Major debates and challenges

CT acquisition modality for routine brain CT: incremental or helical?

Until recently, helical CT has been disregarded for routine brain scanning, resulting in a paradoxical conservatism of an ‘old’ modality for brain examination and dynamic activism using cutting-edge technology combining helical acquisition mode and multi-row detectors for all other areas of the body.

Incremental scanning has remained the reference for brain imaging for such a prolonged period of time mostly because of the hypothetic loss in image quality (IQ) with helical scanning supposed to impair the diagnostic capabilities of CT in the brain. The suspicion was so deep that recent publications dealing with CT IQ ignored helical brain CT (1). A few papers from the early and mid 90’s proposed the applicability of helical technique in the brain only for angiographic purposes, and accesssorily for 3D reformatting of tumors in the limited cases in which the use of MRI was contra-indicated, or when MR systems were unavailable (2). Indeed, regarding the quality of parenchymal imaging, the low performance of first generation helical CT systems had discouraged neuroradiologists from using the helical technique for routine brain CT. A paper by Jones et al published in Radiology in 2001 made an initial breakthrough by advocating the use of the multi-slice technique for brain CT, but still with incremental acquisition mode (3). The authors demonstrated that the use a four-row detector configuration resulted in enhanced IQ in posterior fossa by dramatically decreasing the streak artifacts in the area. But at the time, the use of the spiral modality was still not considered. However, observing in our clinical practice that spiral CT using a 16-row detector configuration (16 x 0.75 mm) equipped with a high performing software option suppressing artifacts due to the cone-beam effect of higher orders detector configuration had become competitive, we prospectively compared the IQ of incremental versus spiral technique in a short cohort of patients after clearance of the study protocol by our ethic committee. As expected, preliminary findings confirmed the use of the COBRA® (Cone Beam artifact Reduction Algorithm) software option for image reconstruction to be mandatory when using a high order detector row configuration in helical mode (Fig. 1). Two trained neuroradiologists scored in a blinded way twelve IQ items in two image sets corresponding to incremental mono-slice versus incremental multi-slice techniques in a first protocol, and to incremental versus helical multi-slice images in a second one, obtained in the same patients during the same session, and using comparable acquisition parameters, except for the use of the incremental of helical mode. In addition the radiation doses delivered by the acquisition protocols were experimentally quantified and objective measurements of noise level and of low-contrast detection were performed on a standard PMMA Plexiglas phantom of 16 cm in diameter. We failed to demonstrate any significant difference in IQ for the incremental or the helical techniques, regarding both subjective scoring and objective measurements on phantom (Fig. 2). In addition the use of the helical modality resulted in a 40% lowering of the delivered radiation dose in CTDIvol-weighted values. Moreover, some attractive advantages of the helical technique were empirically experienced such as the enhanced quality of 3D reformatted images and the ability to reformat images in standard orbital-metal plane despite variable positioning of the head when images were acquired without gantry tilting. At last, the appropriate use of a set of cushions to be put under patient’s neck enabled the acquisition of native images in an orbital-metal-like plane together with the ability to shift eye lenses outside the acquisition volume, and that of shifting the projection of dental material related material artifacts on the neck instead of the posterior fossa. We concluded that the IQ superiority of the incremental technique had reached obsolescence as well as the need for the CT systems manufacturers to maintain a gantry tilting option for cerebral imaging purpose. Another study published this year reached similar conclusion (5). In practice, up-to-date systems equipped with appropriate software for artifact reduction should be used for routine helical CT scanning.

