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Assessment of Magnetic Resonance Imaging Role in Evaluation of Failed Back Surgery Syndrome

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ABSTRACT

Background: Failed back surgery syndrome (FBSS) is a fairly common problem. Magnetic resonance imaging (MRI) with its multi-planar capabilities and superior soft tissue characterization is the modality of choice for imaging the postoperative spine.

Objective: This study aimed to investigate the role of MRI in evaluation of FBSS.

Methods: Forty-eight patients with FBSS were referred to Zagazig University Hospitals who had previous lumbar spine surgery. All patients were evaluated by history taking and radiological evaluation by dynamic x-ray and a post-operative spine MRI study that consisted of seven series: T1 -weighted sagittal & TI -weighted axial series, a sagittal & axial series for T2-weighted series, post-gadolinium T1-weighted axial and sagittal series and Heavy T2 MRI myelogram.

Results: The major identifiable causes of FBSS in operated patients for lumbar disc herniation included recurrent disc herniation and epidural fibrosis (27 and 10.4% of our patients, respectively), and both occurred in 22.9 %, post-operative infected fluid collection in 10.4%, spondylodiscitis in 6.3%, spondylodiscitis with epidural fibrosis in 4.2%, filum terminal ependymoma and postoperative infected fluid collection with epidural fibrosis in 4.2%, postoperative infected fluid collection with spondylodiscitis in 4.2%, epidural fibrosis with spinal stenosis in 4.2%, pseudo- meningocele with RDH in 2%, both epidural scar & RDH with deposits in 2% and RDH with spinal stenosis in 2%.

Conclusion: MRI is generally a safe and accurate technique, which has been proven to be the technique of choice in evaluation of FBSS with its excellent resolution and multi-planar capabilities.

Keywords: Failed back surgery syndrome, Magnetic resonance imaging.

INTRODUCTION

Eighty percent of the population suffers from back discomfort at some point in their lives [(1)]. With a substantial geographic variance in spine surgery rates and spinal fusion rates, the number of spinal surgeries is increasing [(2)].

Failed back surgery syndrome (FBSS) affects a large percentage of people who have undergone a back surgery. Recurrent or persistent back pain following spinal surgery characterises this syndrome, which has a reported frequency of five to forty percent [(3)].

Postoperative radiological examination necessitates an understanding of both the typical changes in the postoperative spine and the possible postoperative problems. Patient's quality of life is severely impacted by this illness, which is devastating [(4)].

For imaging the post-operative spine, Magnetic resonance imaging (MRI) is the modality of choice because of its multi-planar capabilities and improved soft tissue characterization. This test is critical in determining the root of most cases of failed back syndrome [(5)]. If post-operative problems are suspected, MRI is the preferred modality. MRI is superior for soft tissue, bone marrow, and intra-spinal content examination is made possible by its great spatial and contrast resolution [(3)]. Due to its outstanding capacity to detect soft tissue anomalies such as epidural fibrosis and disc herniation, MRI with and without gadolinium contrast remains the gold standard imaging modality for FBSS [(6)]. It is common practice to perform an MRI after surgery to check for any issues that may have occurred, but artefact reduction techniques can increase the clarity of the images so that they are more easily detectable [(7)].

Postoperative MRI is now more readily available than ever before, even if symptoms haven't worsened, or new deficiencies haven't emerged as a result of the surgery. Additionally, MRIs that have no effect on the patient's clinical course may be performed for medicolegal reasons [(8)].

It was the goal of this study to study the role of magnetic resonance imaging in evaluation of FBSS.

PATIENTS AND METHODS

This study included 48 patients (31males and 17 females) with history of low back pain or sciatica after having previous lumbar spine surgery. Their ages ranged from 23 to 73 years. This work was performed at the MRI Unit of Radiodiagnosis Department, Zagazig University Hospitals.

Ethical approval: All participants completed informed permission papers and submitted them to the research ethics committee at Zagazig University, the study was permitted (ZU-IRB#6598). Ethics guidelines for human experimentation were adhered to in line with the Helsinki Declaration of the World Medical Association.

Inclusion criteria: Postoperative spine patient 3 months after spine operation, and all age and sex groups are included.

