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Research Article

The Contribution of Magnetic Resonance Imaging (MRI) to the Etiological Diagnosis of Slow Spinal Cord Compression

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Abstract

Introduction: The goal of this study was to determine the contribution of Magnetic Resonance Imaging (MRI) in the etiological diagnosis of slow spinal cord compressions. *Methods*: This was a prospective descriptive study conducted over a period of six months, from August 16, 2023, to February 16, 2024. *Results*: During the study period, 1082 MRI scans were performed, of which 68 cases (6.28%) were diagnosed with slow spinal cord compressions. The mean age of patients was 51.85 ±18.87 years, ranging from 3 to 92 years. Males accounted for 72.1% (n = 49), with a sex ratio of 2.57. Most patients were referred by the neurology department (67.6%). The average time to MRI examination after clinical consultation was 2 ±0.71 days. The most common presenting symptoms were spinal pain and motor disturbances, noted in 70.6% of cases. The cervical and thoracic spinal levels were the most frequently affected, each accounting for more than 41.2% (n = 28) of cases. Extradural lesions were predominant, observed in 83.8% of cases. Degenerative pathologies were the most common cause (44.1%), followed by tumoral lesions (42.6%). Cervicoarthrosic myelopathy was the most frequent radiologic diagnosis, accounting for 33.9% of cases. *Conclusion*: Slow spinal cord compression is a recurrent spinal cord pathology affecting individuals of all ages, with a male predominance. The extradural compartment is most frequently involved, primarily due to degenerative conditions, especially cervical spondylotic myelopathy. Tumoral lesions, primarly metastatic, represent the second most frequent etiology.

Keywords

MRI, Slow Spinal Cord Compression, Cervical Spondylotic Myelopathy

1. Introduction

Slow spinal cord compressions (SSCC) are common spinal cord pathologies caused by expansive lesions resulting from mechanical and/or vascular processes [1]."

They represent a diagnostic and therapeutic emergency

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requiring early management to prevent irreversible complications, such as myelomalacia [2, 3].

Spinal pain is the most frequent clinical symptom of spinal cord compression, occurring in almost 90% of cases [4].

Their etiologies are diverse and classified into 3 groups: intramedullary lesions (rare), extramedullary intradural lesions and extradural lesions. [5, 6].

In developed countries, malignant etiologies (tumors) predominate over benign ones [1].

Slow Spinal Cord Compressions (SSCCs) are frequently occurring spinal cord pathologies caused by expansive lesions resulting from mechanical and/or vascular processes [1].

They represent both a diagnostic and therapeutic emergency, requiring early management to prevent irreversible complications such as myelomalacia [2, 3].

Spinal pain is the most common clinical symptom of spinal cord compression, observed in nearly 90% of cases [4]. The etiologies are diverse and can be classified into three groups: intramedullary lesions (rare), intradural extramedullary lesions, and extradural lesions [5, 6]. In developed countries, malignant (tumorous) causes are more prevalent than benign ones [1].

Degenerative spinal diseases account for 59% of non-traumatic spinal cord lesions in Japan, 54% in the United States, 31% in Europe, 22% in Australia, and between 4% and 30% in Africa [7]. There appear to be regional specificities in Africa, with a predominance of tuberculous etiology, although some African studies report a higher prevalence of metastatic spinal causes [1]. Pott's disease remains prevalent in sub-Saharan Africa, much more so than in North Africa. In Côte d'Ivoire, its frequency was considerable, reaching 52% [1]. In Togo, Kassegne I et al. (2013) reported that 27% of SSCC cases were managed in their study [8]. Magnetic resonance imaging (MRI) has undoubtedly simplified the diagnosis and treatment planning, and is now the gold standard in the management of SSCC [1, 9]. The increasing demand for spinal MRI in cases of slow spinal cord compression, along with the lack of prior studies on this subject in our clinical setting, motivated this study. Its general objective was to determine the etiological profile of slow spinal cord compressions on MRI in our context. More specifically, the study aimed to determine the frequency of MRI performed for SSCC, rank MRI diagnostic hypotheses by frequency, identify the most common lesions by spinal segment, and determine the time delay between medical prescription and MRI completion.