Brain MR imaging: 3.0 versus 1.5 Teslas

The clinical value and the research capabilities of 3T MR imaging have been intensely investigated since the clearance by the US Food and Drug Administration (FDA) of human MRI at higher field strength in the year 2000. Clinical systems at field strength up to 4.0 T and research systems up to 8.0 T have now become available. Manufacturers have taken more than five years the 3.0 T MR systems as the new standard of...
equipment for clinical use with the benefit of increased patients throughput and/or enhanced quality of the images. This has led to the progressive replacement of 1.5 T systems by 3 T ones in academic as well as in general hospitals. But medical and socioeconomical efficiency of the 3 T substitution has raised concerns. No doubt that increasing by two the field strength results in a similar increase of signal due to the increased proportion of spins in aligned state when compared to anti-aligned ones at equilibrium. But does it necessarily mean that 3 T is twice as ‘good’ as 1.5 T? And which are the greatest benefits, specific constraints, and significant drawbacks of increasing the basic magnetic field $B_0$? Basic dilemma is well known: signal doubling may be re-invested in either shortening the acquisition time at constant IQ, or in increasing IQ (e.g. by increasing the matrix size, thereby lowering the voxel size) at constant time (Fig. 3-5). At last, intermediate options are feasible such as mixing speed and IQ improvement in variable proportions, or increasing the number of sequences, thereby potentially refining diagnosis – if necessary – at constant complete examination time. But 3 T imaging has also significant drawbacks essentially due to changes in relaxation time constants: as we move to higher field strength, T1 gets longer, T2 and mainly T2* get much shorter (6). The former change leads to a significant decrease in T1 contrast, with subsequent need for compensating by either magnetisation prepared pulse sequences, such as inversion recovery (IR) or magnetization-driven equilibrium Fourier transform (MDEFT) which enhance the white-gray matter contrast. The former also results in greater sensitivity to all artefacts: magnetic susceptibility, field inhomogeneity, patient’s movement, bowel peristalsism, cardiac beating, breathing, etc... Neurologic patients are frequently uncooperative, which results in severe limitation to the benefits of the 3 T imaging which are otherwise obvious. However, structural or morphological neuroimaging is improved because of higher spatial resolution (see above).

Perfusional, molecular, and functional imaging techniques which all suffer low native signal dramatically also benefit from increased signal at 3T.

**Diffusion-weighted imaging (DWI)**

Increases in both susceptibility and SNR at 3T synergistically contribute to enhance the quality of the diffusion-weighted images, resulting in higher sensitivity in detection, and better delineation of acute ischemic lesions from normal adjacent parenchyma. MR at 3T detects more and delineates better than MR at 1.5 T (7). However, greater image distortion, especially with echo-planar imaging (EPI) technique may lower the benefit of increased sensitivity. As for other EPI-based techniques, the use of parallel imaging (PI) techniques such as sensitivity encoding (SENSE® or PAT®) in combination with EPI seems mandatory since the reduction in the number of phase-encoding steps is diminished allowing for shorter echo train length resulting in reduced blurring.

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**Fig. 1. — Cone Beam artefact Reduction Algorithm (COBRA) suppressing deleterious ‘en nappes’ cone beam effect artifacts at the base of the skull using a 16 row detector configuration (16 x 0.75 mm) with reconstruction of 4 slices of 3 mm thickness) with helical acquisition.**

_A_: Spiral image without COBRA at image reconstruction: ‘positive’ hyperdense (arrows) and ‘negative’ hypodense (ball-arrowheads) artifacts are prominently seen at the basifrontal and temporal areas.

_B_: Similar image from the same 16 x 0.75 data set but with COBRA: artifacts are suppressed.
Fig. 2. — IQ similarity when comparing incremental and spiral images from the same patient
A: Incremental image (16 x 0.75 mm yielding four 3-mm-thick slices)
B: Spiral image with COBRA option in a similar slice location (id.).

Fig. 3. — Comparison of fluid attenuated inversion recovery (FLAIR) images at 1.5 T (A) and 3 T (B) in the same patient, in similar slice location, and at constant acquisition time: better IQ at 3 T because of better SNR is obvious.
and also for reducing field-related susceptibility leading to reduced image distortion.

**Spectroscopy (MRS)**

Increased spectral resolution and improved SNR at 3 T translate into more accurate metabolite measurements (particularly for proton 1H single-voxel acquisitions) regarding both peaks separation and quantification, and into reduced measurement times because of allowing the use of higher turbo factors (8). This may help at integrating MRS to routine clinical MR protocols, particularly in patients with neoplastic or degenerative diseases, or those being monitored after radiation therapy.

