Impact of whole spine screening and role of radiologist in taking axial cuts at suspected tandem pathology while doing whole spine screening in the same setting

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Abstract

Purpose: Determines the prevalence of incidental findings (IF) which need attention or concurrent treatment i.e. meaningful coexisting spine lesion (MCSL) reported in the MRI’s with spinogram. Determine role of radiologist in providing axial cut at same time in tandem lesions. Also determine what percentage of treating clinician order a spine MRI without a spinogram.

Methodology: It is a retrospective analytic study carried out at Department of spine surgery in our institution. Accumulation of data from two MRI centres (A and B) of city done from 1st Jan 2018 to 30th September 2019. We blind the identity of all MRI centres as well as the referring clinicians. Of those clinician ordering only regional MRI were counted. MRI centre ‘A’ routinely providing us axial cuts of tandem pathologies of MCSL apart from dedicated area along with whole spine screening in same setting. All number of such reports counted and compared with reports of MRI centre ‘B’ who doing repeat MRI at tandem lesions when we advised only. All the MRIs reports segregate between MRIs with spinogram and only regional or area specific MRI study. Around 2000 MRI films were studied Statistical analysis of data carried out to determine the prevalence of incidental findings of coexisting spine lesion in MRI’s spinogram. Data was analysed using chi square test to determine the correlation between the findings, P value <0.05 considered significant.

Results: Total 2000 MRI films were studied in which regional MRI were done in 445 (22.3%) and regional along with whole spine screening were done 1555 (77.7%) patients. Around 6 out of 36 (17.5%) treating physician ordered only regional MRI investigations. Number of primary spine lesions seen in area specific MRI 708 (45.5%) which were radiologically significant. MRIs with IF of meaningful coexisting spine lesions” (MCSL) 274 (17.6%). Area wise distribution of MCSL were, cervical spine 84 (5.2%), thoracic spine 24 (1.5%), lumbar spine 168 (10.8%). There were 274 (17.7%) MCSL lesions out of 1545 MRIs of whole spine group, which was significant (P<0.05) compared to number of primer lesion i.e. 708, found in same group. Total number of patients who had done repeat MRI at tandem lesion were 154 of which centre ‘A’ performed 34 (20%) and centre ‘B’ 122 (79%) which was statically significant.

Conclusion: Whole spine MRI screening is useful for diagnosis of coexisting spinal diseases to avoid, missing of an asymptomatic but significant lesion. Considering the potential advantages in identifying significant IF and the minimal extra time spent to perform whole spine screening as well as taking axial cut at same time which save extra time and cost. Its application can be considered to be incorporated along with regional studies of spine. Role of radiologist cannot be neglected in taking axial cuts at Grade 3 and 4 MCSL at same time.

Keywords: Spinogram, incidental finding (IF), tandem stenosis, meaningful coexisting spine lesions (MCSL), axial cuts

Introduction

Symptomatic spinal disorders with radiculopathy and myelopathy often warrant a radiological investigation. MRI is the mainstay of investigation for these pathologies. Most of the time MRI was advised, of the area where the clinician is suspecting a problem overlooking the rest of spine. In the literatures [1, 2] it is reported that almost 8-26% of subsequent pathologies can be missed if the screening of the entire spine is not added along with the detailed study of the regional spine. Incidental finding of coexisting spine lesions can be asymptomatic but significant enough to cause a cord compression [3].
Also routinely we advise repeat MRI at the level of tandem lesion or at MCSL which were found in whole spine screening to plan surgical intervention levels, for which patient may requires to spend extra time and cost. So can we cut short this extra time and make it cost effective as well and make MRI reporting more productive in one go?

The aim of this study is to assess the advantages of incorporating sagittal screening of the whole spine and axil cut at tandem lesion of MSCL grade 3 and 4 as needed by radiologist along with regional MRI study, for patients presenting with low back pain or neck pain.

