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A plea for the T2W MR sequence for pituitary imaging

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To the Editor,

I am frequently called upon as a reviewer by endocrinology journals due to my experience in pituitary magnetic resonance (MR) image interpretation [1]. I feel compelled to highlight some continuing problems in image choice and quality that severely limits scientific analyses, despite the significant technological advances over the past decade. The principal problem- as I see it- is that at the sellar level, almost all images selected for figures are T1-weighted (T1W) images with gadolinium infusion, while T2-weighted (T2W) images are almost always absent. The performance of T2W MR has been improved enormously, particularly at 3.0 T, but also at 1.5 T. T2W images, if optimized, are frequently more informative and gadolinium enhanced T1W images can be spared in some conditions.

In contrast to the general rules for brain MR imaging, i.e. the use of a large number of sequences, pituitary gland MRI protocols need to be adapted to the clinical situation and a limited number of high-resolution sequences can be sufficient. Even if it is obvious that gadolinium-based contrast agents (GBCAs) have revolutionized MRI examinations by demonstrating lesions otherwise undetectable, their systematic use as a standard protocol for any pituitary region evaluation needs to be revised. Moreover, we now know that gadolinium retention has been observed particularly in the brain, after administration of GBCAs, even in individuals with normal renal function. While such retention has not yet been deemed to be harmful, the U.S. Food and Drug Administration (FDA) recommends limiting GBCA injection to circumstances in which additional information provided by the contrast agent is necessary. More recently, Levine D. et al. recall that "the risks of the test must be weighed against the need for diagnosis and appropriate management" [2]. This restrictive approach can made MRI exams shorter, safer and less expensive and is of particular relevance in countries with emerging economies.

I will present here some conditions (1) where the T2W sequence is sufficiently informative and gadolinium injection can be avoided and (2) where the T2W sequence is more informative that the T1W gadolinium enhanced sequence.

In current practice, *hyperprolactinemia* in women is the leading indication for an MRI of the pituitary. The diagnosis of prolactinoma is usually simple following the interpretation of clinical and hormonal data and MRI is only requested to confirm the diagnosis. There is generally a good correlation between prolactin levels and tumor size and treatment is medical. Most microprolactinomas in women are more or less hyperintense on T2. Gadolinium injection is usually not necessary if the T2W sequence identifies the adenoma (Fig. 1a). After cabergoline treatment, if an MRI is requested, microprolactinomas demonstrate a more T2 hyperintense signal, and hence are even more evident. Gadolinium injection should be reserved for the cases where the diagnosis is not obtained after the nonenhanced T1 and T2W MR sequences.

Nonfunctional pituitary adenomas (NFPA) are frequently discovered by chance and are often managed conservatively in the absence of optic chiasm impingement. *Silent corticotrope pituitary adenomas* account for 13% of NFPA; they may be aggressive and more prone to recurrence and require more active management than other NFPA. Their diagnosis cannot be made with gadolinium enhanced T1W images while the T2W MR sequence demonstrates a characteristic microcystic pattern (Fig. 1b) in more than 50% of the cases.

The investigation of *somatotropinomas* also benefit from of T2W MR. T2 hypointense GH-secreting adenomas (Fig. 1c) are similar to densely granulated tumors, as they more rarely have cavernous sinus invasion than T2 hyperintense adenomas and have a better response to first generation somatostatin receptor ligands [3]. The differences between probably densely and sparsely granulated somatotropinomas cannot be made on T1W images either without or with gadolinium injection. Moreover, T2 sequence is in many cases

