ORIGINAL RESEARCH ARTICLE

MRI following PSARP in Children with Anorectal Malformations: Differences that Matter!

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ABSTRACT

Introduction: Anorectal malformations are a complex group of congenital anomalies affecting rectum, anus and also the urogenital tract in a significant number of patients. A number of imaging studies are performed as a part of preoperative assessment and planning for but postoperative MRI may play a key role in finding out the anatomical differences and analyzing the desired and actual surgical outcome. Objective: To study the MRI findings in children with anorectal malformation (ARM) after surgical repair (3 months after repair) and compare the differences from normal.

Material and methods: Pelvic MRI studies of 20 ARM patients after surgical repair (3 months after all stages of repair completed) were analyzed to determine the location and volume of the neorectum, anorectal angle, anal stenosis, presence of peritoneal fat herniation, status of the puborectalis sling and pelvic floor muscles and other associated urinary tract and vertebral column abnormality. Findings were compared with those of normal children undergoing MRI for unrelated complaints.

Results: Children with incontinence were more likely to have an increased anorectal angle while children with constipation have increased rectosigmoid volume. Puborectalis sling and pelvic floor muscles were thin in almost all patients with high ARM. Lower cord anomalies, lower sacral agenesis and neurogenic bladder are also a frequent association.

Conclusions MRI is a helpful imaging modality in postoperative ARM patients and it shows distinct differences even postoperatively from normal children which may affect the desired surgical outcome. Thus MRI may act as a guide for further management and rehabilitation of these children

Keywords: Anorectal Malformation, PSARP, MRI, Anorectal Angle, Rectosigmoid Volume.

INTRODUCTION

Anorectal malformations (ARMs) are a complex group of congenital anomalies affecting distal anus, rectum and also urogenital tracts at times. The prevalence rate is 1 per 5000 live births with slight male preponderance.[1] Its correction involves multistage surgery with Posterior Sagittal anorecto plasty (PSARP). MRI is a valuable imaging modality for analysis of pelvic anatomy because of its multiplanar imaging capability, inherent soft tissue contrast and non ionizing radiation.[2] Most studies have focused on the preoperative evaluation of ARM with MRI[1] with only few studies having evaluated postoperative MRI findings.[3] We analyzed MRI findings of 25 children after complete surgical correction of ARM and compared those findings with normal children to find the differences.

MATERIALS AND METHODS

The study was conducted at Jawaharlal Nehru Medical College and Hospital from 2015 to 2017 and prior approval was obtained from the institutional ethics committee. Written informed consent was obtained from the parent or guardian of each participant. After thorough evaluation of medical history and operative data 25 cases and 25 controls were enrolled in this study. There were 16 High or intermediate malformations and 9 low ARM malformations. All the children underwent PSARP For high/intermediate ARM and limited PSARP /anoplasty for low ARM. Thorough physical examination was performed in all of the children before MRI.

Enemas were not administered, to enable assessment of the normal state of the bowel. MRI examination was performed on a 1.5-T MRI unit (Magnetom Avanto, Siemens and 8-channel body coil). Axial, Sagittal and coronal fast spin-echo (FSE) T2-weighted (T2-W) and T1 weighted (T1 W) images of the pelvic region were obtained in all children, with the coronal plane perpendicular and the axial plane parallel to the pelvic floor. Short T1 inversion recovery (STIR) in axial and

sagittal planes and T2 TRU FISP coronal imaging sequences were also added. MRI scan duration was 25–30 min. Scanning parameters of FSE T2-Wimages were TR: 4200 ms, TE: 76 ms, FOV: 30 × 30 cm, section thickness 3 mm, spacing: 0.3 mm, T1-Wimages were TR: 600 ms, TE: 12 ms, FOV: 30 × 30 cm, section thickness 3 mm, spacing: 0.3 mm, those of STIR were TR: 3,500 ms, TE: 135 ms, FOV: 30 × 30 cm, section thickness 4 mm, spacing: 0.4 mm. TRU F ISP-- TR: 3.8 ms, TE: 1,6ms FOV: 30 × 30 cm, section thickness 4 mm, spacing: 0.4 mm. Twenty five similar age group controls (0-14 years) undergoing pelvic MRI for unrelated complaints (hip, gonad related complaints) acted as controls. Imaging protocol similar to cases was added in their sequences. These acted as reference images for comparison.

