Diagnostic Accuracy of Susceptibility Weighted Magnetic Resonance Imaging for Glioblastoma Diagnosis

ABSTRCAT

Objective: To determine the ddiagnostic accuracy of susceptibility weighted magnetic resonance imaging (SW-MRI) for glioblastoma diagnosis by taking biopsy as gold standard.

Material and methods: This cross-sectional study was done at department of Radiology, Jinnah Postgraduate Medical Center (JPMC), Karachi from June to December 2017. Total 114 cases with focal neurological deficit, seizures, stroke and CT scan findings of a mass with irregular thick margins and symptoms of increased intracranial pressure were enrolled. All the study subjects undergone SWI MRI. Brain biopsy was done during the same period of hospitalization. All the data was collected by study proforma and analysis of data was done by SPSS version 26

Results: Total 114 cases were studied and mean age of the cases was 50.64±10.37 years. Males were in majority 60.5% and females were 39.5%. Lesion average size was 4.34 cm. Glioblastoma was diagnosed among 68.4% cases on SW-MRI, while its was diagnosed among 71.1% study subjects by biopsy. SW-MRI showed sensitivity 90.1%, specificity 84.8%, PPV 93.5%, NPV 77.7% and diagnostic accuracy was found 88.59%.

Conclusion: As study findings the SW-MRI was observed to be the best diagnostic tool for glioblastoma with diagnostic accuracy of 88.59%, sensitivity 90.1% and specificity 84.8%. This diagnostic tool may helpful to indorse the expected diagnosis in clinical practice.

Keywords: Glioblastoma, uncomplicated diagnostic tool

Introduction

Gliomas are all types of intra-axial tumors that arise as from central nervous system's glial cells. They account for around 80% of all brain malignant tumors and are the most frequent kind of CNS tumor.[1] Improved diagnostic methods, such as current radiologic imaging, and increased access to neurosurgical services, are two likely factors for this increase.[2] With the development of CT and MRI equipment in the 1980s, the number of brain neoplasms increased. Nevertheless, it has been reported that the general rise in occurrence is levelling off, but the upward tendency in older populations continues.[2] Whereas lymphomas show some typical magnetic resonance imaging (MRI) signs, their MR imaging characteristics vary depending on immunological status and histological type, and they frequently overlap with other brain malignancies, making a definite diagnosis challenging.[3] Because of their similarities, it's difficult, if not impossible, to clearly differentiate between glioblastoma and lymphoma. PCNSL, unlike systemic lymphoma, usually has neurological signs. In a survey of 248 lymphoma cases, symptoms included increased seizures, focal deficits and intracranial pressure as well as visual and neuropsychiatric problems.[4] Susceptibility-weighted imaging (SWI) is a unique MR imaging technique that has only recently been created.[3] T1WI and Unlike traditional T2WI, SWI is responsive to T2, which is caused by local vulnerability. This innovative technology has shown to be a very useful tool for evaluating cerebral mass lesions. [3,5] SWI can show the changes in susceptibilities of tissues as well as provide great contrast across blood products, venous blood vessels, iron-laden and calcification identifiable from nearby tissues, which is not possible with traditional MR

imaging.[6] In fact, haemorrhage and infarction were uncommon in lymphomas, most likely due to a lack of blood supply. One of the most important aspects in the biological behaviours of malignant brain tumors is vascular proliferation. It is widely assumed that the more malignant the glioblastoma, the more haemorrhage and intralesional vasculature there is.[7] Brain metastases have also been shown to increase tumor micro vascularity and neovascularity, resulting in an increase in relative cerebral blood volume (rCBV) during the growth and invasion process. Lymphoma is uncommon in tumor neovascularization, in contrast to glioblastoma and brain metastases.[3,8] Furthermore, glioblastoma and lymphoma have comparable MR patterns due to their diffuse infiltrative or invasive development. As a result, traditional MR imaging can be difficult to distinguish these malignancies. Because glioblastoma and lymphoma, which share common MR characteristics with glioblastoma, have radically distinct prognoses and treatments, a precise diagnosis is critical. The diagnostic accuracy of MRI without SWI is quite low, and histology is an intrusive technique. This necessitates a noninvasive, accessible, and sensitive investigation to document glioblastoma. This study has been done to find out whether SWI MRI which is a non-invasive and easily available technique has any role for the early detection of intracranial glioblastoma and to differentiate it with other similar looking intracranial tumors. No recent study has been done in Karachi regarding this study, so my study will help to find out diagnostic accuracy of SWI MRI in detection of intracranial glioblastoma in our population.

