Value of MRI in Brain Ring enhancing lesions

أهمية الرنين المغناطيسي في آفات الدماغ حلقية التلوين

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الخلاصة :
الغرض من الدراسة : تقييم دور الرنين المغناطيسي باستخدام الصبغة الملونة لتمييز **الافات الدماغية** ذات الصبغة الحلقية التلوين بالمقارنة بالتشخيص السريري والفحص النسيجي
المرضى والطريقة : اجريت الدراسة لمدة سنة واحدة **تم تتبع حالة** 20 مريض ذوي افات دماغية حلقية التلوين ، **خمسة عشر ذكرا وخمسة إناث و** وبأعمار تتراوح بين 13 **إلى** 63 سنه. **اجري الفحص بلستخدام** الرنين المغناطيسي بقوة 1.5 **تسلا وبلستخدام الصبغة الملون** (كاديلينيوم) وقورنت النتائج مع الحالة السريرية والفحص النسيجي واستخرجت النسب الإحصائية : نسبة الحساسية ,نسبة التخصيص و **الدقة** .
النتائج :باستخدام الرنين المغناطيسي **والصبغة الملون كانت النتائج كالآتي** : **أربع** حالات غير ورمية وثلاث عشرة حالة ورمية بالمقارنة بالفحص النسيجي الذي اظهر خمس حالات غير ورمية وخمس عشرة حالة ورمية . وكانت نسبة حساسية الرنين المغناطيسي للحالات غير الورمية هي 80% ونسبة التخصيص هي 86.6%. اما نسبة حساسية الرنين المغناطيسي للحالات الورمية هي 86.6% ونسبة التخصيص هي 80% .دقة الرنين المغناطيسي في التمييز بين الحالات الورمية وغير الورمية كانت 85%. كشف الرنين المغناطيسي عن وجود اربع **حالات من الاورام المنتشرة** و تسع حالات من الاورام الاولية ذات المرتبة العالية بينما بين الفحص النسيجي وجود **خمس حالات من الاورام المنتشرة وخمس عشرة حالة من الاورام** الأولية ذات المرتبة العالية وكانت حساسية الرنين المغناطيسي للكشف عن الاورام المنتشرة هي 80% ونسبة التخصيص هي 81.8% ونسبة حساسية الرنين المغناطيسي للاورام الأولية هي 81.8% ونسبة التخصيص هي 66.6%. **كشف** الرنين المغناطيسي عن وجود اربع حالات غير ورمية ,ثلاث حالات خراجات دماغية وحالة واحدة تجمع دموية دماغي متبدد بينما كشف الفحص النسيجي عن وجود خمس حالات غير ورمية ,ثلاث منها خراجات دماغية وحالة واحدة تجمع دموي دماغي متبدد وحالة **واحدة تنخرشعاعي** .
الاستنتاج والتوصيات : دقة الرنين المغناطيسي في التمييز بين **الافات الورمية وغي الورمية هي** 85% .يمكن تحسين هذه النسبة باستخدام **دراسات أخرى** في الرنين المغناطيسي مثل دراسة الا**نتشار والاشباع وكذلك بلستخدام الفحص بالعناصر المشعة** .

Abstract :
The aim of this study : to evaluate the role of contrast enhanced MRI to distinguish the ring enhancing brain lesions with histological findings and clinical diagnosis as reference standard
Patients and methods : This prospective study was done from may 2011 to may 2012. 20 patients with various ring enhancing lesions in the brain detected by MRI with different clinical conditions , fifteen males and 5 females between 13-63years age MR imaging was performed with MRI of (Philips - achiva 1.5 Tesla 16 channels). Routine sequences of T1, T2 and FLAIR spin echo sequences with IV contrast , gadolinium were carried out .Statical analysis include sensitivity , specificity and accuracy accounting in this study
Results : Contrast enhanced MRI revealed 4 cases of non neoplastic and 13 cases as neoplastic brain ring lesions compared with histopathology which revealed 5 cases of non neoplastic and 15 cases of neoplastic brain ring enhancing lesions. Sensitivity of MRI for non neoplastic lesions was 80% and specificity is 86.6% .Sensitivity of MRI for neoplastic lesions was 86.6% and specificity was 80% .Accuracy of MRI in differentiation of ring enhancing brain lesion either neoplastic or non neoplastic was 85%. MRI of neoplastic ring lesions revealed 4 cases as metastasis and 9 cases as primary tumor of high grade astrocytoma(globlastoma multiforme) while histopathology reveal 5 cases metastasis and 10 cases glioblastoma multiforme .Sensitivity of MRI for metastatic ring lesion was 80% and specificity was 81.8% .Sensitivity of MRI for primary neoplastic tumor is 81.8% and specificity was 66.6% .
MRI for non neoplastic ring lesions included 3 cases as abscess , on case resolving hematoma while histopathology revealed 5 cases of non neoplastic ring lesions , 3 cases pyogenic abscess , one case resolving hematoma and one case radiation necrosis
Conclusion and recommendation : The accuracy of differentiation of the neoplastic from non neoplastic ring enhancing lesions by MRI is 85%. In doubtful cases diagnosis improved by use of further sequences like diffusion – perfusion studies and nuclear studies .
Key words : neoplastic; non neoplastic ;ring enhancing brain lesion ; magnetic resonance imaging .

