

MR fluoroscopy for gastrointestinal malrotation in unsedated infants

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Introduction

Gut malrotation is a congenital disorder of abnormal intestinal rotation and fixation, which predisposes to life-threatening mid-gut volvulus. The condition is frequently suspected in neonates with recurrent vomiting and the current diagnostic technique is an upper GI X-ray fluoroscopy contrast study. This is not easy to perform and may give equivocal results [1-3]. It also carries a significant radiation burden, particularly as the majority of patients referred and assessed in this way do not have an abnormality. Occasionally an additional X-ray study, a contrast enema, may be required to identify the position of the caecum, or an ultrasound examination to define the orientation of the superior mesenteric vessels, which may be abnormal in volvulus [4, 5]. No single imaging technique can currently examine all of these structures, but real-time MR imaging has the potential to be an alternative single examination. The aim of this study was to evaluate the feasibility of interactive MR fluoroscopy for defining the gastro-intestinal tract anatomy in un-sedated neonates and children with suspected malrotation.

Methods

Full ethical committee approval and parental consent were obtained. *X-ray protocol:* Fluoroscopy examinations were performed on a multipurpose C-arm fluoroscopic imaging system using a CCD-based image intensifier (GE Precision™ MPI; GE Healthcare, Waukesha, WI). Contrast medium was up to 50 mls Iopamidol (Gastromiro; Bracco) given orally or via nasogastric tube, when in situ. Imaging parameters were: kV 75 / 85, tube current 100 / 160 mA. *MRI protocol:* All patients were examined freely breathing in the supine position on a 1.5T whole-body MR system (Signa HDx; GE Healthcare) using a quadrature head or knee coil. Axial and coronal 2D FIESTA images were acquired prior to feeding to identify the mesenteric vessels and caecal pole location. An in-house interactive single shot fast spin echo (iSSFSE) sequence within a proprietary real-time imaging interface (i/Drive Pro Plus) was used [6] to evaluate the gastrointestinal tract. Starting parameters were TR 1.3 sec, TE 32.1 ms, matrix 256 x 128, and refocussing flip angle 155 degrees. We varied the slice location, field of view and slice thickness in real-time to optimise anatomical visualisation. Phase encode ordering was also switched in real time together with slice thickness to produce thick slab projection T2-weighted images. An in-room communication system was used to co-ordinate the examination (Silent Scan 3000 Series Audio System, MagMedix, Inc., Fitchburg, MA). Contrast medium was a dilute sucrose solution, given in-room orally or via nasogastric tube. Coronal or oblique iSSFSE images were acquired every 2.5 seconds during contrast administration.

Results

9 children (mean age 5 months, range 7 days – 2 years; 6 females) with suspected gut malrotation underwent conventional X-ray upper GI contrast fluoroscopy, followed by MR Fluoroscopy. Both X-ray and MR procedures were performed in all subjects, with no adverse events. 2 children had malrotation on X-ray fluoroscopy, 7 were normal. We confidently identified the duodeno-jejunal flexure in 7 patients (77%) using MRI, but 9 patients using X-ray fluoroscopy. There was one technical (machine) failure and 2 diagnostic failures in MRI, both due to feeding problems in the scanner environment. Otherwise, there was a good correlation between the results of the X-ray and MRI tests. We were also able to identify the superior mesenteric artery and vein (SMA / SMV) using MRI in 8 / 9 (88%) children, and the caecum in all 9 children, which were normal in all cases (Figure 1).

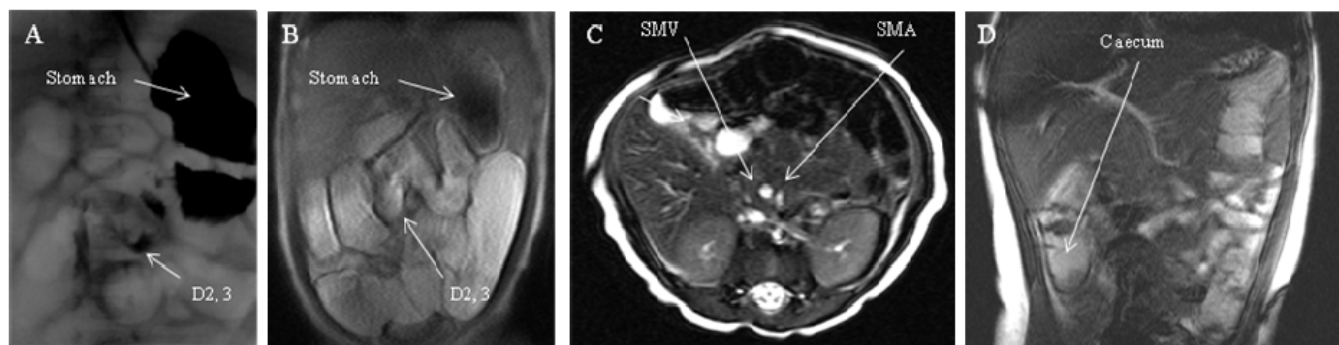


Figure 1 A 1 month old un-sedated child with malrotation: (A) X-ray fluoroscopy imaging demonstrating an abnormal D2 and D3 position. (B) The equivalent MR PD iSSFSE image in the same patient demonstrates abnormal duodenal position. In two other patients at 1 month of age, (C) a normal SMA / SMV orientation was demonstrated on Axial FIESTA, and (D) a normal caecal pole position on coronal FIESTA.

Conclusion

This study demonstrates the feasibility of interactive MR fluoroscopy to image the gut in un-sedated children. Additional MR fluoroscopy strategies are being explored and a larger diagnostic performance trial is underway.

References

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