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Comparison of MRI and CT Scan Findings in Patients with First-episode Psychosis

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ABSTRACT

Background and Objective: Schizophrenia is one of the most severe psychiatric disorders, characterized by symptoms such as hallucinations, delusions, disorganized behavior and speech, and negative symptoms including avolition. Since lesions such as brain tumors, encephalitis, and multiple sclerosis may be responsible for psychotic episodes, neuroimaging is frequently employed in adults to investigate an underlying "organic" etiology. The aim of this study is to compare MRI and CT scan findings in patients with a first episode of psychosis admitted to Golestan Hospital in Ahvaz.

Methods: This cross-sectional study was conducted on 125 patients with a first episode of psychosis who presented to the emergency department of Golestan Hospital in Ahvaz and underwent evaluation with either MRI or CT scanning. Patients were compared across two groups with respect to age, sex, and the findings of CT and MRI.

Findings: Of the 125 patients evaluated, 61 underwent CT scanning and 64 underwent MRI. The frequency of male sex in the MRI and CT groups was 57.8% and 55.7%, respectively, and the age distribution between the two groups did not show a statistically significant difference. Among the 61 patients examined with CT, 53 had normal findings and 8 had incidental findings. On MRI, 54 patients had normal results and 9 had incidental findings. One case of hyperostosis frontalis interna was observed on MRI, which may be associated with psychosis. However, no significant difference was found between MRI and CT findings in detecting psychosis-related lesions.

Conclusion: The study findings showed that MRI and CT are not significantly different in their ability to detect clinically important lesions. Therefore, either imaging method can be used, depending on which one is available at the time of evaluation.

Keywords: *Schizophrenia, Psychosis, CT Scan, MRI.*

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Introduction

Schizophrenia ranks among the most severe psychiatric illnesses, presenting with hallucinations, delusions, disorganized behavior and speech, and negative symptomatology including avolition. A broad range of organic pathologies may precipitate psychotic episodes. Notwithstanding its relatively low prevalence, schizophrenia imposes a substantial economic burden on healthcare systems and is associated with a reduction in life expectancy of approximately 10 years, predominantly attributable to suicide (1). The utility of neuroimaging in first-episode psychosis (FEP) or first-episode behavioral abnormality (FEB) remains a subject of debate. Imaging is routinely utilized in adult populations to exclude an underlying organic etiology, given that intracranial lesions, including brain tumors, encephalitis, and multiple sclerosis, have been documented to manifest as psychotic episodes, with characteristic findings identifiable on MRI (2).

Timely detection of such lesions may confer benefit to a subset of patients, as certain lesions are amenable to surgical or medical intervention. Nevertheless, evidence supporting the routine use of magnetic resonance imaging (MRI) or computed tomography (CT) and their influence on clinical management remains sparse. Neuroimaging is frequently employed as a screening tool to exclude underlying organic pathology (3). Multiple imaging techniques, including MRI, CT, and PET, have been applied to identify cerebral abnormalities in this population. MRI has documented a broad array of findings in schizophrenic patients, including global and focal gray matter volume reduction, ventricular enlargement, cerebral atrophy, and cavum septum pellucidum. However, findings related to developmental anomalies, such as cavum septum pellucidum, are of limited clinical relevance, as no effective therapeutic intervention currently exists for these conditions (1).

MRI studies have sought to identify neurodevelopmental deficits in patients presenting with first-episode psychosis. In addition to the developmental models proposed for schizophrenia, neurodegenerative processes have also been suggested (4). Weinberger was among the earliest investigators to propose indications for CT scanning, which included first-episode psychosis in adolescent and young adult patients presenting with psychosis-related or affective disorders. Neuroimaging serves not only to exclude neurological etiologies but also to inform prognostic evaluation in schizophrenia (5). Canadian clinical practice guidelines recommend brain imaging in first-episode psychosis, citing the increased prevalence of ventricular enlargement and cortical sulcal widening observed in 30–40% of schizophrenia patients (5). Similarly, American and Australian guidelines advocate for routine imaging in first-episode psychosis to exclude structural abnormalities. The choice of imaging modality and specific MRI protocol may influence the detection of underlying pathologies (6). In first-episode psychosis, heightened immune system activity may be assessed via biomarkers in cerebrospinal fluid and peripheral blood; PET imaging can evaluate this activation and also interrogate neurotransmitter binding. TSPO PET studies have demonstrated increased radioligand binding in patients relative to healthy controls (7). Given the substantial disease burden associated with schizophrenia and the critical importance of early identification of potentially treatable etiologies, the present study was conducted to compare MRI and CT findings in patients with first-episode psychosis at Golestan Hospital in Ahvaz.