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Exclusion Criteria: Patients with contraindication to magnetic resonance imaging examination: Patients with implanted pacemaker and other cardiological devices incompatible with magnetic resonance imaging, patients with ocular implants, patients with aneurysmal clips in their brain, and patients with renal function tests impairment.

All patients were subjected to the following:
Clinical assessment including: Personal history (age and sex, patient complaint (low back pain and/ or sciatica), and time and type of the previous spine surgery.

Clinical examination and Radiological examination including: MRI and Dynamic X-ray.
MRI Examination:
Preparation of the patient: Before entering the examination room, patients were instructed to remove any metallic object. They were also routinely asked about the presence or absence of cardiac pacemaker or any metallic operative clips. Then, a brief explanation of the examination was mentioned to the patient. This included the need to lie motionless during the examination, the contra-indication of metallic objects, and patient reassurance (to avoid potential claustrophobia).

Protocol of examination: MR examination was performed at (1.5 tesla) super conducting MR magnet (Philips Achieva system) in the MRI unit, Zagazig University Hospital. Patients were placed supine. Images were obtained in the axial and sagittal planes.
The MRI study included some or all of the following pulse sequences: Axial T1WIs, axial T2WIs, sagittal T1 WIs, sagittal T2 WIs, and post contrast T1WIs after injection of contrast (Gd-DTPA) 0.1mmol/kg body weight. The slice thickness of 4-5mm, and an interslice gap of 0.4 mm.

Statistical analysis

Using SPSS software (USA) version 16. Numbers and percentages are used to represent data (percent) or mean ± SD. Different qualitative factors were examined using the Chi square (X^2) test and Kappa test for agreement between categorical data. If the significant probability was less than 0.05, the threshold for statistical significance, the results were considered statistically significant and highly significant (< 0.001). P value ≤ 0.05 was considered significant.

RESULTS

Table (1) showed that mean age of the studied group was 47.20 ± 14.27 years [ranging from 23 years up to 73 years]. More than half (65%) of which were males, 95% of the studied cases had LBP, 25% complained of bilateral sciatica, 12.5% complained of left sciatica, 8% complained of right sciatica and 2.08% complained of fever.

According to MRI findings, there was 5 (10.4%) had epidural scar, 13 (27%) had recurrent disc herniation, 11 (22.9%) had both epidural scar and recurrent disc herniation, 5 (10.4%) had post-operative infected fluid collection, 3 (6.3%) had spondylodiscitis, 2 (4.2%) had spondylodiscitis with epidural scar, 2 (4.2%) had Filum terminal residual ependymoma and Post-operative infected fluid collection with epidural scar, 2 (4.2%) had Post-operative infected fluid collection with Spondylodiscitis, 2 (4.2%) had spinal stenosis with epidural scar, 1 (2%) had psudomeningocele and RDH, 1 (2%) had both recurrent disc herniation & epidural scar tissue and deposits and 1 (2%) had RDH and spinal stenosis. There was 7 (15%) had instability and 41 (85%) had stability.

Table (3) showed that 62.5% of the studied cases underwent laminectomy operation, 35.4% had laminectomy with fixation and 2% had laminectomy and discectomy, with mean operative time of 15.25 ± 10.99 months.
Table (4) showed that 9 patients were re-operated. Surgery confirmed the preoperative diagnosis of recurrent disc herniation in 2 patients, epidural scar in 1 patient, both recurrent disc herniation and epidural scar in 1 patient, postoperative infected fluid collection in 1 patient, spondylodiscitis in 1 patient, both post-operative infected fluid collection & spondylodiscitis in 1 patient and pseudo-meningocele with RDH in 1 patient. There was 1 false positive finding, and no false negative were encountered in this series of patients, with statistically significant excellent agreement between MRI and surgery exploration findings.
Table (5) showed that MRI could be used to discriminate finding among cases with failed lower back surgery with good strength of agreement, 100% sensitivity, 0.0% specificity, 88.8% PVP and 0.0% PVN

Table (1): Demographic data and Distribution of the studied cases according to complain of the studied cases (n = 48)

	No.	**%**
Sex		
Male	31	65.0
Female	17	35.0
Age (years)		
Min. – Max.	23.0 – 73.0	
Mean ± SD.	47.20 ± 14.27	
Median (IQR)	51.0 (31.50 – 55.0)	
Complain	**No.**	**%**
LBP	46	95.0
Bilateral sciatica	12	25
Left sciatica	6	12.5
Right Sciatica	4	8
Fever	1	2.08

