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Original Article

Concordance and Discordance between Radiology Resident's and Radiologist's Interpretation of Brain MRI in Patients with Head Masses

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ABSTRACT

Diagnosis of head masses involves clinical examination, neurological signs, and radiological imaging. MRI is the preferred imaging tool for detailed assessment of tumor, its extent and treatment plan. **Objective:** To find the level of concordance and discordance between radiology resident's and consultant's interpretation of MRI (Magnetic Resonance Imaging) done for brain masses. **Methods:** A cross sectional study was conducted at the radiology department of Rehman Medical Institute, Peshawar. Simple random sampling was done and sample size was calculated using kappa coefficients (Donner and Rotondi) n=100. 100 patients who visited department of Radiology over a period of two years were assessed by prospective analysis of their radiology reports. Senior resident's and consultant's reports were compared. All pre-op patients were included irrespective of age or gender. Data were collected and recorded on a specially designed proforma and entered into Microsoft excel and analyzed using SPSS (Version 22.0. IBM Corp., Armonk, NY). **Results:** MRI brain reports of 58 male and 42 female patients were evaluated. The most common tumors were gliomas, making up 52% of the total tumors. Metastasis being second most common tumor making 16%, meningiomas in 15%, pituitary tumors in 10% and vestibular schwannomas in 7% of the patients. Concordance, discordance, and Cohen's Kappa values in different masses were gliomas. (Concordance=88.46%, Discordance=11.54%, k=0.336), Meningiomas (Concordance=86.66%, Discordance=13.34%, k=0.423), Metastasis (Concordance=81.25%, Discordance=18.75%, k=0.294), Pituitary Tumors (Concordance=80%) Discordance=20%, k=0.375) and Vestibular Schwannomas (Concordance=85.71%, Discordance= 14.29% k=0.588). **Conclusions:** There was no statistically significant difference between senior resident's and consultant radiologist's report of MRI brain masses.

INTRODUCTION

Intracranial masses are a group of tissues that grow independently without being inhibited by the normal inhibitory factors. In 2021 World Health Organization (WHO) reclassified these tumors into 11 groups i.e., Mesenchymal non-meningothelial tumors, Tumors of Sellar region, Germ Cell Tumors (GCT), Gliomas, Glioneuronal Tumors and Neuronal Tumors, Choroid Plexus Tumors, Pineal Tumors, Melanocytic Tumors, Nerve Tumors, Embryonal Tumors, Meningiomas, Hematolymphoid Tumors and Metastatic Tumors [1]. Brain tumors may be malignant or non-malignant with malignant being further divided into primary or secondary. The most common non-malignant tumors are meningiomas, while glioblastoma, a subtype of gliomas with a poorer prognosis is the most common malignant primary brain tumor [2]. Incidence of brain tumors is between 0.001 to 12 per 100,000 persons in males and 0.01 to 10.7 per 100,000 in females. Incidence differs in various countries. The mortality rate of brain tumors is 3.4 per 100,000 population [3]. The estimated overall prevalence of malignant primary brain tumors is 47.6 per