The MRI images were interpreted by an experienced radiologist (experience>8 years) who was unaware of the clinical findings. Evaluations included the position of the neorectum (midline or not, within the striated muscle complex), volume of the rectosigmoid, anorectal angle (the angle between the longitudinal axis of the anal canal and the posterior rectal wall, normal should be less than 100˚), postoperative scarring and peritoneal fat herniation. Position of fistula with urinary system, neurogenic bladder, other genitourinary abnormalities or other abnormalities of the spinal cord and sacrum were also noted.[4] Puborectalis and sphincter muscle development was considered normal if the muscle had a regular shape and normal thickness (2.5 mm was taken as the lower limit of normal in a 2 month old child, then 2.8 mm 6months- 3 years, 3.6 mm at 3- 7 years and 4.3 mm was taken as the lower limit in 7- 14 years) and poor if the muscle was thin, disrupted or deformed.[5]

STATISTICAL ANALYSIS

MRI findings were compared between patients and normal children. The significance of differences between groups was analyzed using unpaired t-test. A P value of < 0.05 was considered statistically significant.

RESULTS

Of the 25 children undergoing MRI after complete surgical correction of ARM 19 were boys (76%) and 6 (24%) were girls showing the male preponderance with a mean age of 5.2 years (range: 2months to 14 years).Sixteen cases were of high ARM while 9 were low ARM. Regarding the presenting complaints 10 had fecal incontinence as the dominant symptom, 9 had constipation predominantly, 2 had occasional episodes of incontinence alternating with constipation and 4 were almost normal with no significant complaints postoperatively.

On MR Imaging -12(48%) showed increased rectosigmoid volume (Fig 1), 10(48%) had increased anorectal angle (more than 100^{0}) (Fig 2). Significant postoperative scarring was seen in 10(40%), neoanus was off midline in 6(24%), thin puborectalis sling with thin pelvic floor muscles was seen in 17(68%)(Fig 3), peritoneal fat herniation in 6(24%) and anal stenosis in 4(16%).

Associated neurogenic bladder was seen in 10(40%) patients and upper urinary tract abnormality in 2 (8%).

Figure-1: T2 weighted sagittal image showing markedly increased rectosigmoid volume in a 4 year old with persistent constipation after PSARP for high ARM.

Figure-2: T2 weighted sagittal image showing almost straight anorectal angle in a 5 year old with incontinence as the main post PSARP complaint.

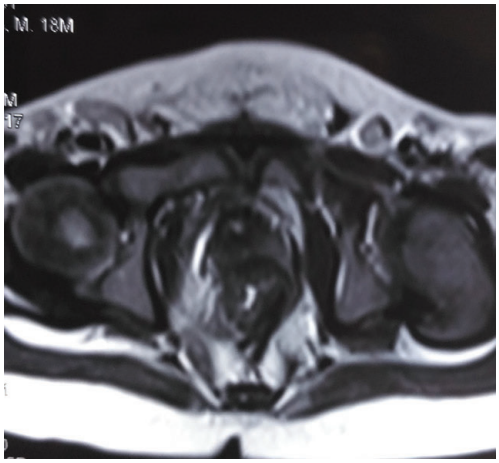

Figure-3: T2 weighted axial image showing thin and disrupted puborectalis sling and irregular sphincter muscle complex [on right side] and slightly off midline location of neoanus.

Vertebral column abnormalities were detected in 6(24%) cases. Increased anorectal angle was seen more frequently in patients with incontinence (8 out of 10 patients) than patients with constipation (2 out of 9). The difference between the two groups was significant(P<0.05).

Increased rectosigmoid volume had more association with constipation. All 9 children with constipation as the main symptom had significantly increased rectosigmoid volume. 2 children with occasional episodes of incontinence alternating with constipation and 1 with no complaints also had increased rectosigmoid volume while none of the patients with incontinence had increased rectosigmoid volume. The difference was significant (P<0.05).