2. Methods

This was a prospective descriptive study conducted over a period of six months, from August 16, 2023, to February 16, 2024 at the CNSS Diagnostic Center in Conakry. Our study included all vertebro-medullary MRI examinations of patients admitted to the department for slow spinal cord compression, in which the MRI protocol was followed and the results were interpreted and validated by a radiologist.

Only the MRI reports confirming the presence of Slow Spinal Cord Compression were included in the analysis.

Excluded were incomplete or non-interpretable examinations (due to artifacts), as well as follow-up MRIs or those performed for already diagnosed and treated conditions.

Our Data collection was based on MRI examination reports and registers. The information were collected using a pre-established data collection form.

We conducted an exhaustive recruitment of all MRI results that met our inclusion criteria. The variables studied included sociodemographic data (age, sex), the time interval between prescription and MRI completion, and the underlying causes of spinal cord compression.

For the examinations we used a 1.5 Tesla TOSHIBA Vantage Elan MRI scanner, which has been operational since 2019.

For all patients, we performed the basic sequences: T1- and T2-weighted sagittal Time Spin Echo (TSE), axial T2 TSE centred on the pathological spinal segments, and sagittal T2 STIR (Short Time Inversion Recovry).

Additional complementary sequences were performed as required by each case, including T1 TSE fat-saturated post-contrast (Fat sat + Gadolinium), T2 (T2-weighted sequence with rapid signal decay), myelographic MRI sequences, and diffusion-weighted imaging (DWI). Data analysis was carried out using SPSS software, version 22.0. The information obtained was used solely for scientific purposes, with the free and informed consent of all participants, and confidentiality was strictly maintained.

3. Results

During our study, 68 cases of SSCC were identified among 1,082 MRI examinations performed in our department, representing a frequency of 6.3%.

Males were the most represented, at 72.1%, with a sex ratio of 2.6 Male/Female (M/F).

The 60-69 age group was the most represented (25%), with an average age of 51.85 +/- 18.87 years and extremes of 3 and 92 years.

The majority of our patients were referred from the neurology department (67.6%), followed by the neurosurgery department (27.9%).

The time interval between the consultation and the MRI ranged from 24 to 72 hours in 50% of our patients, with a mean time of 2 ± 0.71 days.

The reasons for consultation were spinal pain (70.6%), motor deficits (70.6%), radicular pain (33.8%), sphincter disorders (19.1%), and sensory deficits (14.7%). These symptoms were categorized into three main syndromes: spinal syndrome (70.6%, n=48), lesion syndrome (33.8%, n=23), and sublesional syndrome (72.1%, n=49).

Spinal cord compression was located in the cervical region (41.2%), thoracic region (41.2%), lumbar region (5.9%),

cervicothoracic junction (7.3%), thoracolumbar junction (2.9%), and involved multiple levels (1.5%). The types of lesions encountered included degenerative processes (44.1%), tumor processes (42.6%), and infectious processes (13.2%).

The extraforaminal compartment was the most frequently affected (83.8%), followed by the intraforaminal extramedullary (8.8%) and intramedullary compartments (7.4%). Regarding contrast administration, 51.5% (n=35) of patients received gadolinium injection, while 48.5% (n=33) did not.

Cervical spondylotic myelopathy was the most frequently suggested radiological diagnosis in our series (33.9%) (Table 1).