Materials and Methods
It is a retrospective analytic study carried out at Institute at B.K.L Walawalkar medical college, Dervan, India. Collection of data i.e. MRI reports from MRI centres ‘A’ and ‘B’ of the chipuln city was done from 1st Jan 2018 to 30th September 2019. Any additional findings detected on the sagittal screening of the whole spine, which had clinical significance and would otherwise have been undiagnosed, were documented. A “primary spine lesion” was defined as one found on the initially dedicated area-specific MRI (Regional) where treating doctor suspect the pathology and a “coexisting spine lesion or incidental finding ” was defined as a lesion found in the other areas through whole spine screening[1]. These verity of coexisting spine lesions was classified into four grades (0-3) according to the degree of spinal canal compression identified by sagittal imaging as shown in table 1. We used the modified criteria of Takahashi et al. [4] to grade the degree of spinal canal compression

Lesions of grade 2 and 3 coexisting on other spinal areas were defined as “Meaningful Coexisting Spine Lesions” (MCSL). Statistical analysis of data carried out to determine the prevalence of the incidental finding of coexisting spine lesion in MRI spinogram like haemangioma, tandem stenosis, fractures, cord myelopathy, tumours of vertebral body and spinal cord etc.

We blind the identity of all MRI centres as well as the referring clinicians. This study conformed to the widely accepted ethical principles that guide human-based research. We received approval for the study from the Institutional Ethics Committee. As this was a retrospective observational study that involves no additional risk to the patients. Data was analysed using chi square test to determine the correlation between the findings, P value <0.05 considered significant

Exclusion criteria
1. MRI suggestive of postoperative changes like laminecetmy, inter-body fusion, instrumentation
2. MRI suggestive of congenital deformities of spine, hemi-vertebra, scoliosis, neural tube defects

Results
Total 2000 MRI films were studied in which regional MRI were done in 445(22.3%) and regional along with whole spine screening were done 1555(77.7%) patients. Number of primary spine lesions seen in area specific MRI 708(35.4%) which were radiologically significant. MRIs with IF of meaningful coexisting spine lesions” (MCSL) 274 (13.7%). Male to female Ratio 2:1:1, Mean Age was 48 yr old as shown in Table 2. MRIs with IF of meaningful coexisting spine lesions” (MCSL) mainly shows cervical cord edema in 20(7%) films, intra-Dural tumour in 2(0.12%), ossified posterior longitudinal ligament (OPLL) in 34(2.1%), tandem stenosis in 134(48.9%), C1-C2 instability in 2(0.12%), Os Odontoideum in 1(0.06%), infective pathology in 8(0.5%), Disc herniation in 54(19.7%), syrinx formation 2(0.12%), Arnold Chiari Malformation 1(0.06%),Vertebral fracture in 10(0.6%), Secondary involvement of spine in 8(0.5%), haemangiomias in 3(0.15%) films as shown in Table 3.Area wise distribution of MCSL were, cervical spine 84(5.2%), thoracic spine 24(1.5%), lumbar spine 168(10.8%) as shown in table 4. There were 274(17.7%) MCSL lesions out of 1545 MRIs of whole spine group, which was significant (p<0.05) compared to number of primer lesion i.e. 708, found in same group as shown in table 5. Around 6 out of 36 (15.7%) treating physician ordered only regional MRI investigations as shown in table 6 which was statically significant (p<0.5).

Total number of patients who had done repeat MRI at tandem lesion were 154 of which centre ‘A’ performed 34(20%) and centre ‘B’ 122(79%) as shown in table 7 which was statically significant.

Table 1: Grades of coexisting spine lesion depending on cord compression

| Grade 0 | No thecal sac compression (no coexisting lesion) |
|---------|-----------------------------------------------|
| Grade 1 | Minimal subarachnoid space compression         |
| Grade 2 | Mild cord compression (thecal sac compression < 50% in the lumbar area) |
| Grade 3 | Moderate cord compression or cord signal change (thecal sac compression ≥ 50% in the lumbar area) Spinal tumour’s or other structural lesions that needed to be treated or closely observed were classified as grade 3 |

Fig 1: MRI coronal plane, left side Ectopic kidney in pelvis Black arrow while red arrow normal location of right kidney
Fig 2: MRI sagittal plane tandem stenosis and lysthesis at L5 S1, multiple disc herniation, also cervical cord edema

