method used for infants under 6 mo. Between the ages of 6-8 years, programs that recreate the MR examination in a mock setting can be used to decrease the requirement of sedation/general anesthesia during the actual exam. Children older than 8 years of age are typically able to cooperate and hold still during the MR examination and thus do not require sedation/general anesthesia.

SUGGESTED APPROACH

Limited brain MRI of the head may prove superior to CT in eliminating life-threatening conditions and targeting children who would benefit from a more detailed MRI evaluation. The limited brain MRI that we suggest may consist of axial fluid attenuated inversion recovery (FLAIR) sequence, axial diffusion weighted imaging (DWI) sequence and T2-weighted images using single shot fast spin echo (SSFSE) pulse sequence images

in the coronal and sagittal planes. Total MRI scan time would be around 5 min.

Hemorrhage, infarction, hydrocephalus and a large tumor would easily be diagnosed *via* limited brain MR examinations. Such a finding may require a complete detailed MRI. A normal limited brain MRI would not need further imaging, particularly for a common indication such as a headache.

POSSIBLE HURDLES

However, there are few hurdles with a limited brain MR approach to emergent ED head imaging. While accessibility to MR exams is better than ever before, it lags considerably behind CT. This difference is immense among community and rural based hospitals. Further, even if the MR equipment is available, the trained staff available to manage and operate the scanners is very limited, especially after regular working hours.

RECOMMENDATIONS

A retrospective study is required for preliminary evaluation. Such a retrospective study would look at only FLAIR, DWI and T2 sequences of brain MRI done through referral from pediatric emergency. The study design would blind the radiologist from patient identifier and MRI report. Only these few sequences would be provided for review. The blinded researcher report would be then compared with the MRI report generated at the time of examination. Number of cases where clinically important findings would have been missed by this approach would be determined. List of insignificant and significant findings that might have been missed would be generated; If the outcome of the retrospective study suggested above provides support to this suggested approach, similar retrospective studies from multiple centers would be needed; If such multiple retrospective studies provide enough evidence to promote this suggested approach, prospective study will be needed; Cross training CT and MRI technologist may increase the availability of MRI personnel after regular working hours; A separate limited billing code would be required to bill such limited MRI study. Cost of such limited brain MRI without contrast would be comparable to or slightly more than a non-contrast head CT.

CONCLUSION

Limited brain MRI consisting of axial FLAIR, axial DWI, coronal SSFSE and sagittal SSFSE can be performed in under 5 min of scan time. This approach may provide more information than a non-contrast head CT in non-traumatic pediatric head emergency, avoid ionizing radiation from CT scan and stratify patients who need more detailed brain MRI. Research studies suggested above may help provide evidence for feasibility of such an approach.

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