**Functional MR imaging of neuronal activation (fMRI)**

Increasing basic magnetic field strength B, increases susceptibility effects, thereby increasing the sensitivity to changes in the oxy/deoxy-hemoglobin balance, which translates into enhanced blood oxygen level dependant (BOLD) contrast.

**Perfusion-weighted imaging (PWI) using the dynamic susceptibility contrast (DSC).**

Increased susceptibility and shortened T2* relaxation time translate into a more effective sensitivity to the gadolinium-based contrast agents (CA) resulting in shortening of the acquisition times. Also, the total dose of CA being administered for such perfusional studies can be diminished. Ultimately, increased SNR and CNR allow the use of the PI which is limited at 1.5 T because of the inherent SNR penalty with the

![Fig. 4. — Comparison of thin frontal FSE T2-weighted images through hippocampal gyri in the same patient: better SNR at 3 T (B) than at 1.5 T (A) results in enhanced depiction of paleocortical lamination on those 1.5 mm-thick slices.](image1)

![Fig. 5. — Native cranial-caudal MIP reformats of time-of-flight (TOF) angiograms at 1.5 T (A) and 3 T (B). Higher spatial resolution results in better conspicuity of distal M2, M3, and P2 segments.](image2)
lower field. The overall gain in signal at 3 T in combination with the ability of using PI results in an increased number of sampling points during the first pass of the gadolinium CA through micro-vascularity, with much lower temporal resolution (i.e. 1.2 s per dynamic acquisition), thereby increasing the accuracy of perfusional parameters calculations.

Perfusion imaging using blood as endogenous contrast agent in arterial spin labelling (ASL)

This elegant non invasive technique allows for only absolute flow quantification by inverting inflowing spins in a volume of interest, primarily in the brain. Contrary to DSC, ASL does not require CA perfusion but is restrictively governed by the T1 relaxation time. Thus far increase in signal and lengthening of the T1 are synergistically beneficial to the technique which could therefore be included into the daily clinical use at 3 T, e.g. for tumoral perfusion analysis (9).

MR angiography (MRA)

Again, the increased signal intensity permits the use of higher matrix sizes (smaller voxel sizes) resulting in increased spatial resolution at constant acquisition times (10) (Fig. 5). If acquisition times are reduced (without penalty in IQ), repeated acquisitions may allow a dynamic depiction of blood flow dynamics which is highly relevant, e.g. in arterio-venous malformation (AVM) and fistulas, with the potential to image separately an ‘arterial’ and a ‘venous’ phase. The stronger effect of gadolinium-based CA at 3 T results from two synergistic mechanisms. First higher SNR leads to improved CNR. Second, the longer baseline T1 relaxation time results in a relatively stronger relaxivity effect of T1 shortening CA.

Several trials have shown that a higher lesion-to-brain contrast was observed at 3 T when compared to 1.5 T, even though the total dose of contrast material had been halved (11). In addition, other studies have demonstrated that for DSC perfusion imaging, the diagnostic quality and robustness of mean transit time (MTT) calculations were maintained even the total dose of CA had been reduced to one fourth of the standard dose at 1.5 T (12). Manufacturers of MR systems have diffused the information that significant reductions in CA doses could partially compensate for 3T-related extra-costs...

In conclusion, the net benefit resulting from higher signal intensity at 3 T leads to dramatic improvements in IQ regarding both structural and molecular/functional imaging in the cerebral sphere. The preference for 3 T field strength (or higher...) in neuroimaging therefore seems straightforward.

