Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Radiology and Imaging

Sensitivity and Specificity of MRI in Intraspinal Tumor Patients

Pervin R[1*], Hossain MS[2], Goni MN[3], Akhtary SM[4], Begum M[5], Rahman S[6], Abdullah EZ[7]

[1]Dr. Rasheda Pervin, Assistant Professor, Department of Radiology and Imaging, National Institute of Traumatology and Orthopedic Rehabilitation (NITOR) Dhaka, Bangladesh
[2]Dr. Md. Sarwar Hossain, Assistant Professor, Department of Cardiology, Colonel Malek Medical College, Manikganj, Bangladesh
[3]Dr. Mohammad Nasimul Goni, Assistant Professor, Department of Cardiology, Colonel Malek Medical College, Manikganj, Bangladesh
[4]Dr. Syeda Muslema Akhtary, Associate professor, Department of Physiology, Dhaka Central International Medical College (DCIMC), Dhaka, Bangladesh
[5]Dr. Maksuda Begum, Associate Professor, Department of Radiology and Imaging, National Institute of Technology and Orthopedic (NITOR), Dhaka, Bangladesh
[6]Dr. Soma Rahman, Associate Professor, Department of Radiology and Imaging, Anwar Khan Modern Medical College and Hospital, Dhaka, Bangladesh
[7]Dr. Effat Zahan Abdullah, Medical Officer (Gynecology and Obstetrics), Rangpur Medical College Hospital, Rangpur, Bangladesh

DOI: 10.36347/sjams.2021.v09i09.032 | **Received:** 29.07.2021 | **Accepted:** 24.08.2021 | **Published:** 30.09.2021

***Corresponding author:** Dr. Rasheda Pervin

Abstract **Original Research Article**

Background: Cancer is the leading cause of death worldwide, causing a global 10 million deaths just in 2018. Cancer has no cure, but is preventable if diagnosed early. Among the methods of diagnosing cancer, MRI or Magnetic Resonance Imaging is one of the most accurate ones. This study was done with the aim of evaluating the diagnostic usefulness of MRI in detection of intraspinal tumor and comparison with histopathological findings. ***Aim of the study:*** The study aimed to determine the sensitivity and specificity of MRI in respect to intraspinal tumor patients. ***Methods:*** The study was conducted at the Department of Radiology and Imaging, NITOR, Dhaka, Bangladesh, during the period of July 2019 to December 2020 with a sample size of 100 clinically suspected cases of intraspinal tumor aged between 10-70 years. ***Results:*** Among the participants, male: female ratio was 3:2. Thirty-Four (34) % of patients belonged to the age group of 41-50 years. 10% were from the youngest age group of 11-20 years, and 6% were from the oldest age group of 61-70 years. The mean age of the participants was 38.89 years. Weakness of the limbs was present in 92% of the participants, back pain was present in 90% percent of the participants. 58% of the participants had tumors in intradural extramedullary region. According to the MRI diagnosis, 55.56% of the participants had Sequestrated disc, 33.33% had Chronic Inflammatory lesion, and 11.11 % had Epidural abscess. According to the histopathological diagnosis of the patients, 32% had schwannoma tumors, 27% had meningioma tumors, 17% had ependymoma tumors, 5% had metastasis tumors, and 2% neurofibroma and hemangioma were present among the participants. After cross analysis of the MRI diagnosis with histopathological diagnosis, 76 cases were true positive, 2 cases were false positive, 6 cases were false negative and 16 cases were true negative. Sensitivity was found 92.68%, specificity was 88.88 % and accuracy was 82.60%**.** ***Conclusion:*** This study recognized the necessity of MRI diagnosis and the benefits of MRI on diagnosis of intraspinal tumors. This study helped to determine the sensitivity, specificity and accuracy of the MRI. Sensitivity of MRI was the highest, at 92.68% and accuracy of MRI was 92%, higher compared to some other imaging techniques. Specificity was found to be 89%.

Keywords: Tumor, Intraspinal, Imaging, Sequence, Specificity, Accuracy, Sensitivity.

