

An Evidence-Based Approach To Musculoskeletal MRI In The Emergency Department

Broder J. March 2009, Volume 11; Number 3

In this issue of Emergency Medicine Practice, an overview of the technical features of MRI will be presented in order to provide a framework for understanding its limits and potential benefits. Frequently asked questions will be addressed, including the role of contrast in MRI, contraindications to contrast, and contraindications to MRI. Some of the common methodological flaws that limit the internal and external validity of specific studies will be reviewed. A focused discussion will be provided on the diagnostic accuracy of MRI for spinal epidural abscess, occult hip fractures, and occult fractures of the wrist.

EVIDENCE-BASED CLINICAL RECOMMENDATIONS FOR PRACTICE

Key Points	References	Comments
MRI is recommended by the ACR as the most appropriate test when scaphoid fracture is suspected despite normal plain x-rays.	69	A study of 18 children with acute wrist injury found that 4 of 6 fractures detected on MRI were not seen initially on x-ray – though all were evident on follow-up plain film. No fractures were found at follow-up in patients with a normal initial MRI.
MRI is recommended by the ACR as the most appropriate test when hip fracture is suspected despite normal plain x-rays.	9,47	Unfortunately, a clear clinical decision rule for selecting patients for MRI after a negative hip plain film does not exist. Studies suggest that only about 5% of all patients undergoing hip evaluation will have fracture despite negative x-rays. Among those undergoing MRI, the reported rate of fracture is high – over 30% in several studies – indicating that clinicians are relatively astute at selecting high-risk patients for additional imaging.
Definitive studies have not been conducted comparing CT and MRI for acute scaphoid fracture. MRI is likely more useful due to better soft tissue contrast for ligamentous and cartilaginous injuries.	61	The ACR recommends casting with follow-up x-ray in 10 to 14 days or MRI as the most appropriate imaging modalities for suspected acute scaphoid fracture following normal plain x-rays (both receive a score of 8 on the 1 to 9 scale used by the ACR, with 9 being most appropriate). CT receives a score of 4, with the caveat that CT is appropriate if MRI or casting and follow-up are contraindicated.
Definitive studies have not been conducted comparing CT and MRI for acute hip fracture. Cost effectiveness of early MRI for suspected scaphoid and hip fractures is suggested by multiple studies.	45	A limited MRI cost approximately \$450 in 1993, compared with \$455 for bone scan, \$299 for linear tomography (a method rarely used today, not to be confused with computed tomography), and \$797 for CT.
MRI is the definitive study for suspected non-traumatic spinal cord conditions including inflammatory, infectious, neoplastic, and compressive conditions.	25	A review of the literature from the New England Journal of Medicine concluded that the single most important predictor of neurological outcome is the patient's neurological status prior to surgery. Therefore, a vigilant effort to diagnose the patient prior to the progression of neurological signs and symptoms is imperative.
Nephrogenic systemic fibrosis is a potentially fatal condition seen in patients with advanced renal disease receiving gadolinium contrast.	13	Dialysis patients and patients with acute renal failure not yet on dialysis are at particular risk.
MRI may be performed with careful preparation in patients with implanted cardiac pacemakers and defibrillators when benefit of MRI is felt to outweigh risk.	17	There are now over 230 published prospective cases of patients with pacemakers safely having undergone low-field MRI.
MRI is believed to be safe in pregnancy, but the effect of gadolinium contrast on the fetus is unknown. Avoid gadolinium in pregnancy whenever possible.	15	The ACR recommends that gadolinium-based contrast agents not be used routinely in pregnancy. Gadolinium-based contrast may be used in pregnancy on a case-by-case basis with consideration of the risk-benefit ratio, which should be documented in the patient's chart.

* See reverse side for reference citations.

REFERENCES

These references are excerpted from the original manuscript. For additional references and information on this topic, see the full text article at ebmedicine.net.

9. Dominguez S, Liu P, Roberts C, et al. Prevalence of traumatic hip and pelvic fractures in patients with suspected hip fracture and negative initial standard radiographs—a study of emergency department patients. *Acad Emerg Med*. Apr 2005;12(4):366-369. **(Retrospective, cohort study; 764 patients)**
13. Grobner T. Gadolinium—a specific trigger for the development of nephrogenic fibrosing dermopathy and nephrogenic systemic fibrosis? *Nephrol Dial Transplant*. Apr 2006;21(4):1104-1108. **(Retrospective case series; 9 patients)**
15. Kanal E, Barkovich AJ, Bell C, et al. ACR guidance document for safe MR practices: 2007. *AJR Am J Roentgenol*. Jun 2007;188(6):1447-1474. **(Expert consensus guidelines)**
17. Loewy J, Loewy A, Kendall EJ. Reconsideration of Pacemakers and MR Imaging. *Radiographics*. September 1, 2004 2004;24(5):1257-1267. **(Meta-analysis of 232 patients from prospective trials)**
25. Darouiche RO. Spinal epidural abscess. *N Engl J Med*. Nov 9 2006;355(19):2012-2020. **(Review article)**
45. Quinn SF, McCarthy JL. Prospective evaluation of patients with suspected hip fracture and indeterminate radiographs: use of T1-weighted MR images. *Radiology*. May 1993;187(2):469-471. **(Prospective study of 20 patients with suspected hip fracture. Suffers from incorporation bias as MRI result and clinical outcome were used to define the gold standard)**
47. Lim KB, Eng AK, Chng SM, et al. Limited magnetic resonance imaging (MRI) and the occult hip fracture. *Ann Acad Med Singapore*. Sep 2002;31(5):607-610. **(Retrospective review of 57 patients undergoing hip MRI)**
61. Newberg A, Dalinka MK, Alazraki N, et al. Acute hand and wrist trauma. American College of Radiology. ACR Appropriateness Criteria. *Radiology*. Jun 2000;215 Suppl:375-378. **(Expert consensus guidelines)**
69. Cook PA, Yu JS, Wiand W, et al. Suspected scaphoid fractures in skeletally immature patients: application of MRI. *J Comput Assist Tomogr*. Jul-Aug 1997;21(4):511-515. **(Prospective study of 18 children undergoing MRI after wrist trauma)**

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