The public health threat: the nephrogenic systemic fibrosis (NSF)

Since the introduction of gadolinium-chelates as paramagnetic contrast agents (CA) in the late 80s, the combined benefit of using a technique without ionizing radiations together with the use of specific CAs safer than the iodine-containing ones had become axiomatic for almost two decades. But in February 2007, a bomb blew up one of those comfortable certitudes when a note by GE Healthcare reported a significant risk for nephrogenic systemic fibrosis (NSF) when using the gadodiamide (Omniscan®) and, in June 2007 a similar notice by Bayer Healthcare warned for reinforced pharmacovigilance towards gadopentate dimeglumine (Magnevist®). The concern for public health is striking as more than one hundred cases have been reported throughout the world (of which two at the UZ-KUL Gasthuisberg) with two hundred fatal outcomes due to terminal renal insufficiency. The pathogenic mechanism of the disease process still remains speculative (13). It seems that the toxicity of the chelator molecule and that of the atoms of gadolinium-element act in a synergistic way when separated from each other. The molecular stability of the complex gadolinium-chelate is therefore crucial. Linear (non cyclic) and non-ionic molecules are known to suffer lower molecular stability. This is why the Omniscan® which is a linear non-ionic compound was first involved, followed by the Magnevist which is a linear but ionic one. The atoms of gadolinium-element when separated from the chelator are thought to enter cells and penetrate lysosomes through a hydrophobic pole. The high cellular toxicity of the gadolinium-element results in cells death with subsequent reactive inflammation followed by fibrosis. Renal insufficiency yields additional risk factors to gadolinium exposure. First, the drop in pH value due to metabolic acidosis lowers the molecular stability of gadolinium-chelates, and second, the delayed clearance of the gadolinium which is exclusively eliminated by kidneys lengthens the cell exposure to the toxic gadolinium-element. The potential threat of gadolinium-element on renal function has nowadays rendered obsolete the axiomatic innocuity of MR gadolinium-based CAs. Reinforced pharmacovigilance towards those agents must clearly prompt us in our day-to-day clinical activity to restrict CA perfusion to those cases in which it is absolutely mandatory to reach firm diagnosis. For additional information, please see Websites listed at reference 14 for national and European guidelines.

Ongoing administrative debate: the protection of health workers at 3 T

A directive from the European Union (EU) Council dealing with the protection of workers exposed to electromagnetic fields and defining limits of exposure has existed since the year 2004 (15). The upper limit values have been experimentally determined and fixed at 10 mA/m for eddy-currents, and 1 degree centigrade for tissue heating by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) (16). It is now in the process of being translated in the national legislation of each member state of the EU, i.e. in France it is yet (17). It is well known that MR systems interact with the human body through three ways. The communications of the gradients induce eddy currents within tissues; RF pulses induce tissue heating by power deposition, and basic magnetic field B0 generates two kinds of side effects, i.e. static drawbacks due to field strength itself and dynamic effects due to movements of personnel into the static field.

The latter effect is the most controversial: when moving within a static magnetic field, individuals are exposed to variable magnetic fields, which means electromagnetic ones. When repeatedly moving within the immediate vicinity of stronger (3T and above) MR systems, health workers could reach the limits of legal exposure to electromagnetic fields. Mainly personals being susceptible of prolonged exposure (anaesthesiologists, interventional radiologists) could be at risk. The question is however hardly debated since reference levels have been determined by mathematical processing of experimental models, and because the true exposure of...
working personals is not unequivocally calculable (each model is questionable...). However the possibility of a legal limitation to exposure of health workers working at 3T seems real. Wait and see...