There was no significant difference in postoperative scarring (5 in each group), peritoneal fat herniation and abnormal position of neoanus in incontinent and constipated group (P > 0.05). Significantly fistula was not seen in any of our patients. Puborectalis muscle showed average thickness of 2.5- 6 mm increasing with age and appeared smooth and taut in controls while 17(68%) of the cases had maldeveloped, thin puborectalis muscle with irregular contour or breach in continuity. Patients with incontinence and constipation both showed maldeveloped puborectalis muscle and there was no significant difference between these two groups (P>0.05)

Neurogenic bladder was seen in 10(40%) patients and upper urinary tract abnormality in 2-out of which one had absent right kidney and other a horseshoe kidney. Vertebral column abnormality seen included lower sacral agenesis in 2 patients, tethered cord in 2, and spina bifida in 1 and fusion of lower lumbar vertebrae in 1. The MRI findings are tabulated in Table 1.

DISCUSSION

Although surgical treatment of anorectal malformation (ARM) has seen much advancement during the last decades it becomes challenging at times to achieve satisfactory results in spite of best surgical efforts. There might be some inherent differences in the pelvic anatomy of these children from normal which may persist even after surgery and interfere with postoperative bowel control and function. MRI is a valuable imaging modality for evaluation of these children because of its inherent soft tissue contrast and non ionizing radiation.[2] Most previous studies have focused on the preoperative MRI evaluation of ARM.[1] Only few studies have evaluated postoperative MRI findings.[5] We evaluated MRI findings in 25 patients at least 3 months after complete surgical correction of ARM.

MRI findings	No. of patients
Increased rectosigmoid volume	12
Straighter anorectal angle(>100°)	10
Poorly developed puborectalis sling and pelvic floor muscle	17
Neoanus off midline	6
Peritoneal fat herniation	6
Anal stenosis	4
Postoperative scarring	10
Neurogenic bladder	10
Upper urinary tract abnormality	2
Vertebral column abnormality	6

Table-1: Summary of MRI findings

Of the 25 children undergoing MRI, ten had fecal incontinence as the dominant symptom, nine had constipation predominantly, two had occasional episodes of incontinence alternating with constipation and four had no significant complaints. Increased rectosigmoid volume was seen in all 9 children with constipation while none of the patients with incontinence had increased rectosigmoid volume. The difference between the two groups was significant (P<0.05). Dilation of the neorectum is commonly seen in patients after surgery for ARM with a significantly higher incidence in those with constipation. The mechanism of rectal dilation is not clearly understood, but may be associated with abnormalities of innervations, surgical scarring, and damage to the nerves, colonic sensation and motility, leading to fecal impaction. Severe constipation and dilation of the rectum may lead to toxic megacolon and thus requires dedicated treatment.[6]

Our study also showed increased anorectal angle more frequently in patients with incontinence (8 out of 10 patients) than patients with constipation (2 out of 9). The difference between the two groups was significant (P<0.05). A normal anorectal angle is very important for maintaining continence. The straighter the angle higher will be the incontinence.[7] Maintenance of this angle in a large part depends on a normally developed puborectalis sling. Seventeen (68%) of the 25 cases had maldeveloped, thin puborectalis muscle as compared to similar age group children. There was also deficiency in the contour and continuity of the sling in these patients. There was no significant difference in the constipated and incontinent group, indicating that a normally developed sling is essential for normal defecatory function and inadequacy may lead to either of the two conditions depending on the presence of other associated factors.[8,9] Normally positioned neorectum, normal calibre rectosigmoid, acute anorectal angle and a properly developed puborectalis, sphincter muscles and pelvic floor muscle is essential for normal function of bowel and defecation.[10]

Dynamic MRI with defecography offers some advantages over static images. Some conditions such as proctocele, cystocele and even fistula can be visualized on dynamic but not static MRI. Pelvic floor muscle and dysfunction is also better assessed on dynamic MRI.[11,12] Other MRI findings seen in our cases included postoperative scarring, peritoneal fat herniation and anal stenosis. Neurogenic bladder and upper urinary tract abnormality were also seen. Spinal anomalies seen were lower sacral agenesis, tethered

cord, spina bifida and fusion of lower lumbar vertebrae. These anomalies affect the innervation to anorectum and also bladder and affect the overall postoperative results.
The postoperative management of ARM requires special knowledge of the anatomical characteristics of this group of patients and their differences from normal and significant improvements can be expected in these patients with long term follow up guided by MRI findings.

CONCLUSION

Children with ARM have some inherent deficiencies in rectal anatomy and pelvic musculature. These differences even after surgical correction may persist to some extent and may affect the desired surgical outcome. MRI is a very useful imaging modality in such operated children of ARM to study the remaining differences from normal in detail to guide future comprehensive management of these children.

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