Table (2): Distribution of the studied cases according to MRI finding of different FBSS causes (n = 48)

MRI finding	No.	%
Epidural Scar	5	10.4
Recurrent disc herniation	13	27
Epidural scar and Recurrent disc herniation	11	22.9
Post-operative infected fluid collection	5	10.4
Spondylodiscitis	3	6.3
Spondylodiscitis with epidural scar	2	4.2
Filum terminal residual ependymoma and post-operative infected fluid collection with epidural scar.	2	4.2
Post-operative infected fluid collection with Spondylodiscitis	2	4.2
Spinal stenosis with epidural scar	2	4.2
Psudomeningocele and RDH	1	2
Both recurrent disc herniation & Epidural scar tissue and deposits	1	2
RDH and spinal stenosis	1	2
Dynamic x-ray		
Instability	7	15.0
Stability	41	85.0

Table (3): Distribution of the studied cases according to type and time of operation (n = 48)

Type of operation	No.	%
Laminectomy alone	30	62.5
Laminectomy and fixation	17	35.4
Laminectomy and discectomy	1	2
Time of operation (months)		
Min. – Max.	4.0 – 36.0	
Mean ± SD.	15.25 ± 10.99	
Median (IQR)	12.0 (6.50 – 24.0)	

Table (4): Agreement between MRI finding and surgery re-exploration (n = 9)

MRI finding	Surgery re-exploration finding							Total
	Epi. scar	RDH	Both	Inf. fluid	Spondyl.	Both	Pseudo-meningocele & RDH	
Epidural Scar	1							1
Recurrent disc herniation		2						2
Epidural scar and Recurrent disc herniation		1	1					2
Post-operative infected fluid collection				1				1
Spondylodiscitis					1			1
Post-operative infected fluid collection & spondylodiscitis						1		1
Pseudo-meningocele with RDH							1	1
Total	**1**	**3**	**1**	**1**	**1**	**1**	**1**	**9**

	Value	Approximate Significance
Measure of agreement Kappa	0.868	< .001
Number of valid cases	9	

Table (5): Validity and reliability data of MRI finding among re-explored cases as regard total number of findings (n = 9)

MRI finding	Surgery finding		Total	Sensitivity	Specificity	PVP	PVN	Accuracy
	Positive	Negative						
Positive Negative	8 0	1 0	9 0	100%	0.0%	88.8%	0.0%	88.8%
Total	**8**	**1**	**9**					