Specific research fields and domains of Belgian excellence

Multi-modality imaging

Combining information from different imaging modalities has nowadays become a key-point regarding both diagnostic and therapeutic purposes in many body areas. The multi-modality imaging aims at superimposing or 'co-registrating' conventional anatomical information (shape, contours, CT density or MR signal intensity, contrast-enhancement) to functional and/or molecular/metabolic data such as the activated voxels during a defined cerebral task in the so-called 'functional MR imaging' (fMRI), the main directions of major white matter tracts in diffusion tensor imaging (DTI), the spectroscopic data which means a mapping of specific metabolites concentration, and at last, the semi-quantitative or quantitative perfusion parameters such as regional cerebral blood volume (rCBV), regional cerebral blood flow (rCBF), mean transit time (MTT) in dynamic susceptibility contrast perfusion-weighted imaging (DSC-PWI). Some of these application have nowadays become familiar to the whole medical community such as the display of activated voxels of the brain during specific cerebral activity on a surface rendering 3D images of brain circumvolutions (Fig. 6). The superimposition of anatomical CT or MR imaging and of metabolic imaging by positron emission tomography (PET) as also become standard in clinical practice (Fig. 7). The ‘tractography’ of the major white matter tracts has also become familiar. The analysis of the diffusion tensor (DT) in at least six directions allows to identify the direction through which water diffusivity is more prominent, thereby defining the direction of the myelinated axonal bundles, because diffusivity along the axe of the bundle is quite more important than that in any perpendicular direction to which the water molecules are stopped by membrane barriers (Fig. 8). The technique produces so-called ‘tractograms’ defining the highways for transmitting neuronal information. Such tractograms appear complementary to the cortical information yielded by fMRI. The latter reveals where and the former through which ways neuron activity is processed and transmitted. Both concerns of ‘where’ and ‘through which ways’ are of major significance for the neurosurgeon resecting a brain tumor. In this organ domain, as in all others, the surgical procedure is constrained to a trade-off between the carcinologic need of complete resection including ‘security margins’ – if applicable – and the potentially opposite need of preservation of organ function to avoid unacceptable loss in life quality for the patient. This concern is highest in cerebral surgery where small lesional or iatrogenic damage to ‘eloquent’ areas of the brain may result in a severe penalty regarding functions indispensable to day-to-day life and social insertion.

Since more than one decade, brain imaging assists the neurosurgeon by giving an anatomical virtual representation of the brain the surgeon may co-register to the true patient’s brain in order to allow the anticipation of the best approach of a tumor, or of the immediate consequences of any action within the operative field. The term of ‘neuronavigation’ has been coined to define the transmission of the 3D virtual brain into the operative microscope.
and the superimposition of virtual radiological information on the operative field. But additional steps are now being done with the integration of fMRI and DTI tractograms data co-registered to the anatomical 3D virtual brain, enabling the identification of the functionally active grey matter areas, and of the white matter 'highways' transmitting neuronal activity (Fig. 9). The surgeon is so actively helped in the purpose of avoiding lesions to either eloquent cortex and/or to major myelinated axonal tracts (18, 19). Moreover, it is now possible to transmit spectroscopic information into the operative microscope (20). The great deal of MRS is to identify the presence and/or the excessive amount of abnormal compounds within normal appearing brain tissue, in which a disease process is ongoing, but without detectability on conventional anatomical images (the 'invisible' part of the tumor infiltration, or the 'immersed part of the iceberg'). At last, the super-imposition of angiographic data to anatomical images would be beneficial because of the potential for arterial/venous preservation each time it is possible during surgery.

Regarding the diagnostic comparison of multi-modal information in the field of primitive brain tumors, an original and very relevant work has been conducted by the neuroimaging research team of the ULB-Erasme hospital (21, 22). They compared in large prospective patients' series with cerebral tumors the semi-quantitative values of MR-based calculations of rCBV to the specific uptake values (SUV) of 11C-labelled methionine at PET. rCBV values are obtained by post-processing the DSC-PWI data obtained at the first pass of an intravenous compact bolus of paramagnetic contrast agent resulting in a dramatic loss of signal intensity due to susceptibility effect. The brain PET examination using the labelled methionine (PET-MET) is quite more sensitive than 'conventional' fluorodeoxyglucose (FDG)-PET which suffers low sensitivity because of intense uptake of the glucose by the normal brain parenchyma resulting in 'noisy' background. In turn, rCBV maps post-processing yields less 'black-on-white' images and requires more work and more subtle interpretation. Additional investigative clinical works on the potential of multi-modality imaging are ongoing in other academic institutions in the country, e.g. at the UZA in Antwerp where Luc van den Hauwe has initiated a vast research program exploring the value of integrating PWI, DWI, DTI, MRS, and fMRI data into the anatomical imaging for pre-operative work-up of brain tumors. The Vision Laboratory of the University of Ghent (RUG) has developed under the supervision of A. Leemans, PhD, a new multiscale white matter fiber tract co-registration algorithm (23) and has investigated the mathematical framework for simulating DT MR neural fiber bundles (24). The MRI laboratory of UCL-Saint-Luc has developed an original and easy-to-use software for DTI data processing and co-registration (DTI-Studio®, Imagilys, Brussels, Belgium) and has made an atlas of tractographic pat-
terns of the maturating brain in newborns, infants and children (25). The atlas is free on the web at the address: http://www.DTIAtlas.org). A team of the UZ-KULeuven University hospitals in Leuven has recently shown the value of quantifying DTI data in amyotrophic lateral sclerosis (26).