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INTRODUCTION

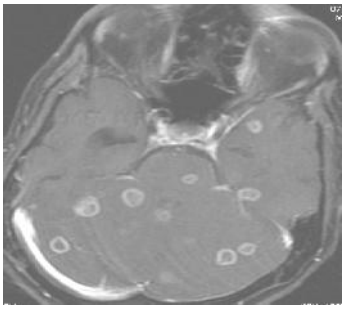
Ring enhancing lesions in MRI of the brain can be caused by different pathological conditions. The common lesions being some primary brain tumours, abscess, granuloma, resolving haematoma and infarct. Less common conditions being thrombosed vascular malformation and demyelinating disease such as Multiple Sclerosis. Uncommon causes being thrombosed aneurysm and other primary brain tumours such as primary CNS lymphoma in AIDS etc.(1)

Routine MRI studies of the brain are performed in T1 and T2 axial planes and either T1 sagittal or T2 coronal planes. Slices that are 5 to 10 mm thick are routinely used, but thinner slices with 2- to 4-mm thickness are needed in the evaluation of sellar and posterior fossa regions. Gadolinium compounds, which are paramagnetic IV contrast media for brain imaging, are especially helpful for identification of extra-axial tumors and intra-axial lesions associated with disrupted blood-brain barrier. The regular dose is about 0.1 mmol/kg of body weight, but in a case with equivocal findings or solitary metastasis, a dose of 0.2 to 0.3 mmol/kg of body weight is advisable .[2][3]Enhancement suggest breakdown of the blood-brain barrier. Consider malignancy, infarct, encephalitis, hemorrhage, or abscess .[4] Ring enhancing lesions are among the most commonly encountered neuroimaging abnormalities. The enhancing lesions are often of variable size and are usually surrounded by a varying amount of perifocal vasogenic edema .[5] Differential diagnosis of ring-enhancing brain lesions include **;**Primary brain tumor (glioblastoma) , metastasis (especially post chemotherapy) , abscess(in HIV most common are toxoplasma (most common), crytococcus, and TB) , multiple sclerosis, resolving hematoma (10-21 days) , tuberculoma , radiation necrosis. And Aneurysm.(6) Metastatic tumors are the most common intracranial neoplasm in adults. Lung cancer, breast cancer and melanoma account for the majority of patients with metastasis in the brain. The incidence of brain metastases has recently increased because of several factors, including improved survival, better treatment of systemic diseases and improved intracranial imaging techniques .[7] Metastatic lesions are typically subcortical, occurring in or near the gray matter-white matter junction, and are usually associated with severe perilesional edema. MRI typically reveals mild T1 hypointensity with T2 hyperintensity and fluid-attenuated inversion recovery hyperintensity at the site of the lesion. After contrast administration, a nodular ring pattern of enhancement is seen. Metastases from malignant melanoma may demonstrate T1 hyperintensity because of hemorrhagic or melanin components of the lesion. [8] Rapidly growing primary brain tumors, such as glioblastoma multiforme or anaplastic astrocytoma, can present with many of the same imaging characteristics as seen in metastatic lesions of the brain . [9] Gliomas represent 40% to 45% of all intracranial tumors. They include all primary brain tumors of astrocytic, oligodendroglial, or ependymal origin—astrocytomas, oligodendrogliomas, and ependymomas as well as choroid plexus papillomas and carcinomas .[10][11] . Glioblastoma multiforme (GBM) (WHO grade IV) is the most common primary tumor of the CNS, accounting for more than half of all intracranial gliomas .[12] As their name implies, these highly malignant tumors have a variegated histologic appearance with interspersed areas of hypercellularity, cellular pleomorphism, endothelial proliferation, and intratumoral necrosis .[13] Areas of

