CLINICAL EXPERIENCE OF THE USE OF GADOLINIUM CONTRAST AGENTS FOR T1-WEIGHTED 3D HIGH RESOLUTION NEUROLOGICAL IMAGING

T. L. Watson[1], U. Estenberg[1], and M. Kristoffersen Wiberg[2]

[1]Department of Medical Physics, Karolinska University Hospital, Huddinge, Stockholm, Sweden, [2]CLINTEC, Karolinska Institutet, Stockholm, Sweden

Introduction: Gd contrast agents (Gd-CA) are commonly used for imaging neurological tumours. This is typically performed using a relatively thick slice width (5 mm) in 2D imaging since there is some debate as to whether the MPRAGE can be used in such a manner. However, results presented here show that Gd-CA can also be used to enhance lesions in 3D high resolution imaging. The authors are not aware of any other published work on this topic and suggest it is very useful for routine clinical work.

Method: A Siemens Avanto scanner was used to acquire the patient images. The MPRAGE sequence was acquired in the coronal direction using a TI 1100 ms, TR 1910 ms, TE 3.93 ms, FA 15°, voxel size 1.4 × 1.4 × 1.4 mm^3. To reduce scan time and minimise the likelihood of motion artefacts the images were acquired using the GRAPPA technique of parallel imaging with acceleration factor 2. After the first MPRAGE scan 0.2 ml per kg of Gd-CA was injected and the scan was immediately repeated.
10 consecutively scanned patients were selected in order to quantify the contrast improvement in the MPRAGE images for all lesions pre and post injection of Gd-CA. Images pre and post Gd were co-registered using the Multimodality program on the HERMES platform (Hermes Medical Solutions). Regions of interest (ROI) were drawn (i) to delineate the areas of enhancement in several slices of each lesion and (ii) around each lesion ROI in the surrounding tissue. Each ROI was then copied onto the pre Gd co-registered images for exact comparison of signal intensity. The image contrast between the lesion uptake region and the surrounding tissue could then be calculated for several slices on both pre and post Gd images. The mean tissue contrast was calculated for each identified lesion using the slices measured. The percentage change in the image contrast was determined for each lesion. The 10 patients presented with a total of 20 lesions including glioblastoma, metastases, and AVM. Figure 1 presents two lesions both pre and post injection of Gd.

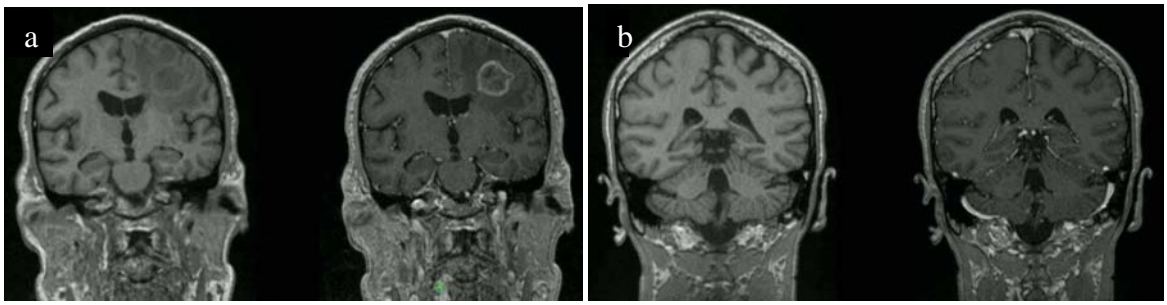

Figure 1: Glioblastoma (a) and metastesis (b) pre (left) and post (right) Gd-CA.

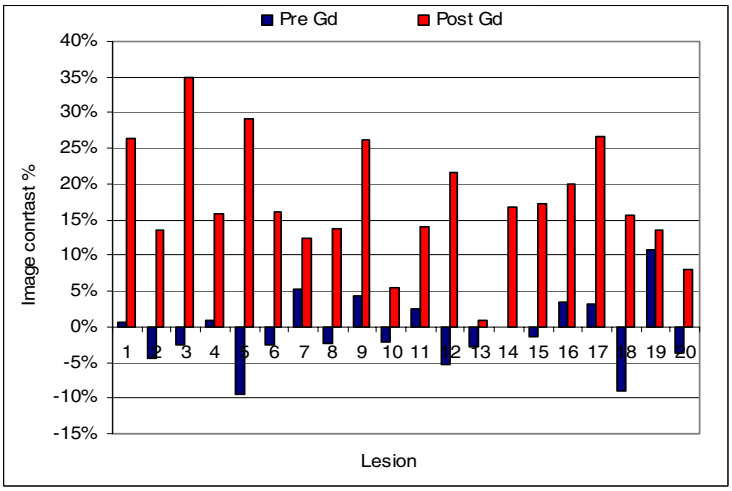

Figure 2: Image contrast for each lesion pre (blue) and post (red) Gd-CA.

Results: Figure 2 shows the image contrast for each lesion measured pre and post Gd. Pre Gd, 55% of all lesions were darker than the surrounding tissue i.e. presented with negative image contrast. The mean absolute contrast between lesion and tissue was 0.7% (st.dev 4.8%). However, post contrast all lesions presented with positive image contrast (all lesions were brighter than surrounding tissue) with a mean absolute contrast of 17.4% (st.dev 8.3%). The image contrast measured between lesion and tissue was on average 26 times better post injection of Gd. Lesions which were not detectable on pre Gd images could clearly be seen in the high resolution post Gd images as indicated in figure 1(b).

Conclusions: The use of a typical 5mm slice in 2D imaging may lead to small lesions being disguised as normal due to a combination of low uptake of Gd and partial volumes effects. However, the use of high resolution 3D imaging with Gd-CA will minimise the partial volume effect, thereby improving the accuracy of lesion detection. The high resolution imaging allows more detail to be seen of the internal structures of the tumours.

Summary: A Siemens MPRAGE sequence has been used to acquire high resolution 1.4 mm cubic voxel images both pre and post injection of Gd-CA for neurological imaging. This protocol has been in clinical use for over one year with great success. The post contrast images show positive image contrast improvement in all cases of enhancing pathology and also allow visualisation with greater structural detail than using a 2D T1-weighted sequence with Gd. Our institution is now routinely using the MPRAGE for evaluation of post Gd-CA images.