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100,000 population [4]. Intracranial masses may present with generalized or focal symptoms depending on their size, growth rate, nature and associated pathologies like edema, hemorrhage, vascular involvement, and blockade to cerebrospinal fluid obstruction. Symptoms include seizures. Local neuronal dysfunction, neuronal hyperexcitability and headache secondary to increased intracranial pressure venous thromboembolism, fatigue, and cognitive dysfunction [5]. Intracranial masses can be detected using imaging studies. Cross-sectional imaging modalities, mainly CT scan and MRI have enabled clinicians to detect it early and with more certainty without doing any invasive procedure. Magnetic Resonance Imaging (MRI), owing to its numerous advantages like multiple ways and planes to characterize the tissue, no radiation, and no bone visibility makes it the gold standard imaging modality for diagnosing intracranial masses [6]. MRI is the keystone in imaging of brain tumors aiding greatly to the diagnosis and treatment of brain tumors. For multiple decades, MRI plays a crucial role in neuro-oncological imaging [7]. However, diagnostic significance of MRI varies depending on type and grade of different tumors [8]. It is crucial for radiologists to have a knowledge of the typical as well as atypical imaging features of different head masses [9]. Multiple MRI sequences including T2w/FLAIR, T1w, DWI/ADC and SWI play important roles in characterization of brain tumor. In addition, multiple MRI techniques including conventional MRI, MRI perfusion, Diffusion tensor imaging, MRI spectroscopy and functional Understanding the technical aspects of these MRI techniques is important in correct diagnosis and thus best possible treatment strategy for the patient [10]. Clinicians rely heavily on radiologists for correctly diagnosing different diseases and brain tumors are no exception. A right and prompt diagnosis of the intracranial masses will direct the clinician to devise an effective line of treatment. As a part of the training, a resident radiologist is usually the first person who makes preliminary report that is later edited by the attending radiologist [11]. Based on experience, discrepancies exist between the resident and attending radiologists' reports that gets improved as the resident gets more experience with time [12, 13]. Radiology residents as part of healthcare team provides care to the patients. Each resident is given specific responsibility based on his/her rotation, level of experience and abilities. Senior residents particularly play an important role during on-call reporting. They impact patients directly by providing diagnostic services. As a part of residency program, residents are continuously assessed for their technical skills, compatibility, behavior, clinical judgements, and reporting skills. This greatly helps in providing improved diagnostic services to the patients during residents on call hours and help clinicians take immediate steps in patients' management. The objective of our study was to find out the level of concordance and discordance between radiology resident's and consultant's reports of MRI brain.

METHODS

This cross-sectional study was conducted in Radiology Department, Rehman Medical Institute Peshawar. After approval from the ethical committee, simple random sampling was done for data collection and sample size was calculated using kappa coefficients. 100 cases of pre-operative MRI brain for intracranial masses were selected randomly between December 2020 and November 2022. Both male and female patients were included without age restriction. Tumors were divided into 5 most common groups namely, glial tumors, meningiomas, schwannomas, pituitary tumors, and metastasis. Only those scans reported by senior residents (R3, R4) and later approved or changed by the consultant radiologists were included. Only differential diagnosis that was on the top of the list was considered wherever necessary, omitting the rest. Resident reports were compared with consultant reports. MRI scans of both male and female patients were included without age restriction. Scans containing already described tumors were included only. All patients who had not undergone surgery, chemotherapy or radiotherapy were included. MRI scans of post op, post-chemotherapy, or post-radiotherapy patients. MRI scan done for other conditions. To quantify the level of agreement, data were put in MS Excel worksheets and analyzed in SPSS version 22. Data put into 2x2 tables and Cohen Kappa value was calculated for each section. The Kappa values were interpreted as follows: <0.20 indicated poor performance; 0.21 - 0.40 indicated fair performance; 0.41 - 0.60 indicated moderate performance; 0.61 - 0.80 indicated good performance; and 0.81 - 1.0 indicated very good performance. Concordance and discordance levels were calculated keeping 95% confidence interval.

RESULTS

A total of 100 cases including 58 males and 42 female patients were evaluated. The mean age of the presentation was 42.03 years. Gliomas were the most common tumors noted in our data with the mean age of presentation as 41.68 years. It made up 52% of the total cases. (Males 65.4% females 34.6%). Concordance was 88.46% and discordance was 11.54% between resident and consultant MRI report with a Cohen's Kappa value of 0.336 (Confidence Interval=95%)(Table 1).

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Table 1: Gliomas

Resident Report	Consultant Report		Total
	A	B	
A	44	3	47
B	3	2	5
Total	47	5	52

A=Glioma B=Others

Meningiomas were third most common tumors in our selected population (40% males, 60% females), mean age of presentation was 45.5 years. Concordance between resident and consultant report was 86.66% with 13.44% discordance and k=0.423 (Confidence Interval=95%) (Table 2).