Table 1. *Distribution of Etiologies of Slow Spinal Cord Compressions According to Radiological Diagnosis.*

Radiological Diagnosis	Number of Cases	Percentage (%)
Cervical spondylotic myelopathy	23	33,9
Metastases	15	22
Spondylodiscitis	8	11,8
Disc herniation	5	7,3
Astrocytoma	3	4,4
Meningioma	2	2,9
Pleural tumor	2	2,9
Vertebral tumor	2	2,9
Protrusional discopathy	2	2,9
Right parasternal muscle tumor	1	1,5
Tarlov cyst	1	1,5
Carcinomatous epiduritis	1	1,5
Ependymoma	1	1,5
Syringomyelia	1	1,5
Osteophytes	1	1,5
Total	68	100

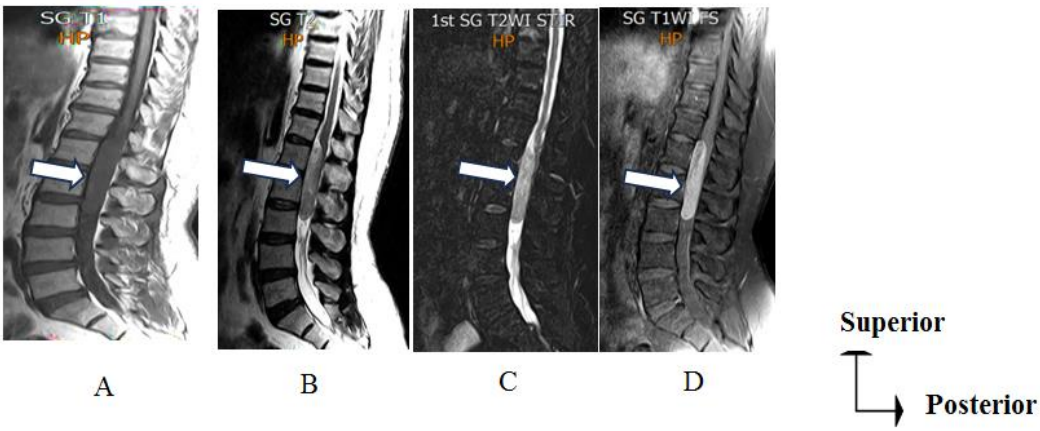

Figure 1. *Sagittal T1 (A), T2 (B), T2 STIR (C), and post-contrast T1 fat-sat (D) sequences demonstrating an intraspinal extramedullary mass in contact with the anterior meningeal spaces. The lesion exhibits intense contrast enhancement and exerts significant mass effect on the conus medullaris, suggestive of meningioma.*

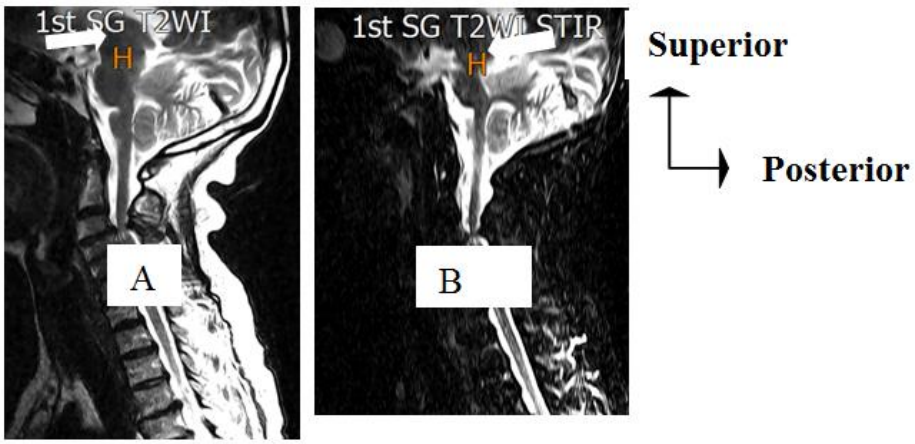

Figure 2. *Cervical spine MRI, sagittal T2-weighted TSE (A) and T2 STIR (B) sequences: Multilevel disc-osteophytic protrusion from C3-C4 to C6-C7, associated with advanced hypertrophic zygapophyseal osteoarthritis at C3-C4, causing severe central spinal canal stenosis. Corresponding T2 hyperintensity within the spinal cord is noted, consistent with cervical spondylotic myelopathy.*