intratumoral central necrosis, which tend to dominate the appearance of the most aggressive of these tumors, appear notably hyperintense on T2-weighted images except where interrupted by more solid masses of cellular debris compared with this central necrotic T2 hyperintensity. Virtually all glioblastoma are associated with edema in the surrounding peritumoral white matter, usually graded as moderate or severe ,the origin of this edema is uncertain, it may reflect production of a vascular permeability factor by the tumor cells .[14,][15] [16] Vasogenic edema and contrast enhancement are usually much more extensive than in anaplastic astrocytomas .Tumour necrosis is a hallmark of GBM and appears on MRI as areas of non-enhancing T1 hypointensity,. Intratumoural hemorrhage contributes to the heterogeneous MR appearance of GBM with areas of high signal on T1W images and low signal on T2W images. A small number of GBMs may show evidence of subarachnoid seeding . [17]

Brain abscess (or cerebral abscess) is an abscess caused by inflammation and collection of infected material, coming from local (like ear infection) or remote (ex; lung, heart, kidney) infectious sources, within the brain tissue. [18] The enhancing ring of an abscess is usually thinner and more uniform than that found in the neoplasm. Granulomatous abscesses tend to have a thicker ring than pyogenic abscesses and have less surrounding edema. Infarcts often show gyral enhancement, occasionally mimicking ring enhancement. Resolving hematoma may have a dense center with ring like enhancement and much less surrounding edema..[19][20][21] The location of the primary lesion may be suggested by the location of the abscess: infections of the middle ear result in lesions in the middle and posterior cranial fossae. [22] Congenital heart disease with right-to-left shunts often result in abscesses in the distribution of the middle cerebral artery .[23] In demyelinating disorders , multiple enhancing ring lesions are encountered in several acute demyelinating disorders. Enhancing demyelinating lesions differ in size, shape or pattern. Most of them demonstrate a nodular pattern. Some of them demonstrate a ring-enhancing pattern and few have other patterns. (24) Radiation necrosis is a late complication of radiotherapy or gamma knife surgery, and can present as an enhancing mass lesion difficult to distinguish from recurrent tumor on conventional imaging .[25] Primary cerebral lymphoma (PCL) has tripled in incidence over the past 2 decades. This is partly due to a rise in patients with AIDS but PCL has also increased in immunocompetent patients. PCL appears as a single (less frequently multiple) lobulated enhancing mass, often abutting an ependymal or meningeal surface and involving basal nuclei. Enhancement is uniform in immunocompetent patients and ring-like in immunocompromised patients, in whom PCL frequently contains areas of central necrosis . [26]

Tuberculomas are frequently encountered brain lesions in tropical countries. Intracranial tuberculoma can occur with or without tuberculous meningitis.. A non-caseating tuberculoma usually appears Hyperintense on T2-weighted and slightly hypointense on T1-weighted images. A caseating tuberculoma appears iso- to ypointense on both T1-weighted and T2-weighted images, with an iso- to Hyperintense rim on T2-weighted images. Tuberculomas on contrast administration appear as nodular or ring-like enhancing lesions. [27] (fig.1)



(fig. 1) post contrast MRI of brain tub erculoma

AIM OF THE STUDY :

To evaluate the role of magnetic resonance imaging in distinguishing neoplastic from non-neoplastic ring enhancing brain lesions.

PATIENTS AND METHODS :

Twenty patients with various ring-enhancing lesions in the brain detected by MRI . Fifteen males and 5 females patients were studied between May, 2011 to May, 2012 in the MRI units. The age range of the patients was 13 to 63 years. A radiologist with 8 years of experience in neuroimaging chose the included patients by viewing imaging data. Descriptive statistics for the entire group include , age , sex and prevalence of each brain ring enhancing lesion. The statical indices use to evaluate the properties of the diagnostic test were sensitivity , specificity and accuracy on MRI and compared with that obtained by histopathology.