1. INTRODUCTION

Intraspinal tumors or intraspinal mass are a rare category of tumor located in the central nervous system. It is an abnormal mass of tissue within the spinal cord or the spinal column. These cells have extremely fast and uncontrollable growth, which can result in serious morbidity. The clinical symptoms of spinal tumor are non-specific and includes a wide variety of physical and neurological deficits such as back pain, limb weakness, paresthesia, gait problem, bladder dysfunction and even impotence. Skeletal deformity and acute headache are some of the less common symptoms. Intraspinal tumors are classified as either extradural or intradural. Intradural tumors are further divided into intramedullary or extramedullary [1]. Spinal tumors account for about 5-15% of all

nervous system neoplasm [2]. Among them, Intradural extramedullary spinal cord tumor constitutes for approximately 53-65%, extradural tumors constitute for about 28-30% and intramedullary tumor are responsible for about 7-22% of all spinal tumor related nervous system neoplasm [3]. In traditional myelography, (CT myelography) radiation hazards are common risk and experienced technician are also necessary. CT myelography also has a prefixed protocol, which makes it a possibility to miss lesions. Because of these reasons, MRI has made a significant impact on diagnosing interspinal tumor. MRI has made it possible to perform multiplane imaging, analyze cross sectional anatomical details, sagittal, coronal, and axial reformate etc. The enhancement of intradural extramedullary lesion with gadolinium makes it extremely easier to notice even the smallest nodules by making them extremely bright. MRI also has some well recognized general advantages, including superior soft tissue discrimination ability, specifically in the imaging of the spinal cord [4]. Because of such advantages, MRI has proven to be an excellent technique for visualizing the spinal cord and its tumors. In the detection and identification of intraspinal tumors by MRI, accuracies are found in 92% of cases in average, and high correlation between MRI and histopathology has also been reported [5]. In a multi-institutional prospective study, the sensitivity of contrast MRI for detection of intraspinal tumor was 95% [4]. Gd-DTPA enhanced MR imaging improves the reliability and spinal tumor diagnosis and increases MRI sensitivity and specificity. This study was done to established that MRI is an effective modality in the evaluation of intraspinal tumor [6].

2. OBJECTIVES

General Objective

- To evaluate the diagnostic usefulness of MRI in detection of intraspinal tumors.

Specific Objective

- To find out the accuracy, sensitivity, specificity, and accuracy of MRI in detection of intraspinal tumor.

3. METHODS

This was a cross sectional study carried out at the Department of Radiology and Imaging, NITOR, Dhaka, Bangladesh, during the period of July 2019 to December 2020, with 100 patients aged between 11-70 years. The patients were selected from the clinically suspected cases of intraspinal tumor attending the radiology department. The written consent of each participant was collected after explaining the aim of the study. After operation specimens were sent to respective departments for histopathological reports. All the data were checked and edited after collection, and entered into SPSS software for analysis. MRI findings were compared with histopathological reports to determine sensitivity, specificity and accuracy of the findings.

Inclusion Criteria

- Suspected cases of intraspinal tumor
- Willing to share personal information
- Patients ≥ 11 years of age

Exclusion Criteria

- Patients older than 70 years of age
- Patients with other physical problems or disabilities making them unsuitable for MRI
- Patients unable to share necessary information
- Mentally unstable

