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Original Article

Anatomical Evaluation of the Brain Via Magnetic Resonance Imaging: T1-Weighted Flair Versus T1-Weighted Spin-Echo Pulse Sequences

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ABSTRACT

Objective: The aim of this study was to investigate the value of T1-weighted (T1W)/FLAIR (fluid attenuation inversion recovery) imaging in routine brain magnetic resonance (MR) evaluation by comparing the T1W spin-echo (SE) sequence with the T1W rapid FLAIR sequence in terms of identifiability of anatomical structures and image quality.

Methods: T1W SE and T1W rapid FLAIR sequences were qualitatively and quantitatively analysed with regard to the identification of anatomical structures, general image quality and presence of artefacts in 30 healthy cases. Signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) values were determined using the signal intensity values of two sequences from equivalent localisations, including the grey substance, white substance and cerebrospinal fluid at the level of the posterior fossa and thalamus.

Results: SNR values were significantly higher in T1W SE than in T1W FLAIR sequences at the level of the thalamus and posterior fossa ($p<0.001$). Measurements at the thalamic level revealed that CNR values of T1W FLAIR for cerebrospinal fluid-grey substance and grey-white substance were significantly higher when compared to T1W SE ($p=0.0001$). The measurements at the posterior fossa level demonstrated that CNR values of T1W FLAIR for grey-white substance were significantly higher when compared to T1W SE ($p=0.006$).

Conclusion: In this study, we found that in T1W imaging of the brain, T1W FLAIR sequence was superior to T1W SE in qualitative and quantitative evaluations in terms of CNR values. Nevertheless, SNR values were found to be higher in T1W SE imaging.

INTRODUCTION

Magnetic resonance imaging (MRI) plays a critical role in brain imaging. Anatomical evaluation by MRI is mediated with T1W sequences. The higher the signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR), the more detailed is the anatomical information that can be provided.

T1W spin echo (SE) is used in routine brain MRI. This sequence consists of 90° and 180° radio frequency (RF) pulses. The operator can control the T1, T2 and proton weight of the images by changing two important time parameters: repetition time (TR) and echo time (TE). TE is the time between the 90° RF pulse and the echo signal while TR is the time between the 90° RF pulses.[1,2] TR is responsible for the T1 weight of the image. When the TR is kept at low values in T1W scans, only the structures with fast magnetisation will be able to reach the maximum longitudinal magnetisation; therefore, the anatomical details of the tissues will be higher. As the duration of the TR increases, the T1 value of the tissue will decrease and the rate of SGO will increase. The TE value is responsible for the T2 weight of the image. T2 weight is important for tissue characterisation. As the duration of the TE increases, many more anatomical structures will complete the longitudinal magnetisation, the SNR will decrease and therefore, the anatomical detail between the tissues will decrease.[1–3]

The short T1-inversion recovery (IR) sequence has advantages in MR imaging of the body. The middle T1 sequence is important in the localisation and enhancement of the brain, especially in determining the pathological signal between soft and fatty tissues.[4] Using the short T1 with IR sequence, this purpose can be achieved by keeping the T1 value longer, when grey-white matter differentiation is desired. The suppression of fat and that of

fluid signals are two important options used with the IR sequence. Suppression of fat signals is called STIR (short tau inversion recovery) sequence, and fluid suppression is called FLAIR (fluid attenuation inversion recovery) sequence.[1]

As in the FLAIR sequence, the fluid is suppressed in the sequence where the TE and TR time is kept long. However, since the TR is long, the examination time will be extended. The anatomical detail is higher, because the T1 factor is two times higher in the SE images.[2]

The T1W fast FLAIR sequence is composed of T1W FLAIR sequence and its commercially available hybrid-RARE output (which implements the eco image mapping scheme and is called the low-high profile layout). This mapping scheme is designed to achieve the shortest possible effective echo times and thus minimises the T2 effects.[3]

In this study, we investigated the value of T1W FLAIR imaging in routine brain MRI evaluation by comparing the T1W SE sequence with the T1W rapid FLAIR sequence in terms of identifiability of the details of anatomical structures and image quality.

