



# A Potential Pitfall in Brachial Plexus Magnetic Resonance Imaging: Better Blood Vessel Suppression Can Lead to Lesion Suppression

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## Abstract

### Keywords

- ▶ brachial plexus
- ▶ gadolinium
- ▶ magnetic resonance imaging
- ▶ short tau inversion recovery

It has been increasingly popular to acquire short tau inversion recovery (STIR) images in brachial plexus magnetic resonance imaging after injection of a gadolinium-based contrast medium in order to improve blood vessel suppression. This example highlights the potential pitfall that the signal of plexus lesions and anatomical structures such as the dorsal root ganglia can be suppressed in gadolinium-enhanced STIR compared with nonenhanced STIR images.

Recent recommendations for brachial plexus magnetic resonance imaging (MRI)<sup>1–3</sup> emphasize suppressing the signal originating from adjacent blood vessels by performing a short tau inversion recovery (STIR) sequence after injecting intravenous gadolinium (IV-Gd). This improves the contrast-to-noise ratio (CNR) of the plexus compared with the background.<sup>4</sup> It is thus useful for visualizing the anatomical course of the plexus. Here, we highlight a potential pitfall of this popular vessel suppression approach, particularly relevant for clinicians used to viewing STIR images for fast screening for plexus pathology.

The widely used STIR sequence, one of several techniques for fat saturation, helps in detecting areas of interstitial edema. However, STIR does not specifically suppress the signal from

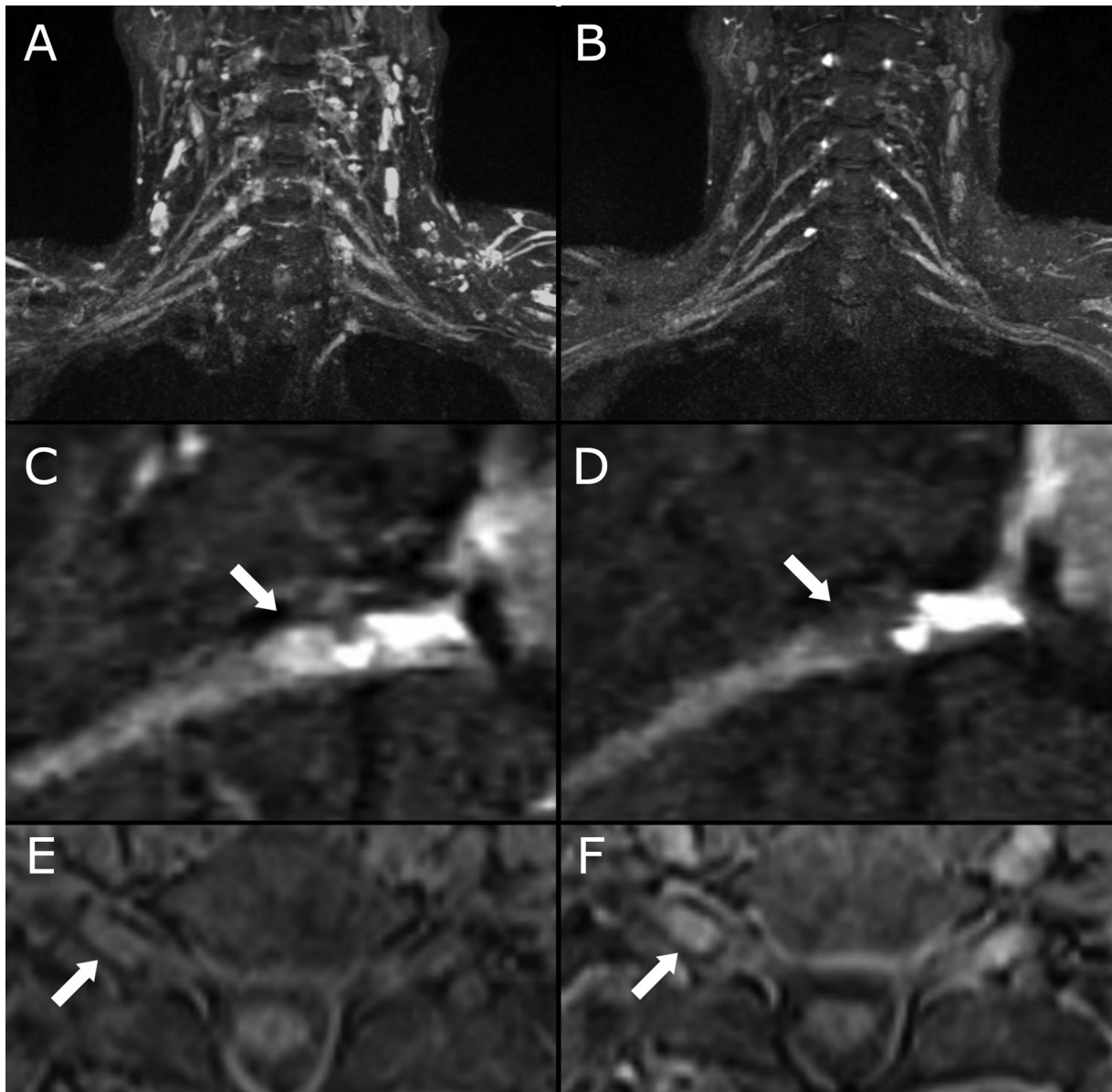
fat. Rather, it suppresses signal from any tissue with a short T1-value of around 150 to 200 ms.<sup>5</sup> Due to the similarity of T1 in fat and contrast-avid tissues after application of IV-Gd, there is a well-established possibility that the increased STIR signal of a pathology would be nullified due to the concomitant uptake of IV-Gd by the same pathology.<sup>5</sup> This reduces the STIR signal after injecting IV-Gd in areas with increased contrast enhancement (CE).<sup>6</sup> This would reduce the ability to detect pathological changes with concurrent edema and CE, which are both generally associated with pathologies.<sup>1</sup>