**Interventional neuroimaging**

Interventional neuroimaging is a specialized domain of neuroimaging experiencing rapid growth of the body of knowledge as well as increased skills of individuals committed to the practice. Two peculiar questions have benefited from dedicated research endeavours in different institutions: the percutaneous vertebroplasty (PV) in vertebral compression fractures (VCF) and the mechanical ‘neuro-protection’ of the brain parenchyma from embolism during carotid stenting by filtering devices placed downstream the site of intervention at the initial phase of the endovascular procedure. The value of prophylaxis of cerebral stroke by treating symptomatic carotid stenosis is well established since the pioneering study by the NASCET group published in the NEJM in 1991 (27). However the incidence of secondary clinically eloquent ischemic stroke is significantly reduced by prophylactically treating severe carotid stenoses, the incidence of treatment-related silent brain infarcts carrying a risk for cognitive decline or even dementia has been hardly debated (28). The introduction in the clinical practice of the diffusion-weighted MR imaging technique allowing the detection of very small acute ischemic foci within brain parenchyma has significantly added to the debate. To overcome these potential drawbacks of endovascular carotid stenting, the industry has released mechanical ‘neuro-protective’ devices. They are placed at the initial phase of the endovascular procedure downstream the stenosis and consist in a filtering basket retaining the microemboli which are detached from the diseased arterial wall during the procedure, thereby putatively avoiding iatrogenic microinfarcts. As others, we conducted a prospective study in our institution comparing the cerebral DW images of patients with carotid stenosis treated either by endarterectomy or by ‘protected’ endovascular stenting immediately before the procedure, and 24 to 48 hours after it. In an initial series of 53 patients undergoing stenting under mechanical neuro-protection, we observed an incidence of silent micro-infarcts reaching 40%, a significantly higher value than the previously published preliminary studies (29). The frequency of silent microinfarctions has been a constant concern, and protected stenting seemed not only to have been underestimated, but also the incoherence of the location of infarcts when considering both the side of intervention and the anterior/posterior circulation dependence had not been appropriately analyzed. That a large number of infarcts had no anatomical relationship with the site of intervention clearly meant that many emboli were not due to parietal disruption at the site of intervention, but were due to the friction of the progressing catheter on the atherosclerotic walls of the aortic arch or of the common segments of the aortoiliac trunks, by far before the protecting device had been spread out at the site of intervention. A study by the UZ-KULeuven Gasthuisberg group has led to similar conclusions, as well as a publication by another team from Frankfurt (30, 31). Because of the failure of mechanical neuroprotection, the debate has started: which technique from surgical endarterectomy (SE) versus endovascular stenting (ES) would carry the lower risk for micro-embolization and subsequent risk for cognitive decline? A recently published prospective study in our institution comparing DW images immediately after procedure in two cohorts of patients undergoing either SE or ES suggested a significant advantage for the surgical option (32).