MATERIALS AND METHODS

This experimental protocol was approved by the ethics committee. Thirty consecutive cases (age = 21–50 (average 32 years); 17 females, 13 males) who underwent brain MRI examinations at our Radiology Department between March and September 2006 and had no pathological findings were included into this study. Brain MRI examinations were performed including T1W SE and T1W rapid FLAIR in the axial plane, T2W FLAIR in the axial and coronal planes, T2W TSE sequence in the sagittal and axial planes using Philips (Gyroscan, Intera, Netherlands) 1.5 MR system. None of these patients had pathological lesions on the brain MRI and the quality of all the images obtained was suitable for evaluation. T1W SE and T1W rapid FLAIR sequences in the axial plane were included in our study. The sequence parameters are presented in Table 1.

Table 1. The signal-to-noise ratio for white matter, cerebrospinal fluid (CSF) and thalamus (grey matter) at the thalamus level

n=30	Min–Max	Mean±SD
Air SE	11–29	16.53±4.14
Air FLAIR	14–36.90	22.25±6.26
White matter FLAIR	668–1036	817.86±107.63
White matter SE	698–1010	831.16±95.44
Thalamus SE	671–962	807.46±91.31
Thalamus FLAIR	565–933	729.06±110.63
CSF SE	262–449	356.13±45.37
CSF FLAIR	26–82	49.6±15.28

SE: T1-weighted spin echo; FLAIR: T1-weighted rapid FLAIR sequences; CSF: Cerebrospinal fluid; Min: Minimum; Max: Maximum; SD: Standard deviation.

The T1W SE and T1W rapid FLAIR sequences were evaluated qualitatively in terms of the determination of anatomical structures, overall image quality and presence of artefacts and quantitatively in terms of SNR and CNR values by a consensus of two different observers.

Quantitative measurements

Signal intensities of the grey matter (Fig. 1a), white matter (Fig. 1b) and 4th ventricle for cerebrospinal fluid (CSF) (Fig. 1c) were measured through the transverse section of the posterior fossa at the level of the vermis. At the thalamus level, signal intensities of the thalamus (Fig. 1d) and adjacent white matter (Fig. 1e), lateral ventricle for CSF (Fig. 1f) and air were measured. According to these measurements, SNR and CNR between white matter-grey matter, white matter-CSF and grey matter-CSF were calculated. The standard deviation of the air signal was used for noise measurements. A round or elliptical region of interest (ROI) of approximately 1 cm^2 was used. The programme available on the MRI automatically adjusted the identified ROI on any cross-section to the equivalent position in the other sequences. Anatomical structures and air signal intensities were taken in equivalent positions in the T1W SE and T1W FLAIR sequences.

Qualitative measurements

Qualitative evaluations were made by a consensus of two observers, considering the identifiability of the basal ganglion structures, 7th and 8th cranial nerves complex, periaqueductal grey matter and the contrast between the grey and white matter. Qualitative evaluation was performed on a 5-point scale (0: minimum quality, 4: maximum quality). The presence of artefact and general image quality rating was performed on a 4-point scale (0: overall image quality good, no artefact; 3: overall image quality is poor, extensive artefact).

SNR and CNR values were calculated according to the following formulas:

$$SNR = \frac{SI_{tissue}}{Noise_{air}} \qquad CNR = \frac{SI_{tissue\text{-}1} - SI_{tissue\text{-}2}}{Noise_{air}}$$

(SI: Signal intensity of related tissue; Noiseair: Standard deviation of air signal used for noise measurements)

Statistical analysis

The results of the SNR and CNR parameters obtained on MRI in T1W SE and T1W FLAIR sequences were compared using the t-test in matched samples. Wilcoxon signed-rank test was used for statistical comparison of T1W SE and T1W FLAIR sequences with regard to anatomical identifiability and image quality with artefact presence. The level of significance was taken as $p \leq 0.05$ and SPSS (version 11.5) programme was used in the calculations.