MR imaging was performed with MRI of (Philips - achiva 1.5 Tesla 16 channels). Routine sequences of T1, T2 and FLAIR spin echo sequences with IV contrast were carried out . MR imaging: signal intensities on unenhanced T1- and T2-weighted images for enhanced and unenhanced solid portions, enhancement patterns, margins, cortical involvement, mass effect, and presence of vasogenic edema. T2-weighted isointensity was defined when a lesion signal intensity was similar to that of gray matter. High signal intensity was defined as one similar to that of cerebrospinal fluid. Enhancement patterns were categorized as none, focal, diffuse or rim enhancement (180° of a ring). The patterns of rim enhancement were also divided into two subgroups: incomplete and complete. Margins were categorized as well or poorly defined, and mass effects were graded as none, mild (presence of sulcal effacement only), moderate (presence of
Ventricular effacement) or severe (presence of mid line shifting) .

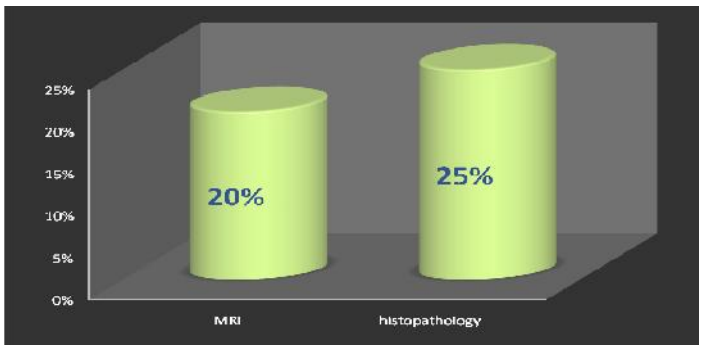
RESULTS :

Twenty patients with various ring enhancing lesions in the brain detected by MRI with different clinical conditions were tabulated. Fifteen males and 5 females' patients were studied .The age range of the patients was 13 to 63 years . This study appeared among twenty cases, the MRI with contrast revealed 4 cases of non-neoplastic ring enhancing brain lesions and thirteen cases as neoplastic brain lesions, compared with histopathological study that revealed five cases of non-neoplastic lesions and fifteen
cases as neoplastic lesions. (Table 1).

Table (1) distribution of ring enhancing brain lesions according to MRI & histopathological findings

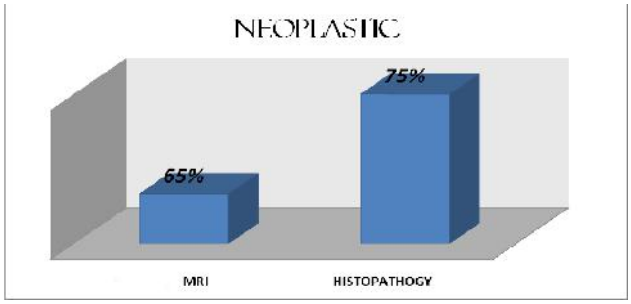
modality	Non neoplastic	%	neoplastic	%	No definit. diagnosis
MRI	4	20%	13	65%	3,(15%)
Histopath.	5	25%	15	75%	

MRI showed 20% of cases were non-neoplastic ring enhancing brain lesions in comparison with 25% revealed by histopathology. (Fig. 2).



(Fig.2) Bar chart shown frequency of non-neoplastic ring enhancing brain lesions by MRI compare with histopathology

MRI , according to this percentage revealed sensitivity in detection of non-neoplastic lesions of 80% and specificity of 86.6% . Thirteen cases (65%) diagnosed by MRI as neoplastic ring enhancing brain lesions in comparison with fifteen cases (75%) revealed by histopathology.(Fig.3).



(Fig.3) Bar chart shown percentage of neoplastic ring enhancing brain lesions by MRI compared with histopathology

Sensitivity of MRI according to this percentage reach to 86.6% and specificity 80%. Accuracy of MRI in differentiation of ring enhancing brain lesions (either neoplastic or non-neoplastic) was 85%.

MRI revealed neoplastic cases of ring enhancing lesions as following frequency: Four cases metastases, nine cases as primary brain tumor of high-grade astrocytoma (glioblastoma multiforme).While histopathological results were as following: Five cases metastases, ten cases primary brain tumor of (glioblastoma multiforme). So by MRI the metastases represented 26% of neoplastic ring enhancing intracranial lesions compared with 33% revealed by histopathological technique. (Table 2)

Table (2) Neoplastic cases by MRI compared with histopathological results.

