Original Article

Evaluation of Diagnostic Value of CT Scan and MRI in Brain Tumors and Comparison with Biopsy

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Abstract

Background

Cerebral neoplasm arises from brain, spinal cord and meningeal cells. Not only malignant cerebral neoplasm also benign tumor could lead to death due to mass effect on vital structures. Access to these tumors is difficult, and MRI and CT scan could be helpful in determining anatomical location of tumors and distinction of malignant from benign.

Objective

For better and earlier diagnosis and treatment, present study determined the accuracy of MRI and CT scan in compare with pathological findings.

Materials and Methods

This experimental case-series study compare the results of tumor imaging (MRI and CT scan) with biopsy in patients who came with brain mass between April 2004 and April 2010. Demographic characteristic and medical history were recorded. The results of CT scan, MRI and biopsy reports were recorded for patients, and all data compared and analyzed by SPSS software version 15.

Results

Results of 218 patients were analyzed. 189 patients had definite diagnosis using CT scan, which 13 (7.2%) were diagnosed benign and 159 (92.4%) malignant. Sensitivity, specificity, positive predictive value and negative predictive value of CT scan in comparison with biopsy were 83%, 10%, 93% and 3% respectively. The accuracy of this method was 78%. Fifty four patients (24.4%) were evaluated by MRI. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of MRI were 92%, 25%, 93%, 2% and 87% respectively.

Conclusion

According to the results, positive results by MRI and CT scan are valuable and have diagnostic value, but negative reports need more evaluation and no roll out malignant tumor. So remarkable specificity, but low sensitivity were achieved for CT scan and MRI. They accepted as easier and more accessible methods to approach brain tumors.

Keywords

Brain Neoplasms, Computerized Tomography, Magnetic Resonance Imaging, Biopsy

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Introduction

Intra cranial tumors could originate from brain, pituitary gland, skull, embryonic tissues, spinal cord and meningeam also could be metastasis from other parts of body. The incidence rate is 9.5 in 100000 in United States, which more than 60% of primary tumors are glioma (1). These tumors usually have non-specific symptoms like headache, nausea and vomiting. Specific symptoms depend on the location of the tumor, which are paralysis, aphasia, visual field disorders, seizure and so on (2). A good evaluation of the patient with a suspected brain tumor needs a complete history, exact physical examinations especially neurologic ones, and suitable diagnostic neuroimaging studies. The differential diagnosis of patients with signs and symptoms suggesting a brain tumor includes both neoplastic and non-neoplastic conditions. Imaging is the best diagnostic modality in the evaluation of brain tumors. They are important for surgery planning, and usually estimating the etiology of tumor (3). Computed tomography scan (CT) and magnetic resonance imaging (MRI) are important tolls for diagnosis of intra cranial tumors. CT scan remains a good choice in diagnosis of some conditions like bone or vascular involvement and metastases to the skull base (4, 5). MRI usually recommended diagnosing brain tumor (6). MRI is a gold standard test for diagnosis of the glial tumors. When MRI is not available, CT scan with contrast can be used insteadly. However, it might miss posterior fossa tumors with false negative report (7).

For more accurate and earlier diagnosis and treatment, this study was designed to determine sensitivity and specificity of MRI and CT scan in compare with the results of tumor biopsy.

Materials and Methods

This experimental case-series study was done on the records of patients with cerebral tumors, who attended in Shahid Sadoughi Hospital (Yazd, Iran) between April 2004 and April 2010. CT or MRI was done in Shahid Rahnemon Hospital (Yazd, Iran). Demographic characteristic, medical history, and CT scan or MRI and biopsy reports were taken out from their medical records. Chief complains of all patients documented from their medical record. Pathologists evaluated the lesions as benign or malignant, without any information about CT scan or MRI reports. CT scan reported cystic or solid lesion, with or without calcification and edema, shifting and enhancement. CT scan or MRI reports were concluded lesions as benign or malignant. Information of 218 patients with cerebral tumor gathered for this study.

Statistical analysis

All data were analyzed by SPSS software version 15 with fisher-exact test. Differences were considered significant in PV less than 0.05.