Table 2: Meningiomas

Resident Report	Consultant Report		Total
	A	B	
A	12	1	13
B	1	1	2
Total	13	2	15

A=Meningioma B=Others

Metastasis from other body tumors were the second most common, making up 16% of the tumors. (Male 50%, Female 50%). The mean age of presentation was 46.3 years, level concordance between resident and consultant radiologist was 81.25% with 18.75% discordance with k=0.294 Confidence Interval=95%) (Table 3).

Table 3: Metastasis

Resident Report	Consultant Report		Total
	A	B	
A	12	1	13
B	2	1	3
Total	14	2	16

A=Metastasis B=Others

Pituitary tumors made 10% percent of the total (Male=70%, Females=30%) with mean presenting age of 23 years. Concordance between resident and consultant radiologist report was 80%, discordance was 20% with k=0.375 (Confidence Interval=95%) (Table 4).

Table 4: Pituitary Tumors

Resident Report	Consultant Report		Total
	A	B	
A	7	1	8
B	1	1	2
Total	8	2	10

A= Pituitary Tumors B=Others

Vestibular schwannoma was present in 7% of the patients (Male 28.6, Female 71.4%) with 32.7 years as mean age of presentation. The concordance rate between consultant and resident radiologist was 85.71% with a discordance rate of 14.29% and k=0.588 (Confidence Interval=95%) (Table 5).

Table 5: Vestibular Schwannoma

Resident Report	Consultant Report		Total
	A	B	
A	5	0	5
B	1	1	2
Total	6	1	7

A= Vestibular Schwannoma B=Others

DISCUSSION

Resident radiologists make up the main bulk of the radiology working force in medical teaching institutions. As part of their training, they are rotated through various modalities like X-Ray and Ultrasonography. CT scan and MRI with gradual exposure to simple and then complex cases. Naturally, with constant rectification by the consultants, their diagnosing and reporting skills get polished with every passing. Consultants follow the same pathway. Residents are the frontline workers who diagnose and report the disease firsthand. MRI is investigation of choice for intracranial masses owing to its inherent qualities of no radiation exposure and better spatial resolution. A study published showed that the overall discrepancy rates between on call radiology residents' and neuroradiologists' interpretation of brain and spine MRI was 16%. In our study discrepancy rates for different brain tumors ranged between 11-20% [14]. Another study showed that the discrepancy rates for MRI reports of residents and faculty members was 3.7% and it improved with increasing experience years of residents [15]. In our study, the concordance rate for MRI scan done for brain metastases was 81.25% with k=0.294 while another study reported it as 89% for lung carcinoma metastasis to brain between raters of unknown difference of experience [16]. All the patients included in our research article were pre-operative. Both the consultant and residents in our study agreed on 88.46% of glioma cases with a k value of 0.336. In another study the inter-rater agreement for enhancing gliomas is reported to be excellent between novice and expert radiologists although no values have been mentioned [17]. The concordance rate in our study came out to be 86.66% with a k=0.423 for meningiomas that corresponds to moderate agreement. In a recently published study, it was found out that radiologists with even lesser years of experience can make accurate diagnosis [18]. Another study showed that sufficiently low error rates were observed in reports of on call residents [19]. In addition, multiple factors including multiple online resources greatly impact the on-call performance of radiology residents [20].

CONCLUSIONS

This study concludes that radiology residents and consultants have fair to moderate level of agreement in

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diagnosing head masses on MRI. A system of initial assessment of the scan by the resident followed by consultant will take the level of care to a superior level that will benefit the junior radiologists in term of learning as well.

Authors Contribution

Conceptualization: KA
Methodology: KA, IK
Formal analysis: KA, AS, HA, UA, TA, AS
Writing-review and editing: KA, AS, IK, TA, AS

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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