Different Belgian teams have led pioneering works in the field of endovascular treatment of brain and spine vascular malformations, i.e. thanks to the late Pierre Flandroy in Liège who died in June 2005 leaving behind him a major scientific and clinical work (33), and to Georges Rodesch who initiated the development of interventional neuroradiology in Belgium since the year 1984 within the neuroradiology group of the ULB-Erasme hospital. Georges sustained a doctoral dissertation in 2005 entitled “Contribution to the study and therapeutic management of intra-dural spinal cord arteriovenous shunts in adults and children”. He is the first author of many major publications and has become in his domain a worldwide expert in spinal arteriovenous malformations (34). He now has become the head of the Department of Radiology at Hospital Foch in Paris. At ULB-Erasme, Boris Lubicz now develops interventional neuroradiology and prepares a doctoral dissertation on the new diagnostic and therapeutic approaches of intra-cranial aneurysms (35-37). Different other Belgian teams such as that of the UZ-KULeuven Gasthuisberg (38-39), and that from UCL-St-Luc (40-42) have also published significant contributions in the field of interventional neuroradiology. Regarding percutaneous vertebral cementoplasty (PV), Maurits Voormolen from the UZA in Antwerp has also defended a thesis leading original and practical conclusions, i.e. that the absence of MRI-detectable bone marrow edema (BME) within collapsed vertebral bodies should not be considered as an exclusion criteria for PV (43), that a decrease in BME systematically occurred after PV, but without significant correlation to pain relief (44), and that PV always resulted in a rapid subsidence of pain and a better and quicker functional improvement than with any medical treatment, even optimised (45).

**Functional MR imaging of neuronal activation (fMRI)**

The MR functional imaging of neuronal activation using the BOLD contrast principle is a major topic in which the research activity of Belgian academic teams has been intensely sustained throughout the past years, i.e. by that of the KUL-Gasthuisberg in Leuven (46-48), and by that of the RU in Ghent (49-51). The comparison of 1.5 T versus 3.0 T has been widely investigated. In a work crowned by the Annual Prize for Neuroradiology sponsored by the company Codali-Guerbet, Ann Tieleman and the team of Ghent have demonstrated the benefit of using a 3 T system for 4 paradigms used in the day-to-day practice of pre-surgical brain mapping, but with the expected need to modify the thresholds of significance because of the substantial increase in number of activated pixels (51). Pursuing its investigations in the field of epilepsy, the same team has shown that stimulus pacing during a semantic classification task affected the activations in medial temporal lobe if the patient himself guided his pacing or not (49). In another paper published in Radiology, they have shown that the concordance of side lateralization for memory encoding task between fMRI and
conventional Wada test using super-selective instillation of amobarbital by intra-arterial catheter was present only for patients with right-sided temporal lobe epilepsy (50). The team of UZA in Antwerp has assessed the limits of feasibility of fMRI of the cervical spinal cord at 1.5T using the standard motor paradigm of finger tapping (52).

Miscellaneous

Jan Casselman in the AZ Brugge has finalized his well known investigative works on the value of the diffusion-weighted MR sequence in characterizing primitive and residual cholesteatoma of the inner ear in different papers (53-54). An emphasis on the great work of the AZ-VUB team about the differential diagnosis of bright lesions on cerebral DW images presented at the RSNA and published in Radiographics in 2003 should be done (55). The VUB team has now moved towards the characterization of the primitive brain tumors by perfusion-weighted MR imaging (56). Our colleagues from the University of Liège, after the disappearance of Pierre Flandroy in June 2005, have pursued excellent clinical work in Head & Neck imaging (57). The largest experience in Europe (57). Our colleagues from the University of Liège, after the disappearance of Pierre Flandroy in June 2005, have pursued excellent clinical work in Head & Neck imaging (57). Our colleagues from the University of Liège, after the disappearance of Pierre Flandroy in June 2005, have pursued excellent clinical work in Head & Neck imaging (57). Our colleagues from the University of Liège, after the disappearance of Pierre Flandroy in June 2005, have pursued excellent clinical work in Head & Neck imaging (57).

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