Journal of Pediatric Surgery 51 (2016) 1859–1863

Contents lists available at ScienceDirect

Journal of Pediatric Surgery

journal homepage: www.elsevier.com/locate/jpedsurg

Correlation between magnetic resonance imaging findings after posterior sagittal anorectoplasty for anorectal malformations and the clinical outcome: Preliminary report

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ARTICLE INFO

Article history:
Received 19 January 2016
Received in revised form 1 July 2016
Accepted 18 July 2016

Key words:
Anorectal malformation
Magnetic resonance imaging
Posterior sagittal anorectoplasty
Fecal incontinence

ABSTRACT

Background/Purpose: To assess the anatomical results after posterior sagittal anorectoplasty (PSARP) by magnetic resonance imaging (MRI) and to evaluate the correlation of these findings with clinical outcomes.
Methods: Patients followed-up at our center after PSARP, being at least 6 year old, with neither evidence of sacral abnormalities nor spinal dysraphisms were prospectively included. Complex ARMs were excluded. MRI was performed on a 1.5 T unit. T1- and T2-weighted sequences were acquired, in orthogonal planes, according to the anal canal orientation. The degree of anorectal centering in the muscle complex (DARC), the pelvic floor symmetry, the rectal maximum diameter, the fat tissue interposition, and the presence of fibrosis were evaluated. A clinical questionnaire (Rintala score) was filled in by the parents. MRI findings were compared to the clinical outcomes assessed by the Rintala score. For statistical analysis the Spearman rho correlation coefficient was calculated and the Wilcoxon rank-sum test was performed.
Results: We recruited 11 patients (mean age 12 years, range 6–19) with MRI. DARC (range 252–360°) was strongly correlated with the degree of fecal incontinence (rho = 0.70), mildly with the ability to hold back defecation (rho = 0.58), constipation (rho = 0.46) and total Rintala score (rho = 0.41). Pelvic floor symmetry correlated with the frequency of defecation (rho = 0.58). Rectal maximum diameter negatively correlated with the ability to feel the urge to defecate (rho = −0.60). Patients with fibrosis were slightly more constipated ($p = 0.056$) and presented more social impairment ($p = 0.04$). Fat tissue interposition had no correlation with the clinical outcome.
Conclusions: Thanks to soft tissue definition, multiplanar imaging, and lack of ionizing radiation, MRI is a valuable tool in the postoperative anatomical evaluation of patients with ARM. Our preliminary results show that abnormal anatomical findings can correlate to a nonoptimal functional outcome, thus helping in understanding the clinical course. The degree of anorectal centering in the muscle complex (DARC) seems to have the better correlation with the outcome, especially in terms of fecal continence.
Type of Study: Prognosis study.
Level of Evidence: level IV.

Anorectal malformations (ARM) comprise a wide spectrum of congenital malformations of the anus and rectum, ranging in severity from minor with excellent prognosis after an appropriate anorectal reconstruction to those that are complex and difficult to manage with relatively poor prognosis. Several factors have been identified to have a prognostic role in the functional outcome of these malformations, such as the type of ARM, the presence of sacral abnormalities and neurospinaldysraphisms, and the quality of anorectal reconstruction.

One of the main steps of the anorectoplasty is positioning the mobilized rectum within the muscle complex, ensuring its correct trajectory through the levatorani [1]. However no particular attention has been addressed directly on the anatomical results of surgery and their influence in the clinical outcomes. Magnetic resonance imaging (MRI) is commonly performed in patients with ARM, especially to evaluate the presence of associated anomalies. Thanks to its soft tissue characterization it has also been described to evaluate the pelvic anatomy [2,3]. The aims of our study were to evaluate the anatomical findings after

Abbreviations: ARM, anorectal malformations; MRI, magnetic resonance imaging; PSARP, posterior sagittal anorectoplasty; DARC, degree of anorectal centering.

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http://dx.doi.org/10.1016/j.jpedsurg.2016.07.009
0022-3468/

posterior sagittal anorectoplasty (PSARP) for ARM by MRI, and to test the correlation of these findings with the clinical outcome.

