Journal of Neuroradiology (2017) 44, 57—64

Available online at ScienceDirect www.sciencedirect.com

Elsevier Masson France EM|consulte www.em-consulte.com/en

CORRESPONDENCES

Atypical intracranial artifacts caused by dreadlocks during brain Magnetic Resonance Imaging: Keep calm and recognize them

Introduction

Artifacts in magnetic resonance imaging (MRI) are widely known and discussed [1,2]. They are divided into three groups: image reconstruction-related artefacts, system-related artifacts, and physiology-related source artifacts. The most frequent artifacts encountered during clinical practice are motion artifacts, aliasing artifacts, chemical shift artifacts, and magnetic susceptibility artifacts [3—5].

Among patients with dreadlocked hairstyles, we encountered an unusual and undescribed artifact with 3D spin echo (SE) T1 and 3D fluid-attenuated inversion recovery (FLAIR) weighted imaging (WI) intracranial hyperintense lesions. We tried to identify and describe this artifact.

Technical note

We reported on eight patients from a single center whose brain MRIs showed artifacts, ostensibly due to their hairstyles. This study has been approved by our institutional research ethics board. Patient informed consent was waived due to the retrospective nature of the study. Table 1 shows the patients' demographic and clinical characteristics.

MRI exams were performed with a 3T Philips Ingenia for six patients and a 1.5Tesla Philips Achieva imager with a 32-channel head coil (Philips Medical Systems, Best, The Netherlands) for two patients. Characteristics of the main sequences are presented in Table 2.

Six patients presented with intracranial hyperintense abnormalities on post-contrast 3D-SE T1-WI including four punctiform hyperintense abnormalities (Figs. 1 and 2) and two lace-like hyperintense abnormalities (Fig. 3). All patients presented with supratentorial signal abnormalities, involving deep white matter and the cortex. Two patients had infratentorial abnormalities involving the cerebellum or the pons. These hyperintense abnormalities could be seen on pre-contrast imaging in three patients, but were not distinguishable in the two others (Fig. 4). One patient did not have a pre-contrast T1-WI sequence. The abnormalities were not visible on other MRI sequences, except in FLAIR sequences for one patient (Fig. 5). In this patient, the FLAIR and 3D-SE T1-WI intracranial hyperintense abnormalities presented with the same pattern, but at different locations, the latter being deeper in the brain. None of the patients with additional 3D gradient echo (GE) T1-WI presented with these abnormalities. We observed the artifact in a patient who changed hairstyles over the course of two MRI's. When the hair was styled close to the scalp, no intracranial hyperintense abnormality could be observed, but once dreadlocks were in place, MRI showed punctiform hyperintense abnormalities projecting inside the brain when reading results.

When adjusting the range of the signal intensity, the MRI showed hyperintense structures corresponding to the dreadlocks outside and around the skull in all eight patients, including the two without any intracranial abnormalities.

We performed additional T1-WI sequences with different parameters on two patients in order to understand the origin of these probable artifacts. By decreasing the acceleration factors, the artifacts completely disappeared. By changing the direction of the acceleration factors, the location of the intracranial artifacts changed. For all patients we measured the distance between the extracranial 3D-SE T1-WI hyperintense abnormalities corresponding to the dreadlocks and the intracranial signal abnormalities. This distance was always equal to the FOV/Acceleration Factor value result, suggesting that the intracranial 3D-SE T1-WI hyperintense abnormalities observed were a simple projection of the extracranial 3D-SE T1-WI hyperintense dreadlocks (Fig. 6). MRI findings are shown in Table 3.

Abbreviations: MRI, magnetic resonance imaging; WI, weighted imaging; SE, spin echo; GE, gradient echo; FLAIR, fluid-attenuated inversion recovery; DRA, dreadlocks-related artifacts.

Table 1 Patients' demographic and clinical characteristics.

Number of patients	8
Sex (female/male)	4/4
Median age (years) [range]	29 [19—42]
MRI indication	
Exploration of neurological symptoms	6
Exploration of ocular symptoms	2
Clinical symptoms	
Headache	5
Dizziness	1
Papillary edema	1
Decreased visual acuity	1
Final diagnosis	
No abnormal findings	5
Idiopathic intracranial hypertension	1
Cortical venous thrombosis	2

Discussion

We reported on the cases of eight patients presenting with challenging intracranial MRI dreadlocks-related artifacts (DRA), including six patients with intracranial punctiform or lace-like hyperintense abnormalities on 3D-SE T1 and 3D FLAIR-WI.

DRA have been previously described in two case reports with descriptions of a so-called ''aura sign'' [6,7]. This was described as an unusual appearance around the skull, with striking image distortions arising from susceptibility artifacts. Such abnormalities were explained by the presence of iron oxide particles inside the black beeswax used to style dreadlocks. However, this aura sign was never seen inside the parenchyma but was limited to the outer side of the skull. Thus, it did not alter the radiologists' diagnoses. None of our patients had this 'aura sign'. On the contrary, DRA were visible inside the brain parenchyma in six patients in our study. These artifacts have never been described in the literature to the best of our knowledge.

DRA were consistent with aliasing artifacts, observed when the dimensions of the explored volume are bigger than the defined field-of-view [3]. The extent of the artifacts was therefore related to the hairstyle, with more striking signal abnormalities in patients with longer dreadlocks. DRA were mainly seen on the pre- or post-contrast 3D-SE T1-WI. We hypothesized that it might be a consequence of the use of acceleration factors (sense factors), since the use of acceleration factors imposes an aliasing to the resulting MR image [8,9]. Concerning a sagittal 3D acquisition, which is preferentially performed during our 3D acquisitions, artifacts can be observed along the two phase encoding directions of the sequence. So, when using an in-plane acceleration factor, aliasing artifacts will occur in anterior-posterior encoding directions, while applying a through-plane acceleration factor projects artifacts along the left-right encoding directions [8,9]. Thus, our hypothesis was confirmed by the additional sequences we performed in two patients in which the artifacts disappeared after decreasing

Table 2 Characteristics of the main MRI sequences at 3T and 1.5T.

At 3T	Sagittal T1-WI	Pre-contrast 3D-SE T1-WI	Post-contrast 3D-SE T1-WI	3D FLAIR-WI
TR (ms)	350	350	350	8000
TE (ms)	27.325	27.839	29.275	354.729
FOV (mm)	100 × 184	100 × 392	82.6 × 223	100 × 223
Thickness (mm)	3	1	1	1.2
Gap (mm)	0	0	0	0
Bandwidth (Hz)	929	863	925	1024
Number of excitations	2	2	2	1
Number of slices	54	352	352	304
In-plane acceleration factor (Sense S)	1.5	2	2	2.2
Through-plane acceleration factor (Sense P)	2	2	2	3
At 1.5T	**Sagittal T1-WI**	**Pre-contrast 3D-SE T1-WI**	**Post-contrast 3D-SE T1-WI**	**3D FLAIR-WI**
TR (ms)	632.1	400	400	5500
TE (ms)	14	9.3	9.3	337.6
FOV (mm)	167 × 192	162 × 208	162 × 208	164 × 200
Thickness (mm)	5	1.2	1.2	1.3
Gap (mm)	1	0.6	0.6	0.65
Bandwidth (Hz)	280	835	835	755
Number of excitations	2	2	2	1
Number of slices	20	300	300	288
In-plane acceleration factor (Sense S)	1.5	1.2	1.2	1.5
Through-plane acceleration factor (Sense P)	2	2	2	2

WI: weighted imaging; SE: spin echo; FLAIR: fluid-attenuated inversion recovery; ms: milliseconds; mm: millimeters; Hz: Hertz.