Technique	primary tumor	%	metastases	%
MRI	**9**	**60%**	**4**	**26%**
HISTOPATHOGY	**10**	**67%**	**5**	**33%**

Sensitivity of MRI in the detection of secondary neoplastic ring enhancing brain lesions was 80% and specificity was 81.8% . Percentage of primary brain tumor (glioblastoma multiform) revealed by MRI was 60% while histopathological results was 67%.
Sensitivity of MRI in the detection of primary neoplastic ring enhancing brain lesions was 81.8% and specificity was 66.6%. Accuracy of MRI in differentiation between primary and secondary ring enhancing brain lesions was 65%. This study illustrated the causes of non-neoplastic ring enhancing brain lesions diagnosed by MRI were four cases as following: Three cases of abscess, one case resolving haematoma. Follow up , histopathological and clinical findings results revealed five cases of non neoplastic brain lesions as three cases of pyogenic abscess, one case of resolving haematoma and one case radiation necrosis.

Table (3) distribution of non-neoplastic cases according to the causes

Non neoplastic	abscess	haematoma	radiation necrosis
MRI	**3**	**1**	
Clinical follow up	**3**	**1**	**1**

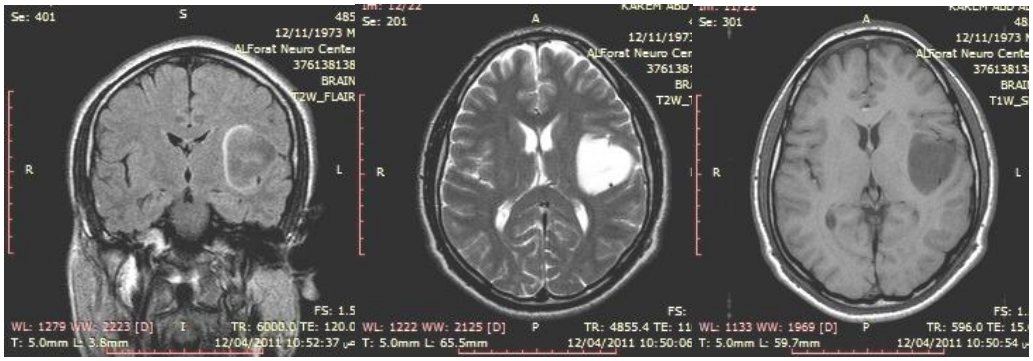
This study revealed that the majority of neoplastic cases were above age of 40 years, from 12 cases above age of 40 years, there were 11 cases neoplastic(91%), one case non neoplastic (9%), while below 40 years age equal number were resulting whether neoplastic or non neoplastic ring enhancing brain lesions.

DISCUSSION :

This study revealed that among the twenty cases of ring enhancing lesion there were four cases diagnosed by MRI (20%) as non-neoplastic ring enhancing brain lesion, compared with five cases diagnosed as non-neoplastic lesions by histopathology (25%).Thirteen cases diagnosed as neoplastic ring enhancing brain lesions by MRI (65%), compared with fifteen cases diagnosed as non-neoplastic lesions by histopathology (75%) . MRI according to this percentage revealed sensitivity 80% and specificity 86.6% in detection of non-neoplastic lesions. Sensitivity MRI in detection of neoplastic ring enhancing brain lesions was 86.6% and specificity was 80%. Accuracy of MRI in differentiation of neoplastic ring enhancing brain lesions from non-neoplastic lesions was 85%. Study by Ronald L. Wolf who used a strategy was on the basis of conventional MR imaging, diffusion-weighted MR imaging, perfusion MR imaging, and proton MR spectroscopy to classify intra axial masses , the accuracy and sensitivity of the strategy, were 90% and 97% respectively for discrimination of neoplastic from non-neoplastic diseases .[28] Another study done by Sarah. H. O'Connell revealed Conventional MR Imaging: Diagnostic accuracy 61.4% , Sensitivity 61.9% and specificity 60.9%.