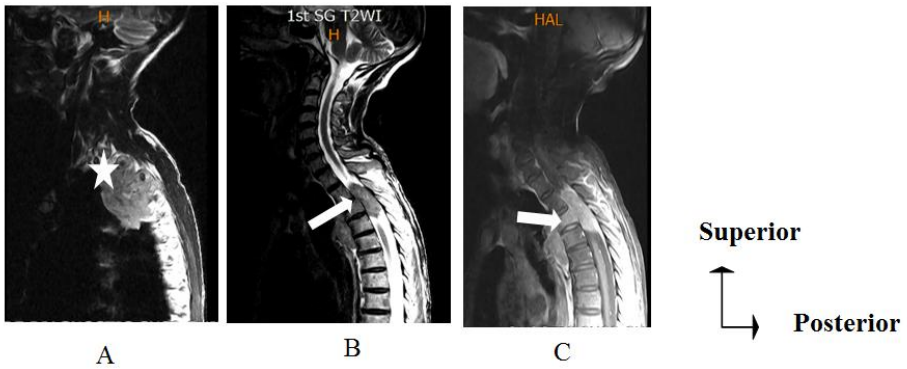

Figure 3. *Sagittal T2 TSE (A), T2 TSE (B), and T2 STIR (C) post-contrast sequences revealed a pulmonary lesion suspicious for malignancy in the right upper lobe, with invasion of the D2, D3, and D4 vertebral bodies and intraspinal extension compromising the spinal cord at D2–D4 levels.*

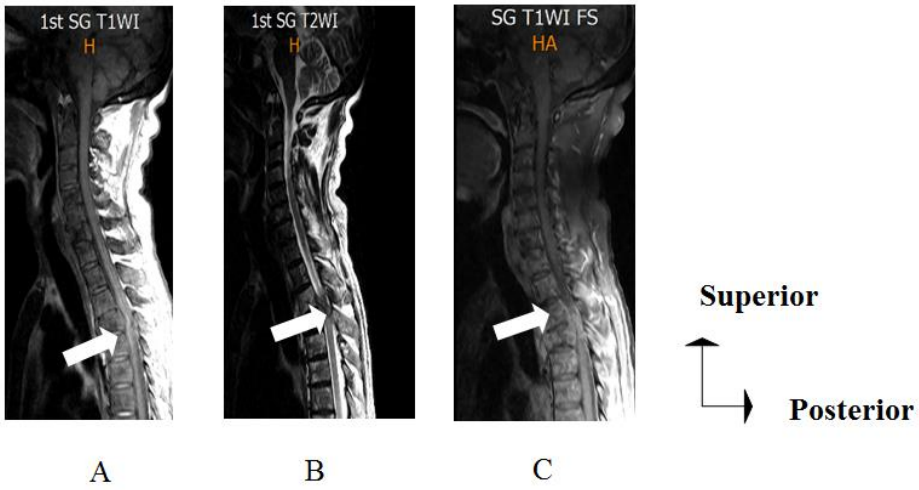

Figure 4. *Sagittal T1 TSE (A), T2 TSE (B), and fat-sat T1 TSE + contrast (C) sequences demonstrate a D4 vertebral collapse with posterior wall bulging, causing spinal cord compression at this level. Associated multiple cervical, thoracic, and lumbar vertebral lesions show T1 hypointensity, T2 hyperintensity, and contrast enhancement, consistent with metastatic disease.*