MATERIAL AND METHODS

This was a cross-sectional study, which done at radiology department, Jinnah Postgraduate Medical Center, Karachi, during six months from June to December 2017. All the new admitted patients presented with raised intracranial pressure symptoms, focal neurological deficit, symptoms like stroke caused by intra tumoral hemorrhage, seizures, with CT scan findings of a mass with irregular thick margins: iso to slightly hyperattenuating (high cellularity), surrounding vasogenic oedema, intense irregular, marked mass effect, haemorrhage, marginal heterogeneous enhancement and cases having age >30 and <70 years of either gender were included. All the patients with previous radiotherapy, previous chemotherapy, previous surgery and not consenting to participate in the study were excluded. Baseline demographic data i.e. age and sex were recorded in proforma. All the patients underwent SWI MRI. After the procedure patients were shifted to ward and provided standard medical treatment. Brain biopsy was done during the same period of hospitalization. The samples of biopsy were preserved in Normal Saline and Formalin and were sent to histopathology laboratory of Pathology department of JPMC. The reports were verified by consultant histopathologist at the lab. The MRI scans were performed using an eight-channel head coil and a whole-body Philips 1.5 MR scanner with dynamically shielded image gradients. From the base of the skull to the vertex, all sequences were aligned parallel to the midline structures. The imaging parameters were flow-compensated 3D gradient echo, and the susceptibility-weighted sequence was a flow-compensated 3D gradient echo sequence. All the MR images were examined blinded to surgical or pathological results by two radiologists with > 5-year experience. The tumor size and location were among the imaging features examined. Intralesional hemorrhagic burden and Intralesional vessel score were also counted and graded as per operational definitions on SWI. Data were analyzed in SPSS version 26.

RESULTS

Total 114 cases were studied and mean age of the cases was 50.64±10.37 years. Males were in majority 60.5% and females were 39.5%. Lesion average size was 4.34±1.46 cm. 41.2 percent of the 114 cases have a frontal lesion, 31.6 percent have a parietal lesion, and 27.2 percent have an occipital lesion. SW-MRI revealed that 68.4 percent of the cases had glioblastoma. Glioblastoma was evaluated in 71.1 percent of the cases based on biopsy findings. Table.1

SWI MRI diagnostic accuracy, sensitivity, specificity and predictive values for the identification of glioblastoma were computed using biopsy as the gold standard. As per study findings SW-MRI showed sensitivity 90.1%, specificity 84.8%, PPV 93.5%, NPV 77.7% and diagnostic accuracy was found 88.59%. Table-2.

Table - 1 Descriptive statistics of demographic characteristics and diagnosis of Glioblastoma n=114

Variables		Statistics
Age		50.64±10.37 years
Gender	**Males**	69(60.5%)
	Females	45(39.5%)
Lesion size	**<3cm**	9(8.0%)
	≥3cm	105(92.0%)
Lesion location	**Frontal Region**	47(41.2%)
	Parietal region	36(31.6%)
	Occipital region	31(27.2%)
Diagnosis of Glioblastoma by SWI MRI	**Yes**	78(68.4%)
	No	36(31.6%)
Diagnosis of Glioblastoma by Biopsy	**Yes**	81(71.1%)
	No	33(28.9%)

TABLE – 2. Diagnostic accuracy of SWI MRI with biopsy as gold standard for diagnoses of Glioblastoma n=114

SWI MRI	**BIOPSY**			**P-VALUE**
	Yes	**No**	**TOTAL**	
Yes	73 (90.1%)	5(15.2%)	**78(68.4%)**	**0.000***
No	8(9.9%)	28(84.8%)	**36(31.6%)**	
TOTAL	**81**	**33**	**114**	
Sensitivity	**Specificity**	**PPV**	**NPV**	**Accuracy**
90.1%	**84.8%**	**93.58%**	**77.7%**	**88.59%**

Chi square test was applied. P-Value ≤0.05 considered as significant. *Significant at 0.05levels.