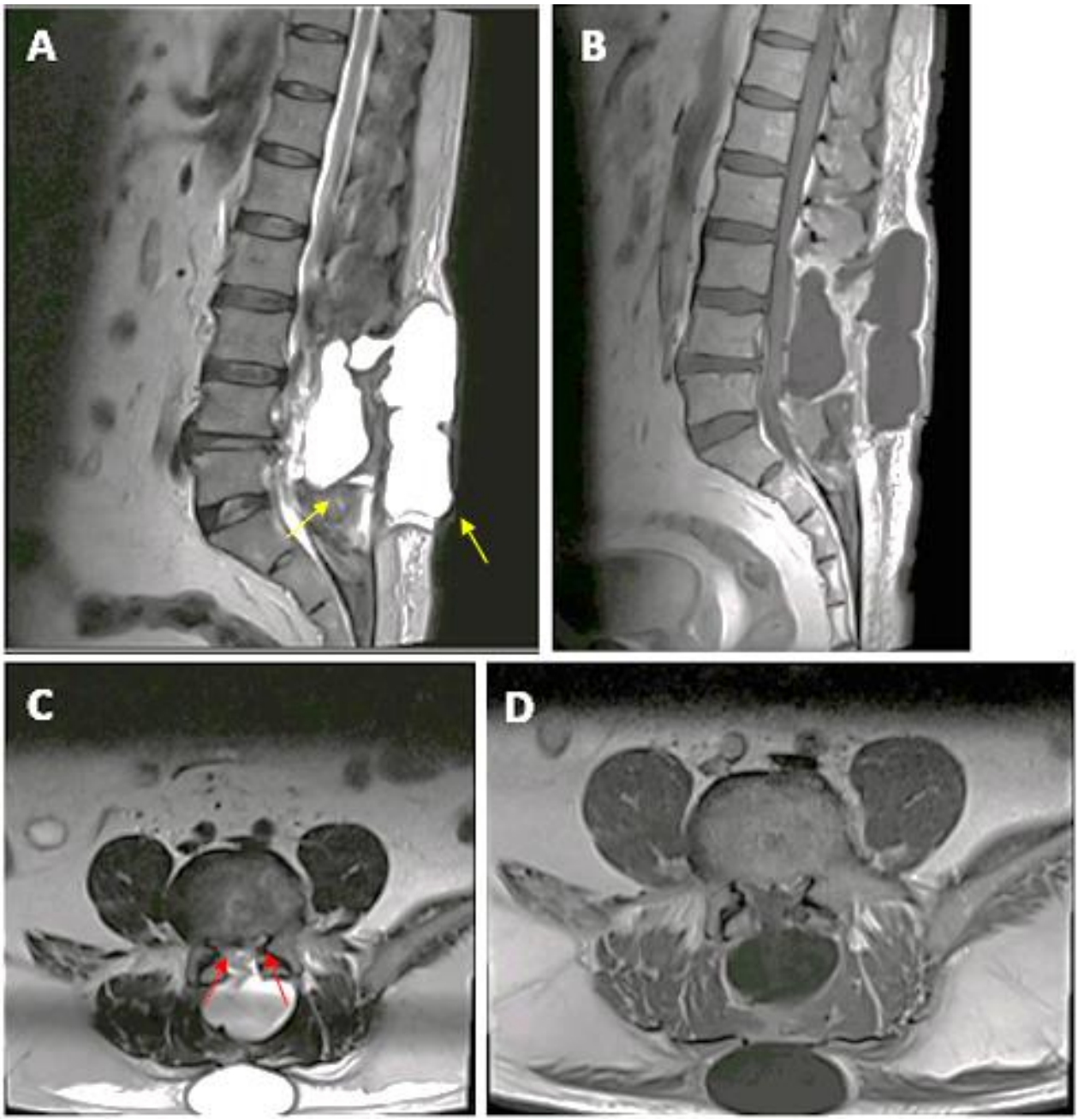

Figure (1): Male patient aged 42 years with history of laminectomy 1 year ago. Then, the patient complained of low back pain and sciatica. Pre- & post-contrast MRI revealed: (A) Sagittal T2WI and (B) post-contrast sagittal T1WI, (C) Axial T2WI and (D) post-contrast Axial T1WI. They showed well-defined fluid like S1 collection (yellow arrows) noted at the laminectomy site at L2-3 & L4-5 defect, decompressing into the superficial tissue at L2-3 level and upper sacral level subcutaneous collection resembling giant psudomeningocele. Diffuse posterior disc hernia (red arrows) at L3-4, L4-5 & L5-S1 levels indenting upon the ventral aspect of the thecal sac & encroaching upon the both exiting canals, degenerated lower disc spaces in the form of loss of normal high signal intensity of examined disc spaces. Diagnosis: giant psudomeningocele and recurrent disc herniation with degenerative changes.

DISCUSSION

The vertebral canal, which houses the spinal cord, is an essential part of the human body. When it comes to sensory and motor functions, nearly all spinal illnesses have an impact on patients [(10)]. FBSS is a prevalent complication in neurosurgical practice and is defined as failures following spinal surgery with persistent or recurrent back pain. Arachnoiditis, spondylodiscitis, mechanical instability following surgery, spinal stenosis, and recurrent or persistent disc herniation are a few of the possible causes [(10)].

Due to its outstanding capacity to detect soft tissue abnormalities, such as disc herniation and epidural fibrosis, MRI with and without gadolinium contrast remains the gold standard imaging modality for FBSS [(11)].

Regarding demographics in our study, patient' ages ranged between 23 to 73 years with the mean ± SD of age in our study was 47.20 ± 14.27 years. The number of males suffering from FBSS was more than females [31 (65%) males versus 17(35%) females]. This significant sex difference may be due to difference in the level of activity and job description. **Dhagat *et al.*** [(12)] reported a similar male predominance. In study by **Dhagat *et al.*** [(12)], the age of the patients ranged from 22 to 65 years and there were 23 males and 7 female patients.