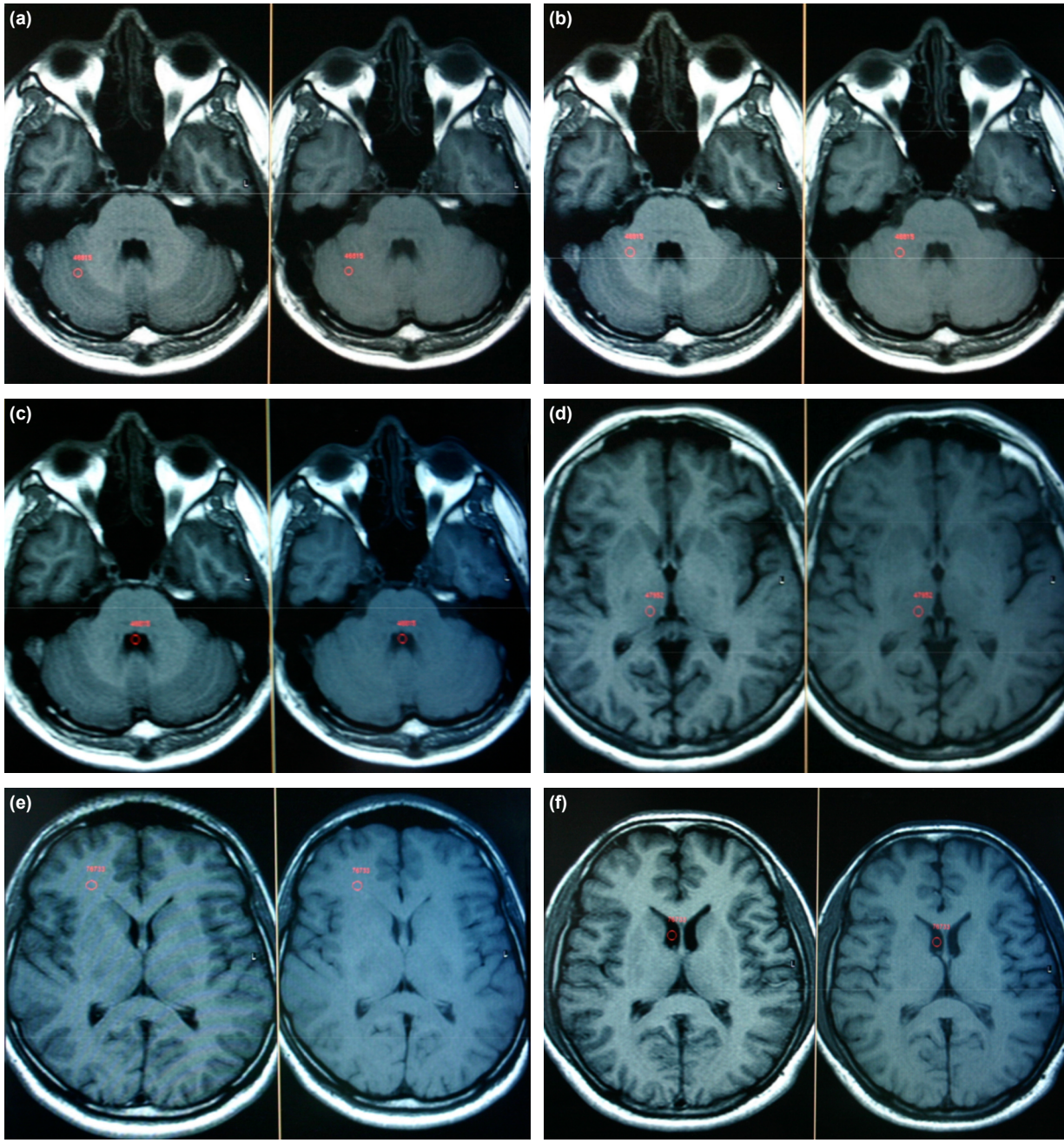

Figure 1. (a) Measurement of grey matter signal intensity through the transverse section of the posterior fossa. **(b)** Measurement of white matter signal intensity through the transverse section of the posterior fossa. **(c)** Measurement of CSF signal intensity for 4th ventricle through the transverse section of the posterior fossa. **(d)** Measurement of white matter signal intensity at the thalamus level **(e)** Measurement of grey matter signal intensity at the thalamus level. **(f)** Measurement of CSF signal intensity for lateral ventricle at the thalamus level.

RESULTS

Examination quality in all the 30 cases included in this study was at a sufficient technical level of evaluation. No radiological pathological finding was detected in all the cases.

T1W FLAIR sequence had higher scores on qualitative evaluation of the posterior fossa sections in terms of grey-white matter contrast (Fig. 2a); whereas in terms of general image quality, artefacts (Fig. 2b) and identifiability of the 7th and 8th nerves (Fig. 2c), the scores of the two sequences were close to each other.

In the thalamus level sections, two sequences were close to each other in terms of overall image quality and artefacts (Fig. 2d-f); however, T1W FLAIR sequence scored higher in terms of grey-white matter contrast (Fig. 2d) and identifiability of the basal ganglia (Fig. 2e, f).