DISCUSSION

In clinical MRI reading, the differential diagnosis of brain tumors is a serious concern. Because clinical symptoms are dependent on tumor site, they are not useful

in determining a differential diagnosis.[9] Individuals having these tumors may experience no symptoms at all, or may experience headaches or focal neurological impairments leading to seizures. Because both tumors grow quickly, the medical history is usually brief, ranging from a few weeks to a month.[9] It's difficult to tell the difference between these tumors on standard MR pictures. In T2-weighted pictures, both appear to be hyper intense, whereas in T1-weighted images, they appear to be hypo intense. However, this criterion is not always accurate, and it might be difficult to tell the difference between glioblastomas and primary cerebral lymphomas in some circumstances. According to some accounts, both cancers appear differently in SWI.[10] In this study mean age of the cases was 50.64±10.37 years, males were in majority 60.5% and females were 39.5%. On other in the study of Min TL et al [10] reported that the males were in majority compared to females and average age of the patients was 61.7 ± 2.2 years. In another study of Law M et al [11] demonstrated that the patients' ages ranged from 4 to 82 years old, with a mean of 43 years old and 108 males and 52 females among them. In this study out of 114 patients, 41.2% have lesion at frontal region, 31.6% at parietal region and 27.2% at occipital region. Out of all 68.4% cases were diagnosed with glioblastoma by SWI MRI, while as per biopsy findings are concerned, glioblastoma was diagnosed in 71.1% patients and sensitivity, Specificity, Predictive values and diagnostic accuracy of SWI MRI for the detection of glioblastoma taking biopsy as gold standard were calculated. The results showed that 73 patients were true positive, correctly diagnosed and 28 patients were true negative, correctly diagnosed. Sensitivity, Specificity, PPV, NPV and accuracy were 90.1%, 84.8%, 93.5%, 77.7%, and 88.59% respectively. Law M et al [11] demonstrated that the conventional MR imaging had 72.5 percent sensitivity, 65.0 percent specificity, 86.1 percent PPV, and 44.1 percent NPV for detecting a high-grade glioma, correspondingly. Peters S et al[12] demonstrated that the radiologists were able to make the accurate diagnosis in 82.2 percent of the patients by using susceptibility-weighted pictures as well. The diagnosis was correct in 75.5 percent of cases without SWI, while the sensitivity for glioblastoma diagnosis was 90.5 percent and the specificity was 100 percent if there was a high rate of intra tumoral susceptibility signals (grade 3). Kong LW et al [13] reported that they employed a typical SWI grading technique to establish connections between ITSS imaging features and tumor as well as molecular pathology, confirming prior research that demonstrated SWI is useful in predicting the status of molecular glioma indicators and they discovered that these SWI imaging properties are linked to tumor molecular marker status. This research offers fresh ideas for non-invasive glioma molecular genetics prediction, as well as a solid foundation for preoperative surgical treatment based on molecular pathology. Xu J et al [14] also observed that the SWI could have a role in glioma grading as a supplemental diagnostic tool. SWI is a new MRI approach that uses a 3D high-resolution gradient-echo sequence (GRE) to detect structures that cause susceptibilities in the tissues, such as blood, calcification and iron. Susceptibility-weighted imaging (SWI) is a technique that uses the difference in susceptibility between tissues to produce contrast for distinct brain regions.[15] In essence, it leverages intrinsic contrast agents such as deoxygenated haemoglobin from

veins, hemosiderin from haemorrhage, and others to allow for much greater visibility of blood and micro vessels without the use of an external contrast agent. It's a rapidly changing field that's always being enhanced and increasingly implemented as new technology becomes available.[15] Because this was a single-center experience with low representation of women, a nonrandomized study design, and a small sample size, the findings may not be generalizable to broader groups.

Conclusion

As per study conclusion the SW-MRI was observed to be the best diagnostic tool for glioblastoma with diagnostic accuracy of 88.59%, sensitivity 90.1% and specificity 84.8%. This diagnostic tool may helpful to indorse the expected diagnosis in clinical practice. Further large-scale studies are recommended on such subject.

Ethical Approval:

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

Consent

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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