4. RESULTS

Among the participants, male: female ratio was 3:2. Thirty-Four (34) % of patients belonged to the age group of 41-50 years. 20% were from 31-40 years of age, 18% were from 21-30 years of age group, 12% were from the age group of 51-60, 10% were from the youngest age group of 11-20 years, and the remaining 6% were from the oldest age group of 61-70 years. The mean age of the participants was 38.89 years. Weakness of the limbs was present in 92% of the participants, back pain was present in 90% percent of the participants. Loss of bowel movement and bladder control was observed in 40%, paraplegia was observed in 30% and loss of sensation was present in 20% of the participants. 58% of the participants had tumors in intradural extramedullary region. 26% of the participants had tumor in the intramedullary location, and the remaining 16% had tumor in the extramedullary region. According to the MRI diagnosis, 26% of the participants had schwannoma type of tumor, 22% had meningioma, 14% had ependymoma, 8% had astrocytoma, 4% had metastasis, 2% had neurofibroma, and 2% had hemangioma. According to the histopathological diagnosis of the patients, 32% had schwannoma tumors, 27% had meningioma tumors, 17% had ependymoma tumors, 5% had metastasis tumors, and neurofibroma and hemangioma were present in 2% of the participants each. 15% of the participants were negative for intraspinal tumor. MRI diagnosis of the non-tumor cases showed that 55.56% of the 18 cases were sequestrated discs, 33.33% of the participants were chronic inflammatory lesion cases, and epidural abscess affected 11.11% of the participants. After cross analysis of the MRI diagnosis with histopathological diagnosis, 76 cases were true positive, 2 cases were false positive, 6 cases were false negative and 16 cases were true negative. Sensitivity was found 92.68%, specificity was 88.88 % and accuracy was 82.60%

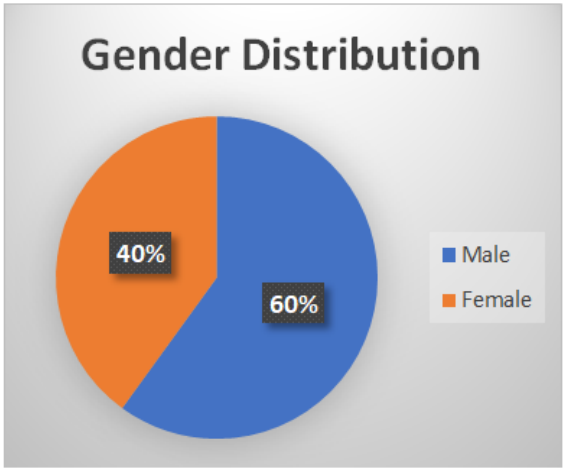

Fig 1: Gender Distribution of the Study Participants (n=100)

Among the participants, male: female ratio was 3:2. 60% of the participants were male, and 90% were female.

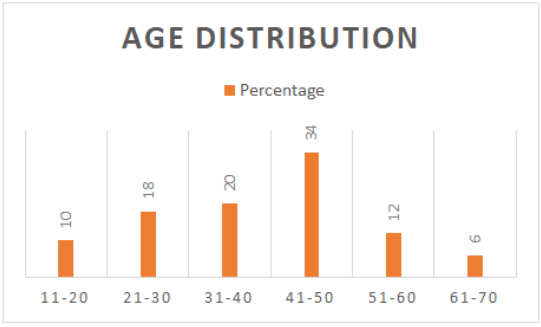

Fig 2: Age Distribution of the Participants (n=100)

The participants were divided into 5 groups based on their age. The highest number of patients (n=34) belonged to the age group of 41-50 years. 20% were from 31-40 years of age, 18% were from 21-30 years of age group, 12% were from the age group of 51-60, 10% were from the youngest age group of 11-20 years, and the remaining 6% were from the oldest age group of 61-70 years. The mean age of the participants was 38.89 years.

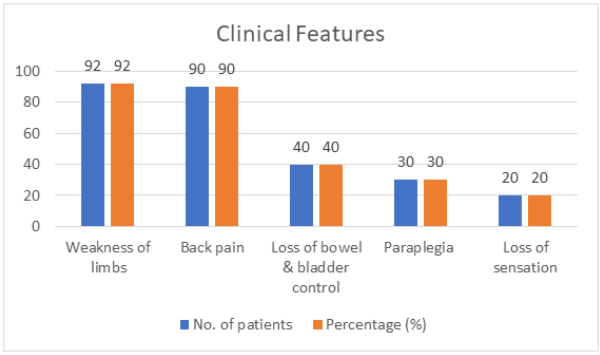

Fig 3: Clinical Features presented in the participants (n=100)

The most common clinical features present in the participants was weakness of the limbs, present in 92% of the participants. This was closely followed by back pain, present in 90% percent of the participants. Loss of bowel movement and bladder control was observed in 40%, paraplegia was observed in 30% and loss of sensation was present in 20% of the participants.