Methods

Following approval by the Ethics Committee of Ahvaz Jundishapur University of Medical Sciences (IR.AJUMS.HGOLESTAN.REC.1403.037), this cross-sectional study was performed on 125 patients presenting with first-episode psychosis to the emergency department of Golestan Hospital in Ahvaz, all of

whom underwent either MRI or CT imaging. Patients were enrolled after providing written informed consent and receiving assurances regarding data confidentiality. Exclusion criteria comprised a history of chronic psychotic disorders or prior psychiatric diagnosis, antipsychotic medication use, focal neurological signs, use of psychosis-inducing substances, and technical limitations precluding imaging. Based on the study objectives, the researcher's assessment, and the prior work of Khandanpour et al. (3), the required sample size was calculated as 50 patients per group, with parameters set at $\alpha=0.05$, $\beta=0.1$, $d=6$, and $s=8.25$, yielding 95% confidence and 90% statistical power.

The diagnosis of first-episode psychosis was established by a psychiatry resident and subsequently confirmed by attending psychiatrists. All patients underwent a comprehensive neurological examination performed by a neurologist or neurology resident. MRI protocols included at least one axial T2-weighted sequence for every patient; additional sequences—including T1-weighted, diffusion-weighted imaging, gradient-echo, and gadolinium-enhanced studies—were obtained as clinically indicated. MRI was performed using a Siemens 1.5 Tesla scanner. CT imaging was carried out using a Siemens 64-slice device, with contrast-enhanced images acquired in selected cases. All imaging studies were formally reported by a consultant radiologist and a radiology resident at Golestan Hospital in Ahvaz. In this study, MRI and CT findings were systematically compared, with particular attention to potential psychosis-related etiologies such as intracranial tumors and encephalopathies associated with infections such as AIDS. Incidental findings deemed unlikely to be related to psychosis were also compared between modalities. Data were entered into SPSS version 22 for statistical analysis. Categorical variables were compared using the chi-square test; continuous variables were analyzed using the t-test when normally distributed and the Mann-Whitney U test otherwise. Correlations between quantitative variables were assessed using Pearson's correlation coefficient, and statistical significance was defined as $p<0.05$.

Results

The results of the present analysis revealed that the gender composition of the two study groups was well-balanced and homogeneous, with no statistically significant difference detected between the MRI and CT cohorts in terms of sex distribution. Additionally, when the age group distributions were compared across the two imaging modalities, the findings indicated that the age profiles were closely matched, and no meaningful statistical difference was observed between the groups. With respect to overall gender frequency across the entire study population, the cohort consisted of 54 female patients, accounting for 43.2% of the total, and 71 male patients, comprising 56.8% of the cohort (Table 1).

Table 1. Descriptive indices of demographic characteristics

Variable	Number(%)
Gender	
Female	54(43.2)
Male	71(56.8)
Age (years)	
15-24	13(10.4)
25-34	46(36.8)
35-44	40(32)
45-54	7(5.6)
55-64	14(11.2)
65-74	5(4)

Assessment of gender frequency in the MRI and CT scan groups revealed that in the CT group, 27 patients (44.3%) were female and 34 patients (55.7%) were male. In the MRI group, 27 patients (44.2%) were female and 37 patients (57.8%) were male. In this study, 61 patients in the first group underwent CT scanning, of whom 53 had normal findings and 8 demonstrated incidental findings. In the second group, 64 patients were evaluated with MRI, with 54 reporting normal results and 9 showing incidental findings. Additionally, in one patient, a psychosis-related finding—hyperostosis frontalis interna—was identified on MRI. Accordingly, the prevalence of psychosis-related findings in the MRI group was estimated at approximately 1%, with no statistically significant difference observed (Tables 2 and 3).

The results of this study demonstrated no significant difference between MRI and CT scan in detecting psychosis-related lesions. Although incidental findings were observed in both imaging modalities, only one psychosis-related finding was identified on MRI, with a prevalence of approximately 1% among the patient population. Demographic characteristics, including gender and age distribution, were comparable between the two imaging groups, with no statistically significant differences observed in these variables. Analysis of age groups revealed that 10.4% of patients fell within the 15-24-year age range, while 4% were in the 65-74-year age group (Table 4).

Table 2. Frequency distribution of incidental CT and MRI findings

Variable	Frequency
Incidental Findings (CT)	
Temporal atrophy	1
Falx lipoma	1
Old infarct	1
Mild ventriculomegaly	1
Brain atrophy	1
Basal ganglia calcification	1
Falx calcification	1
Benign skull lesion	1
Incidental Findings (MRI)	
Small vessel disease	2
Arachnoid cyst	1
Hyperintense focus	2
Pineal cyst	1
Brain atrophy	1
Old infarct	1
Partial empty sella	1

Table 3. Evaluation of incidental, normal, and psychosis-related findings in the MRI and CT scan groups

Variable	CT Number(%)	MRI Number(%)	p-value
Incidental finding	8(13.1)	9(14.1)	0.6
Normal	53(86.9)	54(84.3)	0.6
Psychosis-related finding	0(0)	1(1.6)	0.6