Table 2: Demographic data from MRI films

| Parameter | Numerical value | Percentage |
|-----------|-----------------|------------|
| Dedicated Area specific MRI only | 445/2000 | 22.25% |
| Dedicated Area + Spinogram (spinogram group) | 1555/2000 | 77.75% |
| Total number MRI reports | 2000 | |
| Number of Primary spine lesion in area specific MRIs of spinogram group | 708/1555 | 45.5% |
| MRIs with Incidental Finding of MCSL in screening area on spinogram | 274/1555 | 17.6% |
| Age Group | | |
| < 40 year | 450/2000 | 22.5% |
| 40-60 year | 880/2000 | 44% |
| >60 year | 670/2000 | 33.5% |
| Mean Age in year | 48 | |
| Male to female Ratio | 2.1/1 | |
| clinicians found to be ordering regional MRI study only | 6/38 | 15.7% |
| Total number of repeated MRI at tandem lesions out of 1555 | 154/1555 | 9.9% |

Table 3: Incidental finding of meaningful coexisting spine lesions grade 2 and 3 from 1555 MRI films

| Spinal cord | Number | Vertebral body | Number |
|------------|--------|----------------|--------|
| Cord myelopathy | 20 | 1.2% | Haemangioma | 3 | 0.19% |
| Intradural tumor | 2 | 0.12% | Ossified ligament OPLL | 34 | 2.18% |
| Syrinx | 2 | 0.12% | C1-C2 instability | 2 | 0.12% |
| Arnold-Chiari malformation | 1 | 0.06% | Secondaries involving spine (tumour) | 8 | 0.5% |
| Tandem stenosis | 134 | 8.6% | | |
| Other Incidental finding | | | Disc herniation | 54 | 3.4% |
| Lumbosacral Transitional Vertebra | 184 | 11.8% | Vertebral fractures | 10 | 0.6% |
| Renal cyst | 4 | 0.25% | Infective pathology | 8 | 0.5% |
| Ectopic kidney | 1 | 0.06% | Os odontoideum | 1 | 0.06% |

Table 4: Anatomic distribution of incidental findings

| Anatomical distribution of incidental findings of “Meaningful coexisting spine lesions” (mcsl) in spinogram |
|-------------------------------------------------|
| Cervical area | Thoracic area | Lumbosacral area |
| 82 | 5.2% | 24 | 1.5% | 168 | 10.8% |

Table 5: comparison between primary and coexistent spine lesion in whole spine screening group

| Total number of MRI investigated of dedicated + whole spine screening | Primary spine lesion of MCSL in dedicated area specific MRI | Incidental finding of MCSL on spinogram in Non-dedicated area | P Value, significant <0.05 Chi-square test |
|-------------------------------------------------|--------------------------------|--------------------------------|--------------------------------|
| 1555 | 708 | 274 | 0.00001 |

Table 6: Comparison between doctors who advised whole spine MRIs and dedicated area MRIs

| Total Number of Doctors Advised MRI | Number of Doctor Advised screening of whole spine | Number of Doctors who not advised screening of whole spine | P value, Significant <0.05 Chi-square test |
|-----------------------------------|--------------------------------|--------------------------------|--------------------------------|
| 38 | 32 | 6 | 0.0004 |
Discussion

The discovery of incidental lesions has always been a part of clinical practice and it is worth noting that sometimes an incidental finding can prove even more important than the suspected condition. The necessity of whole spine MRI has been advocated for the precise diagnosis and proper treatment of specific spinal diseases. However, its routine use for the diagnosis of degenerative spinal diseases is controversial and need clinical correlation with patient symptoms, as radiological finding may be worse compared to clinical finding. The dedicated area-specific MRI still being used popularly but has the possibility of missing these asymptomatic but meaningful coexisting lesions which need close follow up in future. In our study 15.7% of treating physician ordered regional MRI as investigation of choice. In Asian country like India there are multiple parallel medical systems like Homeopathy, Ayurveda, Allopathy, Unani medicine coexist and these number may be a just tip of iceberg needing further evaluation in whole country. When cervical and lumbar lesions coexist, the symptoms from one lesion might be masked by dominant symptoms from the other.

