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REVIEW / *Technical*

Clinical utility and economic viability of a 3T MRI in an anti-cancer centre: The experience of the centre Oscar Lambret

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Abstract This paper will try and describe the installation of a 3T MRI in an anti-cancer centre. Functional sequences become indispensable in the assessment of targeted treatments. It is only possible to carry out these treatments on a routine basis in acceptable examination times with 3T. The technical constraints are overcome with third generation MRI and the improvement of the spatial resolution in examination times reduced by 30 to 50% increases patient comfort. Nevertheless, the financial constraints represent a major handicap. It is not possible to obtain an economic balance with rates based on the cost and depreciation of 1.5T imagers that are half the price.

3T MRI were first commercialised at the beginning of the 2000s in the United States, first with ''skull'' and then full body imagers. Since 2005—2006, the industrial offer has quickly evolved and in 2010 the main constructors proposed third generation MRI allowing for standard work in clinical practice. The literature on 3T MRI has followed the same evolution. The summary that we provided on the Pub-Med site (http://www.ncbi.nlm.nih.gov/pubmed/) on 11 January 2011 found: two to 17 articles between 1999 and 2003, 33 to 94 between 2004 and 2006 and 156 to 252 between 2007 and 2009. Most of these articles concern the neurological applications. However, since 2007, 50% of the literature concerns other domains, mainly osteoarticular, the male or female

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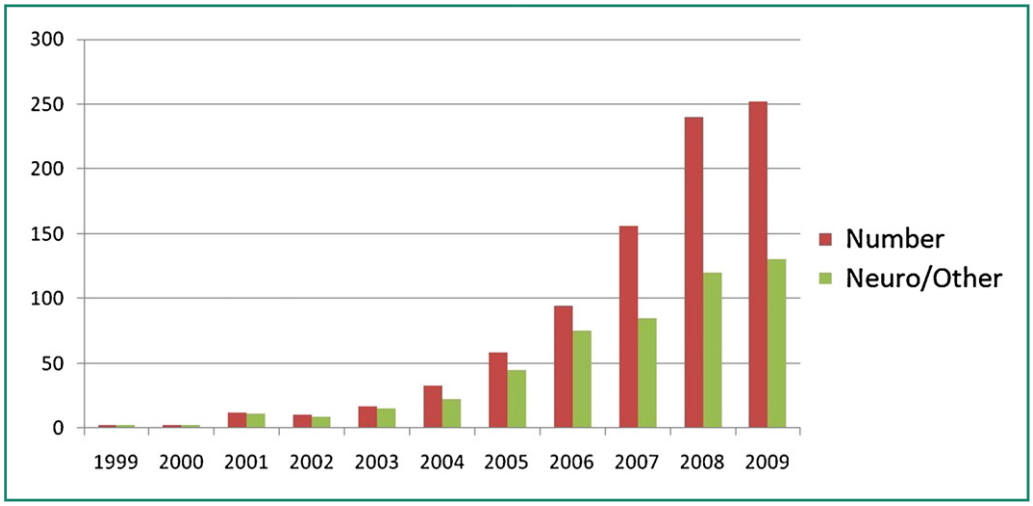

Figure 1. Number of references in the Pub-Med indexed literature and distribution by domain: neurology/other locations on 11 January 2011.

pelvis in oncology and full body diffusion imaging (Fig. 1) [1]. The theoretical advantages of the high field are [2]:

- the improvement of the signal over noise ratio, therefore a reduction in the time for acquisition and/or an increase in the spatial resolution;
- an increase in the diffusion effect (diffusion imaging and diffusion tensor);
- an increase in the magnetic susceptibility effects. This disadvantage related to MRI technology may turn out to be an advantage in certain explorations (better contrast in angiography, BOLD technique in functional MRI);
- an improvement in perfusion imaging since it is possible to work at very high temporal resolution;
- the improvement in spectroscopy imaging and a better spectral resolution. The value of spectroscopy is to visualise the different spectrums of biological metabolites as well as their concentration due to the specific resonance frequencies.

However, the disadvantages are:

- an increase in the artefacts of magnetic susceptibility, flow artefact, and chemical shift between water and fat;
- the difficulty in obtaining an homogenous magnetic field over a large volume;
- the increase in the specific absorption rate (SAR), corresponding to the calories absorbed by the tissue;
- the cost of purchase and maintenance: about twice a 1.5T imager.

The purpose of this paper is to assess the clinical benefits and analyse the economic constraints after 1 year of routine use of a 3T MRI.

Installation

Inventory

The Oscar Lambret centre is one of 19 anti-cancer centres in France. The imaging department includes a 128 section CT, two digital mammographs including one with tomosynthesis, a remote-controlled room, three sonographs and a macrobiopsy table. We have a radiologic information system (RIS), a computerised patient file and a PACS (picture archiving communication system) installed in April 2007 and have been working without film since September 2007. Nine post or senior radiologist have been budgeted, six to seven are filled on a regular basis. The department is open from 8 a.m. to 5:30 p.m., five days a week without emergency activity for section imaging. From 1996 to 2009 we have had access by convention to two 1.5T MRI installed at the Lille Regional University Hospital: 19 hours per week until 2004 then 30 hours per week. In 2009, we carried out 2738 MRI and 23 breast macrobiopsies (Fig. 2), accounting for 1.7 patients per hour of availability of the MRI. The authorities authorised the installation of a 3T MRI in September 2008. From September 2008 to January 2009, we drew up plans for the building meant to house the machine on a lot adjacent to the imaging department and on which an existing building had to be integrated, we chose the MRI and organised the reception and circulation of the patients in the centre as well as the new work-flow induced by this population for the daily work of the imaging department. We not only carry out examinations for oncology: breast screening for patients with a genetic mutation, diagnostic assessment, extension assessment, therapeutic targeting for radiotherapy, evaluation during treatment (chemotherapy, radiotherapy) and protocol monitoring of treated cancers.

Choice of the machine

After a classic invitation to tender according to the public market code, the Discovery MR750 MRI (GEMS) was chosen in January 2009.

Starting

First examinations

The work was carried out in the time allocated and the clinical use of the machine began on 6 January 2010. Based on previous experience in starting a new machine with teams of