By MR spectroscopy diagnostic accuracy in differentiating similar -appearing brain lesions ranges from 85-92% and when combined with conventional MR imaging and DW imaging diagnostic accuracy 97.7% ,sensitivity 95.2% and specificity 100%.[4]. Other studies which used positron emission tomography (PET) can provide dynamic information regarding the metabolism of a lesion, which may be useful for differentiating tumors from abscesses**,** sensitivity in this modality reaches to 90% .[29][30]

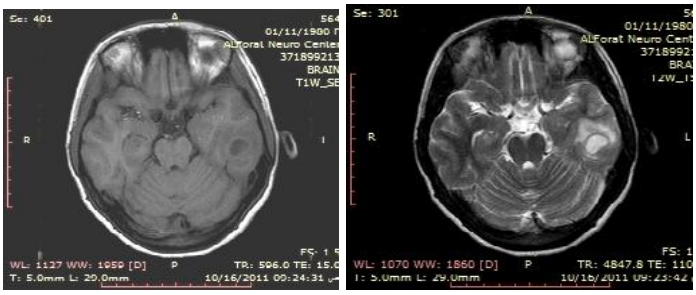
Imaging findings for glioblastoma multiforme were ,typically heterogeneous, lobulated, marked surrounding white matter edema and necrosis. Tumor nidus shows T1 and T2 prolongation (dark on T1 and bright on T2). Ring Enhancement was thick irregular ,shaggy inner margin , and multilocularring patterns. (fig. 4)



(Fig. 4) glioblastoma multiforme

Imaging findings for metastatic lesions were**,** multiple foci at gray–white matter junction. hypointense on T1W, variable signal intensity on T2W , marked vasogenic edema surrounding each lesion and intense nodular or ring enhancement. Depending on these criteria with clinical findings and past medical and surgical history of patients, this study revealed 65% of cases as neoplastic cause of ring enhancing brain lesions, while histopathology revealed 75%.In comparison with another study by K. M. Schwartz, B. J. Erickson and C. Lucchinetti that revealed 70% were neoplastic depending on the T2 weighted pattern. Study by S. H. O'Connell also revealed 70% of cases were neoplastic**.** Therefore, the results of those studies were relatively similar to this study. By MRI, the metastases represent 26% of neoplastic ring enhancing intracranial lesions, and primary tumour (glioma) represents 60%. Sensitivity of MRI in the detection of secondary neoplastic ring enhancing brain lesions was 80% and specificity was 81.8%. Sensitivity of MRI in the detection of primary neoplastic ring enhancing brain lesions was 81.8% and specificity was 66.6%. The accuracy of MRI in differentiation between primary from secondary ring enhancing brain lesions was 65%. Other two studies by K. M. Schwartz, B. J. Erickson and C. Lucchinetti · [31]. And S. H. O'Connell revealed 40% gliomas, 30% metastases, these results also were very close to our results.

Imaging findings for abscess lesions were , well defined rim of enhancement, thin (2-7mm), uniformly convex, smooth inner and outer margins (late abscess).Capsule is isointense or hyperintense to white matter onT1. Capsule is hypointense to white matter on T2. ((Which is not usually seen in tumor)). Area of Central Necrosis appear low signal on T1, high signal on intermediate images, FLAIR images, and T2. Prominent surrounding vasogenic edema usually present large edema in comparison with size of lesion.The size, shape and wall thickness of the ring enhancing lesions in MRI with the extent of surrounding oedema often helps to distinguish the kind of condition provided the clinical history and age of the patient was taken into consideration. Correlation with history and clinical finding and other imaging finding, like acute sinusitis and history of diabetes assessed us to reach to this diagnosis.(fig.5).



(Fig.5) post contrast MRI brain abscess

Depending on these criteria, this study revealed 10% of cases as abscesses, while the other two studies by K. M. Schwartz, B. J. Erickson and C. Lucchinetti and S. H. O'Connel**l** revealed 8% of ring enhancing brain lesions were abscesses

CONCLUSIONS AND RECOMMENDATIONS :

1-This study that depended on magnetic resonance imaging with contrast in evaluation of ring enhancing brain lesions was accurate in acceptable percentage in narrowing differential diagnosis and illustrating causes of theses lesions.

2-The accuracy of differentiation the neoplastic from non-neoplastic ring enhancing brain lesions was 85% and histopathology stills the standard reference in doubtful cases.

3-For the future of our locality , the new imaging modalities very important to give final result in the differentiation of ring enhancing brain lesions such as diffusion-perfusion weighted MRI and nuclear imaging.

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