Regarding clinical data, 46 (95%) of patients complained of low back pain, 12 (25%) of patients complained of bilateral sciatica, 6 (12.5%) of patients complained of left sciatica, 4 (8%) of patients complained of right sciatica and 1 (2.08%) of patients complained of fever. In study by **Dhagat *et al.*** [(12)], 27 of patients complained of backache, 11 complained of neurological deficit, 2 complained of mechanical instability and one patient complained of fever. **Skaf *et al.*** [(13)] reported radicular pain in all cases while only 28% of cases had predominant back pain. This notable difference reported in different studies refer to that the clinical picture of FBSS cases varies according to the etiology of failed back surgery.

In our study, 62.5% of the studied cases underwent laminectomy operation, 35.4% had laminectomy with fixation and 2% had laminectomy and discectomy. The average duration of symptoms ranged from four to thirty-sex months, with mean operative time of 15.25 ± 10.99 months. In study by **Dhagat *et al.*** [(12)], a total of 26 patients had surgery for the degenerative disc disease and four patients had spinal fixation surgery, The average duration of symptoms ranged from six months to three years. The average duration of symptoms ranged from six months to three years.

The main finding of our study was that after MRI, recurrent disc herniation was detected as the first FBSS cause in 13 (27%) patients, 11 (22.9%) patients had both recurrent disc herniation & epidural scar, 5 (10.4%) had epidural scar, 5 (10.4%) had post-operative infected fluid collection, 3 (6.3%) had spondylodiscitis, 2 (4.2%) had spondylodiscitis with epidural scar, 2 (4.2%) had filum terminal residual ependymoma and post-operative infected fluid collection with epidural scar, 2 (4.2%) had post-operative infected fluid collection with spondylodiscitis, 2 (4.2%) had spinal stenosis with epidural scar, 1 (2%) had pseudo-meningocele and RDH, 1 (2%) had both recurrent disc herniation, epidural scar and deposits, and 1 (2%) had RDH and spinal stenosis.

Regarding dynamic X-ray, there was 7 (15%) of patients had instability and 41 (85%) had stability. In study by **Dhagat *et al.*** [(12)], of 30 FBSS cases which were evaluated with contrast enhanced MRI of the spine, recurrent disc herniation was detected as the first FBSS cause in 16 (53%) patients, epidural scar tissue is found out in 6 (20%) cases, 3 (10%) patients had recurrent disc herniation and scar tissue, 2 (7%) patients had postoperative discitis, 2 (7%) had evidence of post-surgery arachnoiditis and 1 (3%) patient had implant malalignment. In a study by **Eseoğlu and Akdemir** [(14)] of 70 FBSS cases; there was 45 (64%) patients had recurrent DH, 9 (12.8%) had epidural fibrosis and recurrent DH, 8 (11.4%) had paraspinal abscess, 3 (4.2%) had lumber stenosis, 3 (4.2%) had foraminal stenosis, 1 (1.4%) had postoperative discitis, and 1(1.4%) had CSF fistula. **Teixeira *et al.*** [(15)] reported that their lumbar spine dynamic study did not show instability in any patient.

In our study, 9 patients were re-operated. Surgery confirmed the pre-operative diagnosis of RDH in 2 patients, both epidural scar and RDH in 1 patient, epidural scar in 1 patient, spondylodiscitis in 1 patient, postoperative infected fluid collection in 1 patient, pseudo-meningocele with RDH in 1 patient and both post-operative infected fluid collection & spondylodiscitis in 1 patient. There were two false positive findings, and no false negative were encountered in this series of patients, with statistically significant excellent agreement between MRI and surgery exploration findings. Thus, MRI could be used to discriminate finding among cases with FBSS with good strength of agreement, 100% sensitivity, 0.0% specificity, 88.8% PVP and 0.0% PVN.

CONCLUSION

MRI is generally a safe and accurate technique, which has been proven to be the technique of choice in evaluation of FBSS with its excellent resolution and multi-planar capabilities. It also plays an essential role in identifying the probable cause of symptoms and helps to guide the correct treatment.

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