▶ **Fig. 1** highlights this potential pitfall in the case of examinations of the plexus with the help of an analogy: the physiological CE (due to the lack of a blood–nerve

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**Fig. 1** Example highlighting an interpretational pitfall following a recently popular modification of brachial plexus MRI protocols: 3D STIR imaging (Siemens Magnetom Sola 1.5T, repetition time: 4,000 ms, echo time: 251 ms, inversion time: 160 ms) of the brachial plexus before (A, C) and after (B, D) injection of Gd in a patient without brachial plexus pathology. The maximum intensity projections (A, B) highlight the improved vessel suppression and consequently improved clarity of the anatomical course of the plexus. The detailed views (C, D) show decreased signal intensity of a dorsal root ganglion (arrows) in the image acquired after Gd injection (D). T1 VIBE Dixon water images before (E) and after (F) Gd injection showing physiological enhancement of the ganglion (arrows).

barrier<sup>7</sup>) and nonenhanced STIR hyperintensity of the cervical dorsal root ganglia.<sup>8</sup> The ganglia thus exhibit a physiological signal behavior which is otherwise expected in focal pathological (e.g., inflammatory) lesions of the plexus.<sup>1</sup> As explained earlier, a relative signal loss from the dorsal root ganglia is to be expected in an STIR post IV-Gd even in the absence of pathological changes. The corresponding example in the figure can help understand the potential to overlook pathological changes due to inadvertent signal loss of contrast-enhancing lesions in the STIR sequence.

This pitfall of a potentially reduced sensitivity for focal lesions within the plexus, despite overall better plexus visualization has received little attention in recent articles dealing with brachial plexus MRI.<sup>1,3,9-11</sup> In particular, there is a risk of completely missing a true pathology if either the STIR before Gd is not acquired or STIR is used for a fast identification of plexus disease in clinical care situations outside full radiological reporting. On the other hand, if kept in mind, this behavior might serve as an additional marker for contrast uptake in T1-hyperintense tissue.

It is recommended that plexus MRI sequences are interpreted in a particular order, first looking for focal edema in STIR before Gd and then looking for a pathological CE in the fat-saturated T1-weighted images. In this way, the likelihood of missing out on masked pathologies could be significantly reduced. Despite these limitations, we do, however, believe that CE 3D STIR is of high value for assessing the anatomical course of the plexus and differentiating the plexus from adjacent vascular structures.

#### Authors' Contributions

V.C.: idea, original draft. C.M.: supervision, revision for important content. H.B.: idea, supervision, revision for important content. B.S.: idea, supervision, revision for important content, figure preparation.

#### Ethical Approval

Ethical approval is not applicable (clinical case/routine image, no original research).

#### Patient's Consent

The patient provided written informed consent for the publication of the image. However, no potentially identifying information is provided in the figure or text.

#### Conflict of Interest

C.M.: Consulting and lecturing for Siemens on behalf of the employer (Evangelisches Krankenhaus Oldenburg). The other authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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