Tables 1 and 2 show that SNR for the white matter, CSF and thalamus (grey matter) was significantly higher in T1W

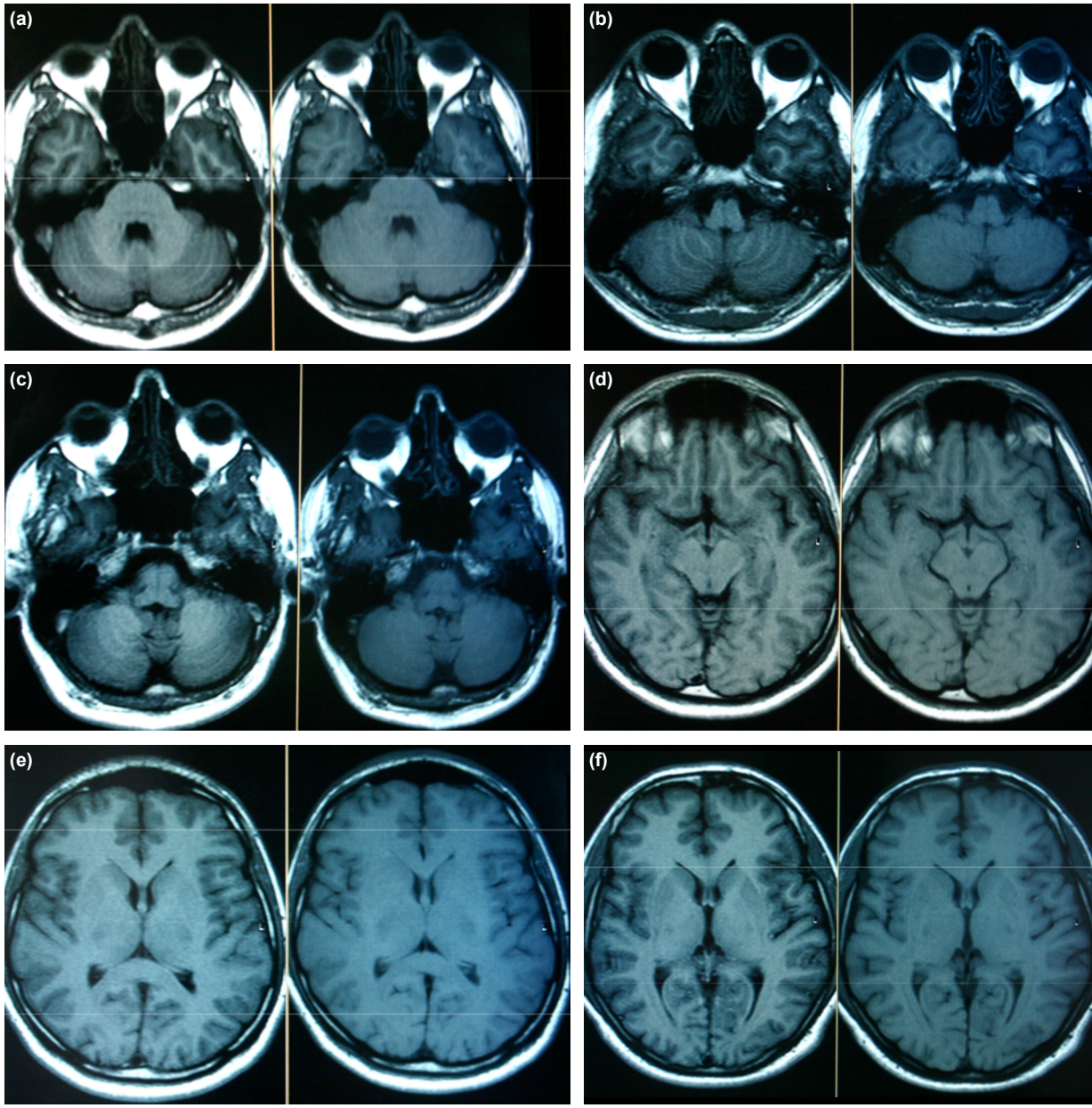

Figure 2. (a) Identifiability of cerebellum, white and grey matter structures in images of both sequences in sections at the posterior fossa level. **(b)** The image quality of both sequences in sections at the posterior fossa level. **(c)** Identifiability of 7th and 8th nerves in images of both sequences in sections at the posterior fossa level. **(d)** Grey-white matter contrast in images of both sequences in sections at the mesencephalon level. **(e)** Identifiability of basal ganglia structures in images of both sequences in sections at the thalamus level. **(f)** Identifiability of basal ganglia structures in images of both sequences in sections at the 3rd ventricle level.