Table 1: Location of the tumor in the participants (n=100)

Location of the tumor	N=100	N (%)
Intramedullary	26	26
Intradural extramedullary	58	58
Extramedullary	16	16
Total	100	**100%**

The most common occurrence of tumor was in the intradural extramedullary, with 58% of the participants having tumors in this region. 26% of the participants had tumor in the intramedullary location, and the remaining 16% had tumor in the extramedullary region.

Table 2: MR Diagnosis of the patients (n=100)

MR diagnosis	No. of cases	Percentage (%)
Schwannoma	26	26
Neurofibroma	2	2
Meningioma	22	22
Ependymoma	14	14
Astrocytoma	8	8
Metastasis	4	4
Hemangioma	2	2
Others/Negative for Intraspinal tumor	22	22
Total	**100**	**100**

According to the MRI diagnosis, the most common type of tumor in the participants was schwannoma, present in 26% of the cases. 22% had meningioma, 14% had ependymoma, 8% had astrocytoma, 4% had metastasis, 2% had neurofibroma, and 2% had hemangioma. In the remaining 22% of the participants, MRI showed negative for intraspinal tumor, and found some other forms of deformity.

Table 3: Histopathological diagnosis of the study participants (n=82)

Histopathological diagnosis	Frequency	Percentage (%)
Schwannoma	26	32
Neurofibroma	2	2
Meningioma	22	27
Ependymoma	14	17
Metastasis	4	5
Hemangioma	2	2
Others/Negative for Intraspinal tumor.	12	15
Total	**82**	**100**

According to the histopathological diagnosis of the patients, 32% had schwannoma tumors, 27% had meningioma tumors, 17% had ependymoma tumors, 5% had metastasis tumors and hemangioma were present in 2% of the participants each. 15% of the participants were negative for intraspinal tumor.

Table 4: MRI Diagnosis of non-tumor cases in the study participants (n=18)

MRI Diagnosis	No. of cases	Percentage (%)
Sequestrated disc	10	55.56
Chronic Inflammatory lesion	6	33.33
Epidural abscess	2	11.11
Total	**18**	**100**

MRI diagnosis of the non-tumor cases showed that 55.56% of the 18 cases were sequestrated discs, 33.33% of the participants were chronic inflammatory lesion cases, and epidural abscess affected 11.11% of the participants.

Table 5: Validity of MR evaluation of intraspinal tumors (n=100)

MRI	Histopathology		Total
	Positive	Negative	
Positive	76 (TP)	2 (FP)	78
Negative	6 (FN)	16 (TN)	22
Total	**82**	**18**	**100**

After cross analysis of the MRI diagnosis with histopathological diagnosis, 78 cases in total were positive for tumors, and 18 were negative. Among them, 76 cases were true positive, 2 cases were false positive, 6 cases were false negative and 16 cases were true negative.

Table 6: Sensitivity, specificity and accuracy of MRI in comparison with histopathology findings (n=100)

Incident	Percentage
Sensitivity	92.68
Specificity	88.88
Accuracy	82.60

Using the TP, TN, FP and FN cases, the sensitivity, specificity and accuracy of MRI in the selected patients was determined. Sensitivity was found 92.68%, Specificity was 88.88 % and accuracy was 82.60%

