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ADOLESCENT IDIOPATHIC SCOLIOSIS AND PREOPERATIVE MAGNETIC RESONANCE IMAGING

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ABSTRACT

Aim: Adolescent Idiopathic Scoliosis (AIS) is a challenging disease to manage. As patients might require major demanding surgeries, careful preoperative assessment is required. In this study, we aim to elaborate the role of MRI in this particular patient's population and assess it's importance in routine preoperative evaluation. **Methods:** From December 2016 to July 2019, a total of 42 patients with adolescent idiopathic scoliosis were evaluated. We will study a total of 42 patients with adolescent idiopathic scoliosis at the spine clinic of our institute. All patients to be included in the study are diagnosed with adolescent idiopathic scoliosis with a surgical curve pattern and had a complete physical and neurologic examination. Magnetic resonance imaging of the brain and the spinal cord were performed as part of their preoperative work-up. The study group included 3 male patients and 17 female patients. The average age at the time of the imaging study was 13.6 years (range, 10.2-19.1 years). The average curve was 54 degrees (range, 41-79 degrees). **Results:** Six abnormalities were seen. There were four cases of Arnold-Chiari type I malformation, pediatric neurology and neurosurgical evaluations were obtained. Surgery was not thought to be contraindicated, and both underwent fusion without incidents. Two patients were found to have a collection of fat in the body of T10. This was thought to be benign, and surgery was performed without any major complications. In eight cases, the report on the initial MRI was equivocal but not necessitating further studies. In four other cases, the question of a dural sac deformity was raised. These films were subsequently reviewed in a double blinded fashion and found to be normal except for scoliosis. The rest of cases showed no MRI abnormalities besides AIS. **Conclusion:** We think that routine preoperative MRI is probably not indicated in adolescent idiopathic scoliosis if the patient has a normal neurologic examination.

INTRODUCTION

The adolescent idiopathic form of scoliosis remains one of the most common types seen in spine orthopedic practice; its cause is still unknown.

Doctors are often called on to justify their use of various tests and studies because of cost,\ containment, resource allocation, and managed care.

As a rule, a neurogenic etiology of scoliosis should be considered before it is classified as truly idiopathic. Increased awareness of the possibility of a neurogenic cause of scoliosis has led to more frequent investigation with magnetic resonance imaging (MRI), and more positive findings have been reported in patients with asymptomatic idiopathic scoliosis.[1,2,3]

MRI is sensitive, noninvasive, avoids ionizing radiation, and is the current imaging study of choice for evaluating pathology of the neural axis.[4,5]

It is well known that patients with abnormal neurological findings, with left thoracic curves, or with atypical curves, should undergo magnetic resonance imaging (MRI) or a myelographic examination before management of their scoliosis to rule out an intraspinal pathology.[6,7,8]

The prevalence of intraspinal pathology associated with scoliosis has been reported to be as high as 26% in some series and, on the basis of this finding, preoperative magnetic resonance imaging is used in the screening of patients with adolescent idiopathic scoliosis. However, this practice continues to be highly controversial and the need for such studies in adolescent idiopathic scoliosis is uncertain and answers to the following questions remain to be answered: (a) What is the incidence of MRI-demonstrable abnormalities in typical adolescent idiopathic scoliosis? (b) What are the specificities of this test? (d) Is it necessary to obtain routine before surgery for adolescent idiopathic scoliosis?

MATERIALS AND METHODS

From December 2016 to July 2019, 42 patients met the criteria for inclusion in this study. There were 34 girls and 6 boys. The mean age at time of surgery was 13.6 years (range, 10.2-19.1). The median Cobb angle of the major curve on the preoperative standing spine film was 54º (range, 41º-79º).

Physical and neurologic examinations were performed by the orthopedic team and a pediatric neurologist as all patients entered in the study had to meet the following criteria: (a) normal physical examination (other than scoliosis), (b) normal neurological examination, including superficial abdominal reflex, (c) right thoracic or thoracolumbar or double major curve, (d) adolescent idiopathic scoliosis for which surgery had been advised, and (e) age.

Three series of images were obtained. The first was a localizer in the sagittal plane. Diagnostic T1-weighted images of the entire spine from the base of the skull to the sacrum were then acquired. If an abnormality was noted on either image set, axial T1-weighted images and axial fast spin echo T2-weighted images were obtained.

Imaging was performed on a 1.5-T unit (Symphony, Siemens.Germany2002) with the first three sequences using the following parameters: multiecho multiplanar (MEMP), 16 kHz, flip angle (FLIP), frequency Superior/Inferior (S/I) and center frequency W on all patients with the following variations:

Series 1: Sagittal localizer images with options: None (300/16 repetition time msec/echo time msec), 128 × 128 matrix, 0.5 signals acquired, 5 mm thick slices with a 2.5 mm intersection gap, and 48 cm field of view.