SE than in T1W FLAIR according to measurements from the thalamus level (p=0.0001). Also, measurements from the same level indicated that CNR for CSF-white matter and grey-white matter was significantly higher in T1W FLAIR than in T1W SE (p=0.0001); however, there was no statistically significant difference between these two sequences for grey matter-CSF CNR.

Grey matter, white matter and CSF measurements from the posterior fossa level (Table 3, 4) indicated that SNR for CSF was significantly higher in T1W FLAIR than in T1W SE (p=0.0001). According to grey-white matter measurements from the posterior fossa level, CNR was significantly higher in T1W FLAIR than in T1W SE (p=0.006). There was no statistically significant difference between these two sequences for grey matter-CSF and white matter-CSF CNRs measured from the posterior fossa level.

The identifiability of the anatomic structures was significantly higher in T1W rapid FLAIR sequence than in T1W SE (p<0.0001) (Table 5).

The statistical evaluation of the overall image quality-artefact (Table 6) showed that the mean artefact value of T1W rapid FLAIR sequence was lower than T1W SE but not statistically significant (p=0.443).

Table 2. The mean values of CNR and SNR measurements at the thalamus level and comparative p values of T1-weighted SE and T1-weighted rapid FLAIR sequences

n=30	Mean±SD	p-value
CNR (WM - GM) $_{SE}$	5.71±5.29	
CNR (WM - GM) $_{FLAIR}$	14.18±6.9	0.0001
CNR (WM - CSF) $_{SE}$	114.50±15.30	
CNR (WM - CSF) $_{FLAIR}$	122.72±18.44	0.0001
SNR (WM) $_{FLAIR}$	130.64±17.19	
SNR (WM) $_{SE}$	200.34±23.00	0.0001
SNR (GM) $_{SE}$	194.63±22.01	
SNR (GM) ^{FLAIR}	116.46±17.67	0.0001
SNR (CSF) $_{SE}$	85.84±10.94	0.0001
SNR (CSF) $_{FLAIR}$	7.92±2.44	
CNR (GM - CSF) $_{SE}$	108.79±15.04	0.924
CNR (GM - CSF) $_{FLAIR}$	108.54±19.04	

CNR: Contrast-to-noise ratio; SNR: Signal-to-noise ratio; WM: White matter; GM: Grey matter; SE: Spin echo; FLAIR: T1-weighted rapid FLAIR sequence; SD: Standard deviation.

Table 3. The signal intensity values for grey matter, white matter and CSF at the posterior fossa level

n=30	Min–Max	Mean±SD
Air SE	11–29	16.53±4.14
Air $_{FLAIR}$	14–36.90	22.25±6.26
White matter $_{SE}$	527–967	770.3±79.58
Grey matter $_{SE}$	585–892	711.37±71.61
White matter $_{FLAIR}$	577–971	724.8±91.80
Grey matter $_{FLAIR}$	496–822	592.23±70.74
CSF $_{SE}$	284–503	367.63±52.79
CSF $_{FLAIR}$	39–204	105.03±49.01

TE: T1-weighted spin echo; FLAIR: T1-weighted rapid FLAIR sequence; SE: Spin echo; CSF: Cerebrospinal fluid; Min: Minimum; Max: Maximum; SD: Standard deviation.

DISCUSSION

The IR sequence can reset and de-signal the signal of a single tissue using an appropriate reverse cycle time.[4]

The T2W fluid attenuated IR (FLAIR) sequence, also known as the "black cerebrospinal fluid T2W sequence", in which the signal from the CSF is suppressed by the IR pulse, is widely recognised and has been added to routine MRI examination in most radiological centres.