Results

Two hundred and eighteen patients with brain tumors were investigated. Ninety eight were women (45%) and 120 men (55%) with mean age of 44 years old (SD=20). Between 172 cases with definite diagnosis, 13 cases (7.2%) were benign and 159 cases (92.4%) were malignant. In 189 cases (86.6%) brain tumor diagnosis by CT scan, sensitivity of CT scan was 83%, specificity was 10%, positive predictive value (PPV) was 93%, negative predictive value (NPV) was 3% and accuracy was 78% in compare to biopsy results. Fifty four patients had MRI reports, which sensitivity and specificity were 92% and 25% in compare with biopsy. Positive predictive value (PPV), negative predictive value (NPV) and accuracy in compare with biopsy were 93%, 2%and87% respectively. Both CT scan and MRI reports for diagnosis of benign or malignant tumor compared with pathologic findings and they were not significant. (P-value=0.69 and 0.33) (Table1,2). There is no significant correlation between patients chief complains with type of the lesion (Table3). In 44 diagnostic cystic lesions by CT scan, 91.7% was malignant and 8.3% was benign in biopsy reports. Solid reports were 22

cases, that 84.6% were malignant. Malignant tumors with calcification, shifting and edema were 94.1%, 91.3% and 95.8% respectively. Hydrocephaly was found with 21 cases by CT scan, which 76.2% were malignant and it was significant. It means that hydrocephaly may predict malignant lesions (Table4).
Glioblastoma multiform is the most frequent type of malignancy in these specimens (Table5).

Table1: Frequency distribution of CT scan and biopsy reports in diagnosis malignancy

Biopsy reports / CT scan results	Malignant	Benign	Sum
Malignant	148	10	**158**
Benign	30	1	**31**
Sum	**178**	**11**	**189**

P-value=0.69

Table2: Frequency distribution of MRI and biopsy reports in diagnosis malignancy

Biopsy report / MRI report	Malignant	Benign	Sum
Malignant	46	3	**49**
Benign	4	1	**5**
Sum	**50**	**4**	**54**

P-value=0.33

Table3: Relation between chief complaints and type of tumor in biopsy reports

Biopsy reports / Chief complaints	Malignant (%)	Benign (%)	Sum (%)	p-value
Headache	93.1	6.9	53	**0.580**
Seizure	100	0	22	**0.044**
Hemi paresis	98.2	1.8	26	**0.192**
Others	92.7	7.3	62	**0.380**
Sum	**92.4**	**7.2**	**100**	

Table 4: Distribution frequency of biopsies findings based on CT scan criteria

Biopsy reports / CT scan criteria	Malignant (%)	Benign (%)	Sum (%)	p-value
Cystic	91.7	8.3	11.1	**0.641**
Solid	84.6	15.4	11.9	**0.054**
Calcification	94.1	5.9	7	**1**
Shifting	91.3	8.7	31	**0.335**
Edema	95.8	4.2	22	**0.738**
Enhancement	90.7	9.3	24	**0.317**
Hydrocephaly	**76.2**	**23.8**	**9.5**	**0.04**

Table 5: prevalence of brain tumors based on pathological findings

Type of tumor	Prevalence
Glioblastoma	23.9
Astrocytoma	13.8
Meningioma	11.5
Metastasis	10.1
Ependymoma	3.2
Meduloblastoma	2.8
Oligodendroglioma	2.8
Schwannoma	2.8
Pituitary Adenoma	1.4

Discussion

According to our data, CT scan and MRI were sensitive imaging in intra cranial tumors but they are not specific .Their high positive predictive value and low negative predictive value also made them reliable diagnostic procedures when it is difficult to access mass directly. Our data showed also that seizure may predict malignant tumors but other symptoms like headache, hemi paresis, diplopia, vomiting and nausea were not so. In this study relation between CT scan findings and pathologic findings surveyed and concluded that some findings like cystic or solid lesions, calcification, shifting, edema and enhancement did not predispose biopsy reports, but hydrocephaly found as a predictive finding in CT scan reports for determining malignant tumors. Huget and et al in 1995 reported that accuracy between radiological diagnostics and tissue biopsies were 66 %(8) in a similar study in 2000 by Salmon for MRI reports accuracy was 63 % (9).A study in Japan from1997 to 2000 concluded that accuracy of MRI reports for Ependymoma, Schwannoma and metastatic tumors were respectively 100%,92.4%and82% (10.)In a study that on 52 patients 83% MRI reports had correlation with biopsy (11). Some other researches designed for estimating sensitivity and specificity of CT scan in diagnosis brain tumors. Miller and et.al reported these values 89% and 82% but in Italy for metastatic lesions its sensitivity and specificity were 92% and 99% (12, 13). Morano P and et.al in 1998 used the information of 52 patients that 48%CT scan reports were like biopsy ones (14).For MRI reports also similar studies designed. Barlon reported that accuracy between its reports and biopsy was76.1 % (3) but it was 98.7% in Sarkar A. and et.al study (15).According to these studies and our results we concluded that MRI has more accuracy than CT scan for diagnosis brain tumors and biopsy correlation.

Conclusion

According to recent study brain lesions biopsy with pathological reports have a high value in diagnosis of tumors, but sometimes that the biopsy specimens are scanty or acceptability to the tumor is difficult or differentiation between low grade astrocytoma from gliosis is difficult, MRI and CT scan could be very helpful for pathologists to report their diagnosis.

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Conflict of interest

None of the authors have any conflicts of interest to declare.

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