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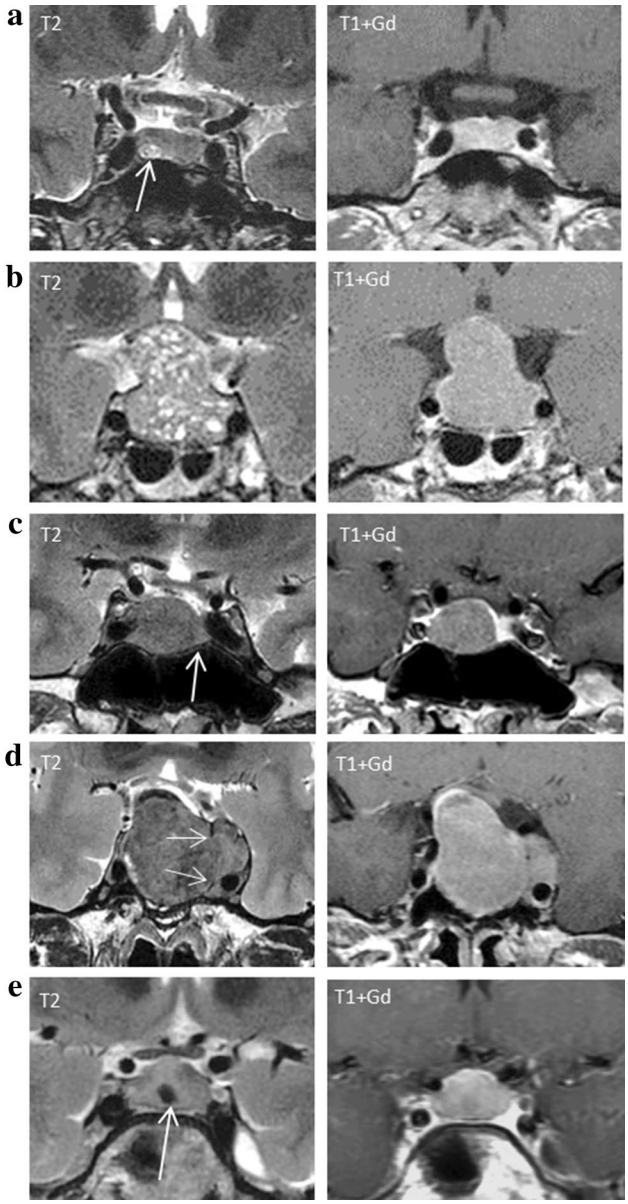

Fig. 1 T2W (left) and T1W gadolinium enhanced (right) images. **a** T2 hyperintense microprolactinoma. **b** microcystic pattern of a silent corticotropic pituitary adenoma. **c** T2 hypointense somatotropinoma (as compared with normal pituitary gland, arrow). **d** left cavernous sinus invasion demonstrated by rupture of the dural medial wall of cavernous sinus (arrows). **e** Rathke cleft cyst (hyperproteic T2 hypointense nodule, arrow)

able to demonstrate the dural medial wall of cavernous sinus, what is of major importance for the diagnosis of *invasion of cavernous sinus* (Fig. 1d).

An increasing number of cases of *hypophysitis* due to cancer *immunotherapy* or *IgG4-related hypophysitis* is reflected in the recent medical literature. The typical signs initially described with lymphocytic hypophysitis are rarely found. In these conditions, MRI can show debatable nonspecific signs (normal sellar size, slight symmetrical volume change, strong gland enhancement and stalk thickening). While it has been stated that a normal MRI does not eliminate the diagnosis of hypophysitis, however the potential contribution of T2W MR is almost never highlighted [4]. As T2W signal generally represents a good marker of inflammation, it is logical that T2 hyperintensity of the pituitary gland is seen in hypophysitis, further emphasizing the utility of T2W sequences.

Rathke's cleft cyst (*RCC*) is the most frequent incidentaloma after nonfunctioning pituitary adenomas. Although RCC give a variable signal on T1W and T2W images, the presence of T2W hypointense proteinic nodules (Fig. 1e) in about 70% of RCC represents a pathognomonic sign that is invisible on gadolinium enhanced T1W images. If the lesion is recognized and is not symptomatic, gadolinium injection can be spared and reserved for the demonstration of a thickened cyst wall in symptomatic patients.

The prominence of appropriate pituitary imaging in endocrinology journals should be increased, particularly the clinical value of T2W sequence. The readership should also be warned that unrestricted use of gadolinium injection as part of standard protocols for pituitary imaging must be reconsidered. While the effect of this may be to push my fellow neuroradiologists out of our routine when performing a pituitary MRI, but the advantages outlined above are significant and outweigh the inconvenience.

The role of medical journals is scientific and educational and they should aim to disseminate the most up to date information. As reviewers, endocrinologists should not be expected to check the relevance of imaging choices and the quality of illustrations presented in pituitary related studies papers. Increasing the involvement of expert pituitary neuroradiologists in endocrinology journal peer-review could be helpful in addressing these issues.

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Compliance with ethical standards

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Ethical approval This article does not contain any studies with human participants performed by the author.

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