Table 4. Evaluation of age frequency distribution in the MRI and CT scan groups

Age Group (years)	CT Number(%)	MRI Number(%)	p-value
15-24	9(14.8)	4(6.3)	0.19
25-34	22(36.1)	24(37.5)	0.19
35-44	15(24.6)	25(39.1)	0.19
45-54	3(4.9)	4(6.3)	0.19
55-64	10(16.4)	4(6.3)	0.19
65-74	2(3.3)	3(4.7)	0.19

Discussion

According to the study findings, the proportion of male patients in the MRI and CT groups was 57.8% and 55.7%, respectively, indicating a broadly homogeneous gender distribution across both imaging cohorts. The age distribution of patients in both groups fell within comparable ranges, and no statistically significant intergroup differences were detected. With respect to imaging outcomes, among the 61 patients who underwent computed tomography, normal findings were reported in 53 cases, while incidental abnormalities were noted in the remaining 8 patients. In the MRI cohort, comprising 64 patients, normal results were obtained in 54 cases, incidental findings were documented in 9 patients, and a single case of hyperostosis frontalis interna was identified—a finding that may be clinically relevant to psychosis. This yielded an estimated prevalence of psychosis-associated abnormalities of approximately 1% within the MRI group. However, when comparing the two imaging modalities, no statistically significant association was found between MRI and CT scan with regard to the detection of psychosis-related findings. Our results are in close agreement with those reported by Kular et al., who observed incidental MRI findings in four patients (9%), including prominent perivascular spaces, hypoplastic transverse sinus, and sinus mucosal thickening, none of which were related to psychosis, and with no corresponding abnormalities detected on CT scan. That study concluded that there was no clear advantage of one imaging modality over the other (2). Furthermore, the findings of Goulet et al. are also concordant with our results, as they similarly concluded that CT scan and MRI do not exhibit a statistically significant difference in the assessment of psychosis-related abnormalities (5).

With regard to the imaging modality, it is widely believed that MRI is more valuable than CT scan in evaluating subtle brain pathology. However, there remains limited evidence regarding the actual effectiveness of MRI in assessing patients with psychotic disorders. When considering the use of neuroimaging, there is no global consensus on the routine use of either CT or MRI for FEP or FEB, and certainly, there are differences in preferences for first-line modalities in different counties. For instance, the Australian and New Zealand Clinical Practice Guidelines (CPG) recommend that a baseline CT scan should be performed as the first-line investigation, whereas the UK National Institute for Health and Care Excellence (NICE) expresses no preference for either scanning method and suggests that further studies and data are needed regarding the use of structural neuroimaging in FEP or FEB (5, 8). When imaging is indicated, several factors should be considered when determining the optimal modality. First, MRI incurs significantly higher costs compared to CT scan. Second, depending on the region and the size of the facility, there may be limitations in accessibility, such as the availability of MRI machines, compared to CT scan (9).

The results of the study by Kular et al. demonstrated that no significant anatomical pathology was identified on either CT scan or MRI—that is, findings that would directly impact patient management. These findings are consistent with previous studies and the present investigation, all of which have concluded that the likelihood of detecting an underlying organic process that substantially influences management in FEP or FEB is low, particularly in the absence of associated neurological abnormalities (2). In the study by Khandanpour et al., it was stated that CT scan and MRI have comparable utility. They also reported that MRI was comparable to CT scan in detecting pathological and incidental brain lesions. Therefore, routine structural brain imaging in FEP patients without focal neurological deficits may not be routinely necessary (3). The findings of that study, in terms of the lack of a significant difference between MRI and CT scan, align with the results of the current investigation. In the present study, one patient examined with MRI demonstrated hyperostosis frontalis interna, a finding that may be associated with psychosis.

Furthermore, the following studies have suggested that hyperostosis frontalis interna may be associated with psychosis and that neuroimaging was able to demonstrate this finding. Elghazouani reported an unusual case of a 44-year-old woman with schizophrenia and hyperostosis frontalis interna who had a history of head trauma, concluding that the long-term pathological effects of brain injuries, including hyperostosis frontalis interna, may interact with genetic vulnerability and potentially lead to the development of schizophrenic disorder (10). Similarly, May et al. noted that the presence of hyperostosis frontalis interna is indicative of reduced brain volume and carries major clinical significance, as it may signal the onset of cerebral degenerative processes (11). In the study by Alvarez et al., it was suggested that hyperostosis frontalis interna may be associated with psychiatric symptoms such as depression (12). Notkin et al. also reported an association between hyperostosis frontalis interna and psychosis in nine women (13). Based on the results of this study, there was no significant difference between CT scan and MRI in the detection of clinically important lesions. On MRI evaluation, one patient demonstrated hyperostosis frontalis interna, which may be associated with psychosis. One limitation of this study is its small sample size and single-center design. It is recommended that further multicenter studies with larger sample sizes be conducted to confirm these findings.

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