5. DISCUSSION

Among the different types of tumors in the human body, there are three main categories. They are benign, premalignant and malignant. Among them, benign tumors are generally harmless, as they are comprised of cells that do not invade other organs or unrelated tissues [7]. But premalignant and malignant types of tumors are dangerous, as they can lead to cancer. Malignant tumors can grow rapidly and spread to other parts of the body. Overgrowth of these cells and tumors can lead to neoplasia, commonly known as cancer [8]. Although cells are the building blocks of any living organism, all purposes and requirements of the body can only be fulfilled by healthy cells. Cancer is caused by the overgrowth of cells that serve no particular purpose, and even spread to other parts of the body, harming the natural workflow [8]. Although cancer is often misinterpreted as a single disease, it is actually a word used to describe over 100 different diseases. All of these diseases have the special characteristic of uncontrollable growth and spread of abnormal cells. Depending on the origin of the cancer cells and the organ it is affecting, cancer can be of very different characteristics. Because of the severity of the disease, Cancer is globally recognized as the number one cause of death worldwide, accounting for nearly 10 million deaths in 2020 alone [9]. Cancer has many risk factors like tobacco use, alcohol use, unhealthy diet, smoking, which are also common risk factors for other non-communicable disease. But some chronic infections are also risk factors for cancer, which is more common in the underdeveloped and developing countries. Almost 13% of globally diagnosed cancer cases were caused by carcinogenic infections like HPV, Hepatitis B, Hepatitis C etc [10]. Although there is no cure for cancer, by avoiding risk factors, up to 50% of cancer cases can be prevented. Early detection and diagnosis can also reduce cancer mortality rates greatly, as at the early stages, cancer cells are more likely to respond to the treatments. Which is why cancer

detection methods are extremely important. There are some commonly used methods that are used for detecting cancer in a non-invasive way. Among them, MRI is more popular because of its ability to take images of any part of the body in all three axes. When compared to a CT scan, MRI produces much clearer images. The present study was conducted to determine the specificity and sensitivity of MRI in respect to 150 intraspinal tumor patients. In the present study, the male population was higher, with 60% of the participants being men, and the remaining 40% were female. Although there were some differences, similar male prevalence in intraspinal tumor cases have been found in other studies [11]. Intraspinal tumor is more prevalent in the younger population [12], which is why the present study had an age range of 11 to 70 years. But in our study, the mean age of the participants was 38.89 years. Here, 34% of the participants belonged to the age group of 41-50 years. The oldest age group of 61-70 years had 6% of the participants, and the youngest age group of 11-20 years had 10% of the participants. Among the clinical features in the current participants, weakness of limbs and back pain had the highest prevalence, common in 92% and 90% cases respectively. This is similar to findings of some other studies, where back pain was most common [13, 14]. Some of the less common clinical features were paraplegia and loss of sensation. Based on the MRI findings, tumors in intradural extramedullary region were the most common, present in over half the participants. 26% of the participants had tumor in the intramedullary location, and the remaining 16% had tumor in the extramedullary region. To analyze the specificity of MRI, types of the tumors were determined both through MRI imaging and through histopathology. According to the Histopathological diagnosis findings, 32% of the participants had schwannoma tumor. This is the most common type of intradural extramedullary tumor, occupying 30% of all intradural extramedullary tumors [15]. Meningioma was present in 27% of the participants, 17% had ependymoma, 5% had metastasis tumor, 2% had hemangioma. MRI diagnosis of the non-tumor cases showed that 55.56 % of the 18 cases were sequestrated discs, 33.33% of the participants were chronic inflammatory lesion cases, and epidural abscess affected 11.11 % of the participants. Based on the histopathological diagnosis of the tumor cases, 32% had schwannoma tumors, 27% had meningioma tumors, 17% had ependymoma tumors, 5% had metastasis tumors, and neurofibroma and hemangioma were present in 2% of the participants each. And according to the histopathological diagnosis, 18% of cases were negative for tumors. Based on both the MRI and the histopathological findings, cross analysis was done to determine the true positive (TP), true negative (TN), false positive (FP) and false negative (FN) cases. 76 cases were true positive, 2 cases were false positive, 6 cases were false negative and 16 cases were true negative. Using these numbers and specific formulas, the specificity, sensitivity and accuracy were determined. For sensitivity, the formula used was (TP/(TP+FN)) *100, and for specificity, the formula used was (TN/(TN+FP))*100. Sensitivity was found 92.68%, specificity was 88.88% and accuracy was 82.60%.

6. CONCLUSION

This study recognized the necessity of MRI diagnosis and the benefits of MRI on diagnosis in respect to intraspinal tumor cases. This study helped determine the sensitivity, specificity and accuracy of the MRI. Sensitivity of MRI was the highest, at 92.68% and accuracy of MRI was 82.60%, higher compared to some other imaging techniques. Specificity was found to be 88.88%.