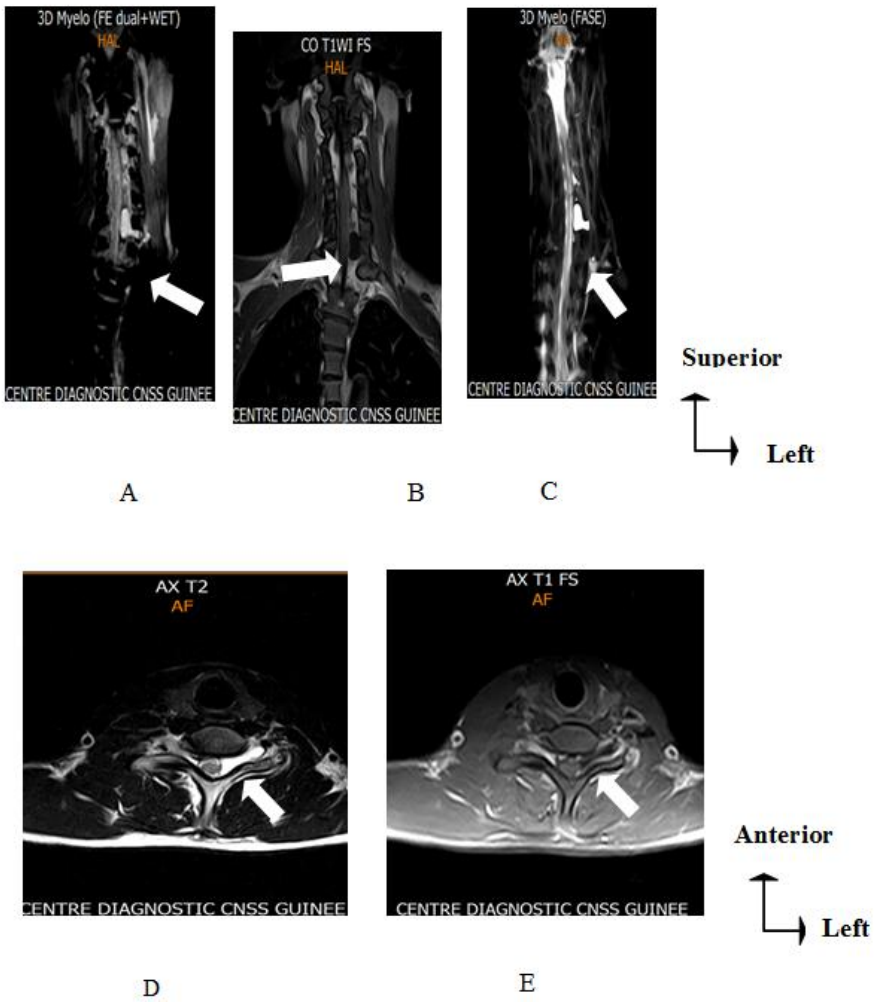

Figure 5. *Cervical spine MRI, sagittal T2-weighted TSE (A) and T2 STIR (B) sequences: Multilevel disc-osteophytic protrusion from C3-C4 to C6-C7, associated with advanced hypertrophic zygapophyseal osteoarthritis at C3-C4, causing severe central spinal canal stenosis. Corresponding T2 hyperintensity within the spinal cord is noted, consistent with cervical spondylotic myelopathy.*

4. Discussion

In our series, spinal cord compression accounted for 6.3% of MRI examinations performed during the study period.

This frequency was higher than that of Dagbe M et al [1] who reported a frequency of 4.9% of patients received for slow spinal cord compression. This result can be explained by the fact that the radiology department of the National Social Security is, on one hand, one of the best-equipped imaging centers in the country, with the largest number of radiologists. On the other hand, it benefits from the proximity to two major university hospitals that house departments of neurology, neurosurgery, and rheumatology, from which the majority of our patients originate.

We observed a male predominance. This result is consistent with data from the literature [1, 2, 5, 10]. This male predominance may be partly attributed to the high prevalence of cervico-arthritic myelopathies and primary osteophilic cancers, including prostate cancer.

The mean age of our patients was 51.85 ±18.87 years, with extremes ranging from 3 to 92 years. This average age was comparable to that reported by Amjoud M [5] in Morocco and by Ndao A. C et al. [6], who found mean ages of 53.2 and 58 years, respectively. In contrast, Badij N et al. [11] and Ekouele Mbaki H. B et al. [12] reported lower mean ages of 42.6 and 49.22 years, respectively.