The T2W FLAIR sequence is known to be particularly useful in the identification of the periventricular white matter, grey-white matter junction and sulcus adjacent lesions.[5] The T2W FLAIR sequence suppresses the CSF signal and the high TE values used increase the T2 weight.[6]

The FLAIR sequence has a higher signal ratio between the lesion and the ground compared to T2W examination; therefore, lesions having intensity close to CSF that are normally not apparent, become apparent on the attenuated CSF background.[7] This sequence is known to increase the contrast of the supratentorial lesions to be more pronounced in areas adjacent to CSF compared to T2W SE.[8–10] The T2W FLAIR sequence increases the sensitivity in T2W sequences even more than the T2-long lesions and makes the lesions more prominent. In contrast, some of the low-contrast lesions in T2W sequences are further reduced in the T2W FLAIR sequence.[11] In the STIR sequence, prolonged T1 and T2 relaxation times show a synergistic effect and increase the contrast of the lesions with moderate T2 relaxation time.[12]

Table 4. The mean values of CNR and SNR measurements at the posterior fossa level and comparative p values of T1-weighted SE and T1-weighted rapid FLAIR sequences

n=30	Mean±SD	p-value
CNR (WM-GM) $_{SE}$	14.21±10.77	
CNR (WM-GM) $_{FLAIR}$	21.18±11.19	0.006
SNR (WM) $_{SE}$	185.68±19.18	
SNR (WM) $_{FLAIR}$	113.63±11.44	0.0001
SNR (GM) $_{SE}$	45.95±10.74	
SNR (GM) $_{FLAIR}$	94.60±11.30	0.0001
SNR (WM) $_{SE}$	185.68±19.18	
SNR (WM) $_{FLAIR}$	115.78±14.67	0.0001
SNR (GM) $_{SE}$	171.471±17.26	0.0001
SNR (GM) $_{FLAIR}$	94.61±11.30	
SNR (CSF) $_{SE}$	88.62±12.72	0.0001
SNR (CSF) $_{FLAIR}$	16.78±7.83	
CNR (GM-CSF) $_{SE}$	82.85±20.68	
CNR (GM-CSF) $_{FLAIR}$	77.83±14.25	0.0001
CNR (WM-CSF) $_{SE}$	97.06±24.79	
CNR (WM-CSF) $_{FLAIR}$	99.01±18.15	0.613

CNR: Contrast-to-noise ratio; SNR: Signal-to-noise ratio; WM: White matter; GM: Grey matter; SE: Spin echo; FLAIR: T1-weighted rapid FLAIR sequence; SD: Standard deviation.

Conventional contrast T1W SE examination plays a critical role in the diagnosis of central nervous system diseases.[12] Studies in a limited number of patients have shown that contrast-enhanced T2W FLAIR examination is more successful than the contrast-enhanced T1W SE sequence in the diagnosis of diseases located in leptomeningeal and subcortical regions. Also, the absence of contrast enhancement in normal vascular structures in contrast T2W FLAIR examination is another superiority it has over contrast T1W SE examination.[13–15]

Hori et al.[16] provided the fast IR pulse sequence (FIR) by adding the IR preparation pulse to the fast SE (FSE, TSE) sequence and using the appropriate time of inversion (TI) to suppress the signal values from the CSF. In our study, we used the T1W rapid FLAIR sequence applying a similar method.

Table 5. The identifiability scoring and p values of anatomical structures for T1-weighted rapid FLAIR and T1-weighted SE sequences

		T1/FLAIR			Total
		2	3	4	
T1/SE	0	1	0	0	1
	1	1	13	0	14
	2	1	12	2	15
Total	3	25	2	30	
	n	**Min**	**Max**	**Mean±SD**	**p-value**
T1/SE	30	0	2	1.43±0.568	<0.0001
T1/FLAIR	30	2	4	2.97±0.414	

FLAIR: T1-weighted rapid FLAIR sequence; SE: Spin echo; Min: Minimum; Max: Maximum; SD: Standard deviation.

Table 6. General image quality-artefact scoring values and p values for T1-weighted rapid FLAIR and T1-weighted SE sequences

		T1/SE		Total	
		0	1		
T1/FLAIR	0	3	12	15	
	1	3	9	12	
	2	2	1	3	
Total		8	22	30	
	n	**Min**	**Max**	**Mean±SD**	**p-value**
T1/FLAIR	30	0	2	0.60±0.67	0.443
T1/SE	30	0	1	0.73±0.45	

FLAIR: T1-weighted rapid FLAIR sequence; SE: Spin echo; Min: Minimum; Max: Maximum; SD: Standard deviation.