7. RECOMMENDATIONS

The study was conducted with small sample size. This was a single-center study, and a multi-center study with a wider demographic is necessary to reach a much clear image.

Funding: Self

Conflict of Interest: None declared.

REFERENCES

1. Frank, B. L., Harrop, J. S., Hanna, A., & Ratliff, J. (2008). Cervical extradural meningioma: case report and literature review. *The journal of spinal cord medicine*, *31*(3), 302.
2. Cari, L., & Yemira, L. Predictive factors of favorable surgical results in the posterior approach of extramedullary intradural spinal tumors: Edgardo Rebagliati Martins National Hospital, January 2011-May 2014 (Doctoral dissertation).
3. Takemoto, K., Matsumura, Y., Hashimoto, H., Inoue, Y., Fukuda, T., Shakudo, M., ... & Ban, S. (1988). MR imaging of intraspinal tumors—Capability in histological differentiation and compartmentalization of extramedullary tumors. *Neuroradiology*, *30*(4), 303-309.
4. Smoker, W. R., Godersky, J. C., Knutzon, R. K., Keyes, W. D., Norman, D., & Bergman, W. (1987). The role of MR imaging in evaluating metastatic spinal disease. *American Journal of Roentgenology*, *149*(6), 1241-1248.
5. De Verdelhan, O., Haegelen, C., Carsin-Nicol, B., Riffaud, L., Amlashi, S. F. A., Brassier, G., ... & Morandi, X. (2005). MR imaging features of spinal schwannomas and meningiomas. *Journal of neuroradiology*, *32*(1), 42-49.
6. Parizel, P. M., Balériaux, D., Rodesch, G., Segebarth, C., Lalmand, B., Christophe, C., ... & Flament-Durand, J. (1989). Gd-DTPA-enhanced MR imaging of spinal tumors. *American Journal of Roentgenology*, *152*(5), 1087-1096.
7. Brazier, Y. (2019). Tumors: Benign, premalignant, and malignant [Internet]. Chun C, editor. Medical News Today. MediLexicon International; [cited

2021 Jun 7]. Available from: https://www.medicalnewstoday.com/articles/249141

8. Modules, S. T. (2009). Module Name. US National Institutes of Health, National Cancer Institute. Day Month Year (of access)< https://training. seer. cancer. gov.
9. Abul-Kasim, K., Thurnher, M. M., McKeever, P., & Sundgren, P. C. (2008). Intradural spinal tumors: current classification and MRI features. *Neuroradiology*, *50*(4), 301-314.
10. de Martel, C., Georges, D., Bray, F., Ferlay, J., & Clifford, G. M. (2020). Global burden of cancer attributable to infections in 2018: a worldwide incidence analysis. *The Lancet Global Health*, *8*(2), e180-e190.
11. Wu, Y. L., Chang, C. Y., Hsu, S. S., Yip, C. M., Liao, W. C., Chen, J. Y., ... & Chen, C. H. (2014). Intraspinal tumors: analysis of 184 patients treated surgically. *Journal of the Chinese Medical Association*, *77*(12), 626-629.
12. Ramirez, N., Charles E Johnston, I. I., & Browne, R. H. (1997). The prevalence of back pain in children who have idiopathic scoliosis. *JBJS*, *79*(3), 364-368.
13. Schiff, D., & O'neill, B. P. (1996). Intramedullary spinal cord metastases: clinical features and treatment outcome. *Neurology*, *47*(4), 906-912.
14. Wang, X. Q., Zeng, X. W., Zhang, B. Y., Dou, Y. F., Wu, J. S., Jiang, C. C., ... & Chen, H. (2012). Spinal meningioma in childhood: clinical features and treatment. *Child's Nervous System*, *28*(1), 129-136.
15. Gösteren, T. K. O. (2008). Totally cystic intradural extramedullary schwannoma. *Turkish Neurosurgery*, *18*(4), 404-406.