The most common age group was between 60 and 69 years. This result is similar to that reported by Konate M. S [13], who found that the majority of cases occurred in individuals aged 60 years and older. This can be explained by the fact that this pathology is more frequently observed after the age of forty [10].

The majority of patients were referred by the neurology department (67.6%), which differs from the findings of Fadiga S. I [9], where most patients were referred by the neurosurgery department (51%). This discrepancy could be explained by the proximity of the neurology department to our unit, combined with patients limited awareness of spinal cord compression symptoms, which may have led them to seek

care in less appropriate departments. Additionally, the absence of a triage system at the admissions unit may have contributed to this pattern.

The mean interval for obtaining an MRI was 2 days, which is notably shorter than the mean delay of over 5 days reported by Dagbe M et al. [1]. This could be attributed to the relatively high cost of MRI which often exceeding the financial capacity of patients from low- to middle-income backgrounds, as well as logistical challenges related to patient transportation.

Spinal pain and motor deficits were the most common reasons for consultation in our studies, each reported in 70.6% of cases. These results are consistent with prior studies, including those by Amjoud M [4], who reported a 70% prevalence of spinal pain, and Musubire A. K et al. [14], who identified motor deficits as the predominant clinical feature in 70% of patients.

The cervical and thoracic spine were the most commonly involved regions, each representing 41.2% of cases. This distribution contrasts with findings by Fadoukhair Z et al. [15] and Ekouele Mbaki H. B et al. [16], who reported higher involvement of the thoracic spine (60% and 47%, respectively) and lumbar spine (24% in both studies).

Regarding contrast agent administration, 48.5% of our patients did not receive contrast enhancement. This frequency of non-enhanced examinations was lower than that reported in Camara B's study [12], where non-enhanced scans accounted for 89.5% of cases.

In both studies, degenerative pathologies were predominant, and the diagnosis of these conditions did not require gadolinium contrast administration.

Gadolinium contrast administration is particularly valuable for detecting tumorous or infectious pathologies, as it not only enhances lesion visualization but simultaneously enables assessment of intraspinal extension and potential spinal cord infiltration.

Degenerative processes accounted for 33.8% of cases, comparable to the 32% rate of degenerative lesions reported by Badji N et al [11] in Dakar. In our study, the affected compartment showed predominantly extraforaminal involvement (83.8%). This result is in line with the findings of Cherif Idrissi El Ganouni N et al. [2], who also reported a predominance of extra-foraminal involvement, accounting for 70% of cases.

In our series, cervical spondylotic myelopathy was the most frequently suspected etiological radiological diagnosis (33.9%). This contrasts with the rates reported by Diomandé M et al. [17] and Kassegne I et al. [7] (14.8% and 23%, respectively). Cervical spondylotic myelopathy is the most common form of spinal cord dysfunction in adults. It results from It results from cervical spinal canal narrowing due to age-related arthritic changes. [18]

5. Conclusion

Slow spinal cord compression represents a highly recurrent spinal pathology affecting patients of all ages, with a predilection for elderly males. The extraforaminal compartment is most frequently involved.

The cervical and thoracic levels were the most frequently involved. Degenerative pathology, particularly cervical spondylotic myelopathy, was the most common diagnosis. This was followed by tumor pathology, with spinal metastasis being the most frequent type of tumor lesion.

However, there is a delay in performing spinal cord MRI after it is requested. A larger multicenter study with a longer investigation period could help identify other etiologies of slow-progressing spinal cord compression on MRI.

Abbreviations

MRI	Magnetic Resonance Imaging
SSCC	Slow Spinal Cord Compressions
TSE	Time Spin Echo
STIR	Short Time Inversion Recovry.
DWI	Diffusion-Weighted Imaging
M/F	Male/Female

Author Contributions

Balde Alpha Abdoulaye: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Validation, Visualization, Writing – original draft, Writing – review & editing

Bah Ousmane Aminata: Methodology, Validation

Conflicts of Interest

The authors declare no conflicts of interest.

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