Asymptomatic MCSL those do not need specific treatment, are also important because the patients might show delayed aggravation. Bednarik, et al. Reported that in 19.7% of the patients with asymptomatic spondylosis cervical cord compression seen by MRI scans, developed myelopathy within at least 2 years of follow-up. In our study 17.6% MCSL were found while screening the whole spine which were significant p<0.05 as shown in table 5.

Concurrent cervical and lumbar spinal stenosis was first described by Teng et al. in 1965, and the prevalence of coexisting cervical and lumbar lesions were reported ranging from 0.12% to 5% in our study it was around 8.6%. The prevalence of MCSL increased significantly in patients aged over 40 years compared with younger patients LaBan, et al. Reported that 94% of the patients with coexisting cervical and lumbar stenosis aged over 51 years. In our study average age was 48 year. Which shows incidental finding most common in older age group. Ligament ossification diseases such, DISH, OPLL or OLF showed significantly higher prevalence of coexistence in different Area of spine. Park et al. reported a high prevalence of symptomatic thoracic ligament ossification in patients who underwent surgery for cervical OPLL (33.8%) and defined this phenomenon as tandem ossification. In our study OPLL were found to be 2.1%, its prevalence in cervical region 90% as compared to thoracic which was 10%.

Spinal cord neoplasms in the early stage usually present with nonspecific symptoms, including local pain and/or stiffness. These early symptoms mimic degenerative disease of the lumbar spine and are occasionally detected incidentally. Screening of the whole spine during imaging of the lumbosacral spine can prove invaluable in this regard. Sagittal MRI sections of the entire spine may be rapidly visualized for the characterization of these lesions. In our study 0.6% of neoplasm found in whole screening group out which most common were Secondaries 0.5%.

Another incidental finding we observed was myelomalacia in the cervical spine. The onset of myelomalacia is usually so subtle that it is often overlooked. In our study 1.2% of cord myelopathy found in whole spine screening. According Ochiai H et al. cervical cord compression patient can present with false localisation sign in the form of lower limb symptoms and truncal band like sensation which requires repeat investigation to rule out cervical cord compression so screening of whole spine can help us to rule out such lesion. MRI centre ‘A’ routinely providing us axial cuts of tandem pathologies of MCSL apart from dedicated area along with whole spine screening in same setting as per our special demand and routine protocol discussed with him, as it is needed to plan surgery. All number of such reports counted and compared with reports of MRI centre ‘B’ which repeat MRI at tandem lesions on demand only requiring reappointment with radiologist and extra cost. In our study total number of patient who did repeat MRI for tandem lesion were 154 of which 32(20%) were from centre ‘A’ and 122(79%) were from centre ‘B’. Because of radiologist from centre ‘A’ already being aware regarding what we expect in MRI investigations which gives us advantage in view of less repetitions, cost effective and time saving as well, compared with those reported from centre ‘B’ required more repetitions as shown in table 7.

A limitation of our study was that the findings were not surgically confirmed. The positive findings were diagnosed through MRI only. Because most of the findings were benign, no active surgical intervention was mandated in the majority of these cases. But grade 3 and 4 MCSL cannot be neglected once we diagnosed it by screening of whole spine and before major insult to spinal cord occurs and axial section at these levels helps us to plan the surgery.

Conclusion

Early detection of incidental lesions provides surgeons with an opportunity to offer early intervention to these patients. Whole spine MRI screening is useful for diagnosis of coexisting spinal diseases to avoid, missing of an asymptomatic but significant lesion. Considering the potential advantages in identifying significant IF and the minimal extra time spent to perform whole spine screening, its application can be considered to be incorporated along with regional studies of spine. Role of radiologist cannot be neglected in taking axial cuts at Grade 3 and 4 MCSL.

Recommendation

MRI gives high prevalence of incidental finding in disc herniation as well as degenerative spine disease careful clinical correlation is mandatory when considering treatment option.

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Table 7: Patient who done repeat MRI at centre ‘A’ and Centre ‘B’

| Total number of patient required repeat MRI | Number of repeated MRI by centre ‘A’ | Number of repeated MRI by centre ‘B’ | P value <0.05 significant |
|-------------------------------------------|--------------------------------------|--------------------------------------|--------------------------|
| 154                                       | 32                                   | 122                                  | 0.000001                 |
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