Series 2: Sagittal T1-weighted with options: saturation pulse (SAT), extended dynamic range (ED); and SAT S/I and A & P; (600/10 repetition time msec/echo time msec), 256 × 256 matrix, 2 signals acquired, 4 mm thick slices with a 1 mm intersection gap, and 32 cm field of view.

Series 3: Coronal T1-weighted with options: SAT, no phase wrap (NP), ED; and SAT S/I, (600/15 repetition time msec/echo time), 256 × 256 matrix, 2 signals acquired, 4 mm thick slices with a 1 mm intersection gap; and 32 cm field of view.

Series 4: Axial fast spine echo T2-weighted images: MEMP fast, 16 kHz, frequency S/I and center frequency W with options: SAT, S/I; and SAT S/I, (4000/120 repetition time msec/echo time msec), 256 × 256 matrix, 4 signals acquired, 4 mm thick slices with a 1 mm intersection gap, and 24 cm field of view.

The standard examination included the cervical, thoracic, and upper lumbar spine. The cost per study at our institution was almost equal to 350 US$.

The appearance of the cord, the level of the conus medullaris, and presence or absence of syringomyelia, meningocele, diastematomyelia, or Arnold-Chiari malformations were noted.

38 patients underwent spinal fusion with instrumentation. Two decided not to undergo surgery after the studies had been done because of travel out of the country.

RESULTS

Six abnormalities were seen. There were four cases of Chiari type I malformation. Pediatric neurology and neurosurgical evaluations were obtained. Surgery was not thought to be contraindicated, and all underwent fusion without incident.

Two patients were found to have a collection of fat in the body of T10. This was thought to be benign, and surgery was performed without incident.

In eight cases, the report on the initial MRI was equivocal but not necessitating further studies. In another, areas of diminished signal intensity of uncertain significance were noted in the spinal canal, MRI repeated and proved to be normal. Instrumentation was performed without incident.

In four other cases, the question of a dural sac deformity was raised. These films were subsequently reviewed in a blind fashion and found to be normal except for scoliosis.

Recognized pulsation artifacts in the MRI were noted in another four cases. No further investigations were done.

DISCUSSION

Routine use of MRI has been recommended for infantile and juvenile idiopathic scoliosis.[8] In a group of 26 patients younger than 11 years old, Lewonowski et al.[9] noted five patients as having syringomyelia, hydromyelia, intramedullary tumor, and lipoma. There is also good evidence that atypical neurologic findings or atypical curves are causes for obtaining an MRI.[10,11,12]

However, the indications for MRI investigation of the spinal canal in typical adolescent idiopathic curves are less well defined.The etiology of idiopathic scoliosis is unknown; however, there is increasing evidence that nervous system dysfunction at any level can induce spinal deformity. This increased awareness of the possibility of a neurogenic cause of idiopathic scoliosis has led to increased investigation with MRI, and more positive findings have been reported in asymptomatic patients.

Twee Do et al.[11] screened 327 patients with idiopathic scoliosis and reviewed MRI results to determine the prevalence of spinal cord abnormalities in these patients. From their 327 patients, Seven patients had an abnormality noted on magnetic resonance imaging.

These abnormalities included a spinal cord syrinx in two patients (0.6%) and an Arnold-Chiari type-I malformation in four (1.2%). One patient had an abnormal fatty infiltration of the tenth thoracic vertebral body. No patient required neurosurgical intervention or additional work-up. All patients who underwent spinal arthrodesis with segmental instrumentation tolerated the surgery without any immediate or delayed neurologic sequelae.[13,14]

Because of reports of normal neurologic examinations in patients with syrinxes and the potential for injury from a missed diagnosis, this study is being continued. However, results to date call into question the need for routine MRI in classic adolescent idiopathic scoliosis with a normal neurologic examination.[15,16,17]

The different limitations of the imaging system should be be resolved before it can be widely applied and accredited in the clinical practice. For patients with AIS, an atypical presentation or neurological co-findings might require the use of computed tomography (CT) and/or magnetic resonance imaging (MRI) to further assess for any underlying pathology. As we know CT produces a high radiation dose, that's why it is not very commonly used in the assessment of scoliosis, and is replaced by MRI, which is expensive on the other hand and is under the scope of our study as elaborated previously. The 3D ultrasound scanning has inherent intrinsic technical limitation and cannot be used in all subjects. Radiography, however, enables diagnosis and monitoring of the adolescent idiopathic scoliosis (AIS). It is thus the gold standard in the evaluation and management of scoliosis curves.[18]

CONCLUSION

The purpose of this study was to answer the question: Are preoperative MRIs warranted in classic idiopathic scoliosis? In our hands, MRI has high sensitivity in the detection of central nervous system abnormalities but has a significant false-positive rate and, at present, no much yield in this imaging modality.

We believe that preoperative magnetic resonance imaging is neither necessary nor indicated for an otherwise healthy and neurologically intact patient with adolescent idiopathic scoliosis.

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