In our study, while the duration of the T1W SE sequence was 3.11 min, the duration of the T1W rapid FLAIR sequence was 2.44 min and it was obtained in a shorter time than SE. IR sequences using conventional MR technology have proven to be useful for fat-suppressed image (known as STIR and T2W FLAIR for fluid-suppressed imaging) for optimising the contrast of grey-white matter in the brain.[1]

Melhem et al.[3] reported that the T1W FLAIR sequence was superior in demonstrating spinal cord lesions in their study involving a heterogeneous patient group in which they compared the T1W SE and T1W rapid FLAIR sequences in the cervical vertebral column. In that study, TI and TR pairs that suppressed the signal from CSF were produced, and fatty marrow-abnormal tissue contrast was optimised and the strong T1 weight continued. They also selected the lowest TE recommended by the authors to optimise the identification of the lesion in spinal imaging. The results of the study showed that the T1W rapid FLAIR sequence had certain advantages like reflecting increased image contrast and facilitating accurate diagnosis.[3] The FLAIR sequence is a valuable modality in spinal T1W imaging.

In the study of 13 patients with primary or metastatic brain tumours, using a low magnetic field (0.5T) MR system, authors compared T1W FLAIR imaging and T1W SE sequences utilizing approximately the same imaging time and in the same examination session.[16] In the Following the intravenous contrast agent, T1W FLAIR and T1/SE images were taken with the same slice thickness, spatial resolution and cross-sectional range.[16] T1W SE and T1W FLAIR images were compared by the same neuroradiologist for qualitative analysis and the lesion clarity, presence of image artefacts and complete image contrast were evaluated in 5 degrees. Both T1W SE and T1W FLAIR imaging lesions were demonstrated in all patients. As predicted, T1W FLAIR provided increased grey-white matter CNR and CSF-white matter CNR compared to T1A/SE imaging. Another remarkable finding was that the blood vessels characteristically did not show enhancement in the T1W FLAIR examination. As expected, in means of lesion-white matter and lesion-CSF CNR values, T1W FLAIR examination provides statistically superior imaging contrast compared to T1W SE images, due to the high contrast provided by the IR technique. In addition, T1W FLAIR provided better grey-white matter and white matter-CSF CNR than T1W SE. In conclusion, based on all the criteria, T1W FLAIR examination was found to be superior in this study.[16]

In our study, we compared only normal anatomical structures qualitatively and quantitatively for both sequences. Similarly, we found superior identifiability and CNR values in T1W FLAIR imaging. Generally, T1W FLAIR and T1W SE imaging protocols produced comparable artefacts.

Previous studies reported that artefacts in T1W FLAIR examination did not cause confusion in the interpretation of the images.[17] In our study, we detected CSF flow artefact in three patients in the fourth ventricle of the posterior fossa on T1W FLAIR images, although it was not statistically significant.

Another contrast comparative study found in the literature was conducted by Zhou et al.[11] According to the results of this study, these two MR imaging sequences had a statistically significant difference in the detection of lesions in different localisations. SGO did not show a statistically significant difference between both sequences. In our study, when the SGO values of the normal anatomical structures were compared, the T1W SE sequence was superior. The authors stated that the T1W FLAIR sequence had advantages, especially in terms of contrast ratios between the lesion and the ground.[11] This finding also coincides with our results.

Although the contrast-enhanced T1W SE sequence is useful in detecting tumour localisation and lesions and evaluating the response to treatment, this method has limitations in definitive diagnosis. For example, this technique may be insufficient to detect lesions adjacent to the lateral ventricle or localised in the cortical areas.[18]

Another finding is that the contrast-enhanced T1W FLAIR examination is not as valuable as the T1W SE examination if the pre-contrast T1W FLAIR examination detects large oedema and high tumour signal intensity.[11,18] The contrast T1W FLAIR sequence gains value when added to contrast T1W SE imaging and the routine use before and after contrast media is useful in detecting superficial lesions. On the other hand, contrast T1W FLAIR examination and contrast T1W SE examination complement each other in the detection of intracranial tumours. Especially for cerebral metastasis and the follow-up of brain tumours after treatment, the enhanced T1W FLAIR sequence should be chosen as a routine MR sequence.[19] When evaluated together with the information in the literature, the necessity of the T1W FLAIR sequence may be even more important, especially for the imaging of cortical areas and CSF neighbouring regions.