1. Materials and methods

1.1. Patients

We conducted a study in patients followed-up in our center after PSARP for ARM by assessing their outcome clinically and with MRI. In order to limit the impact of potential prognostic factors we decided to include only patients with ARM with good prognosis, as defined by Levitt and Peña [4]. ARMs with good prognosis are defined as some anatomical types of ARM (rectoperineal fistula, rectovestibular fistula, imperforate anus without fistula, rectal atresia and cloaca with common channel <3 cm) all with prominent midline groove (good perineal muscle) and normal sacrum. Normal sacrum was defined in the presence of a normal bony development and a normal sacral ratio (anterior–posterior film >0.74, lateral position >0.77). Patients with evidence of tethered cord or other spinal abnormalities either at ultrasound or at previous MRI were excluded. All patients had undergone posterior sagittal anorectoplasty (PSARP) either in our center or in other centers. In our center all patients had been operated on by two senior surgeons, and have undergone the same dilation protocol. None of the patients had undergone a REDO-anorectoplasty. We included only patients being at least 6 year old, as they have definitely completed the toilet training and they can undergo MRI with no need for sedation.

1.2. MRI technique

MRI studies were performed between January and April 2015. A written informed consent was obtained from the parents before proceeding with the MRI. No bowel preparation was performed, in order to evaluate the real condition of the patient and in order to evaluate better the correlation with the clinical outcome evaluated with a questionnaire filled in at that specific time. A 20-French Foley catheter was positioned into the rectum of the patients without inflating the balloon. Only a small amount of echogenic gel was instilled into the catheter to better visualize the rectum, thus facilitating the identification of the bowel lumen in relation to the sphincterial muscle complex. The MRI examination was performed on a 1.5 T machine (MAGNETOM Avanto 1.5 T: Siemens Medical Solutions, Malvern, PA) using a body coil. The imaging protocol includes T1 VIBE and STIR sequences on the axial plane, T2-weighted sequences in the 3 orthogonal planes and T2 SPACE 3D sequence on the coronal plane. T2 SPACE 3D images were reconstructed in a paraxial plane to obtain pubococcigeal orientation used to measure and evaluate the different findings. All the images were evaluated by a single radiologist (7 years experience) blinded to clinical findings.

1.3. MRI findings

1.3.1. Degree of Ano-Rectal Centering in the muscle complex (DARC)

The first parameter that was evaluated on MRI images was the Degree of Ano-Rectal Centering in the muscle complex (DARC), as we wanted to evaluate if the anorectum was completely surrounded by the muscle complex or not. We evaluated the DARC on a para-axial plane at the level of the pubococcygeal line (Fig. 1a). We first of all identified the center of the anorectum, considered as the intersection of the two maximum anorectal diameters. We then traced two lines going from the center of the anorectum to the most anterior part of the muscle complex, thus determining the DARC expressed as an angle that could range from 0 to 360°. A DARC angle of 360° therefore indicates that the anorectum is completely surrounded by the muscle complex, as shown in Fig. 1b. If the anorectum is not completely surrounded by the muscle complex the DARC will measure less than 360° as it is shown in Fig. 1c.

1.3.2. Pelvic floor symmetry

Pelvic floor symmetry was evaluated on a coronal plane at the level of the anorectum. We evaluated the symmetry of the levator ani, by measuring the distance from the skin level up to the more proximal part of the muscle on both sides. We then calculated the ratio between the lower value and the higher value of the two sides. Therefore the ratio may ideally vary from 0 to 1, and the best symmetry is expressed by a ratio of 1. Fig. 2a shows a symmetric pelvic floor with a ratio of 1, while Fig. 2b shows asymmetry (ratio 0.87).

1.3.3. Rectal maximum diameter

By scanning the axial planes we identified the level where the rectum was maximally dilated and we measured the rectal diameter at that point, expressing it in millimeters (Fig. 3).

1.3.4. Fat tissue interposition

We evaluated the interposition of fat tissue between the anorectum and the muscle complex on axial planes, and we expressed it as present or absent.

1.3.5. Fibrosis

Perirectal fibrosis was also evaluated and expressed as present or absent on axial planes.

1.4. Evaluation of the clinical outcome

In order to evaluate the clinical outcome of the patients at the time when MRI was performed, we asked the parents to fill in a questionnaire. We decided to adopt the Rintala score. Thanks to this questionnaire we evaluated the ability to hold back defecation (score 0–3), to

Fig. 1. (a) MRI image showing the pubococcygeal line. The degree of anorectal centering (DARC) was measured on the para-axial plane corresponding to this line. (b) MRI image: paraxial plane at the level of the pubococcygeal line, DARC angle measuring 360° (anorectum completely surrounded by the muscle complex). (c) MRI image: paraxial plane at the level of the pubococcygeal line, DARC angle measuring <360° (anorectum not completely surrounded by the muscle complex).