CONCLUSION

In our study, we obtained the following results from quantitative measurements in T1W FLAIR images that we obtained in a shorter shooting time than in T1W SE: the SNR values for the grey and white matter obtained from the equivalent localisations for two sequences from the level of the posterior fossa and thalamus were significantly higher in T1W SE than in T1W FLAIR. For T1W FLAIR, grey-white matter CNR at the level of the posterior fossa and thalamus and white matter-CSF CNR at the level of the thalamus were statistically superior to that of T1W SE. No significant difference was found in the other measured CNR values. The T1W FLAIR sequence specifically enhances image contrast and identifiability between the different anatomical structures. Although the T1W FLAIR sequence was superior in terms of image quality in qualitative evaluations, no significant difference was found between the two sequences in terms of the presence of artefacts. With all these findings, we think that the T1W FLAIR sequence is superior to the T1W SE in terms of anatomical imaging of the brain. When evaluated together with the information in the literature, the necessity of the T1W FLAIR sequence may be even more important, especially for the imaging of cortical areas and BOS neighbouring regions. Considering the shorter shooting times in the T1W FLAIR sequence, we think that the T1W FLAIR sequence may not be a suitable substitute for SE examination in routine T1W MR imaging of the brain, although it may be valuable. In our opinion, there is a need for further studies to be conducted with a larger number of patients and healthy control groups and the widespread use of advanced MR systems.

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Ethics Committee Approval

This study approved by the Zonguldak Karaelmas University Ethics Committee (Date: 21.09.2006, Decision No: 2006/06).

Informed Consent

Retrospective study.

Peer-review

Internally peer-reviewed.

Authorship Contributions

Concept: S.G.A., E.A.; Design: S.G.A., E.A.; Supervision: S.G.A.; Fundings: S.G.A.; Materials: E.A.; Data: S.G.A., E.A.; Analysis: S.G.A., E.A.; Literature search: E.A.; Writing: E.A.; Critical revision: S.G.A., E.A.

Conflict of Interest

None declared.

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Beynin Anatomik İncelemesinde T1-Ağırlıklı Flair ve T1-Ağırlıklı Spin Eko Puls Sekanslarının Karşılaştırılması

Amaç: Bu çalışmanın amacı, T1-ağırlıklı (T1A) FLAIR (sıvı atenüasyon inversiyon geri kazanımı) görüntülemenin rutin beyin manyetik rezonans (MR) incelemesindeki değerini araştırmak; ayrıca T1A spin-eko (SE) ve hızlı T1A FLAIR sekansları anatomik yapıların tanımlanabilirliği ve görüntü kalitesi açısından karşılaştırmaktı.

Gereç ve Yöntem: T1A SE ve hızlı T1A FLAIR sekansları, 30 sağlıklı olguda anatomik yapıların tanımlanması, genel görüntü kalitesi ve artefaktların varlığı açısından kalitatif ve kantitatif olarak analiz edildi. Sinyal-gürültü oranı (SNR) ve kontrast-gürültü oranı (CNR) değerleri, arka çukur ve talamus seviyelerindeki gri madde, beyaz madde ve beyin omurilik sıvısı dahil olmak üzere eşdeğer lokalizasyonlardan iki dizinin sinyal yoğunluğu değerleri alınarak belirlenmiştir.

Bulgular: SNR değerleri T1A SE'de T1A FLAIR sekanslarına göre talamus ve arka çukur düzeyinde anlamlı olarak yüksekti ($p<0.001$). Talamik seviyedeki ölçümler, beyin omurilik sıvısı-gri madde ve gri-beyaz madde için T1A FLAIR CNR değerlerinin T1A SE'ye göre anlamlı olarak daha yüksek olduğunu gösterdi ($p=0.0001$). Arka çukur düzeyindeki ölçümler, gri-beyaz madde için T1A FLAIR CNR değerlerinin T1A SE'ye göre anlamlı olarak daha yüksek olduğunu gösterdi ($p=0.006$).

Sonuç: Bu çalışmada, beynin T1A görüntülemesinde, T1A FLAIR sekansının CNR değerleri açısından kalitatif ve kantitatif değerlendirmelerde T1A SE'den üstün olduğunu bulduk. Bununla birlikte, SNR değerleri T1A SE görüntülemede daha yüksek bulundu.

Anahtar Sözcükler: Beyin anatomisi; manyetik rezonans görüntüleme; T1A FLAIR; T1A SE.