International Day of Radiology 2014
Interview on brain imaging
Colombia / Dr. Sonia Bermúdez

INTERNATIONAL DAY OF RADIOLOGY
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Dr. Sonia Bermúdez, director of the neuroradiology department at the Santa Fe Foundation and associate professor of diagnostic imaging at El Bosque University, Bogotá, Colombia, about the range of imaging modalities available in her country and how they are used.

European Society of Radiology: Imaging is known for its ability to detect and diagnose diseases. What kind of brain diseases can imaging help to detect and diagnose?
Sonja Bermudez: A large number of brain diseases can be detected with diagnostic imaging techniques:
a. Congenital lesions that can be diagnosed in the prenatal phase with ultrasound or magnetic resonance imaging (MRI), for instance hydrocephalus and anencephaly. In the postnatal phase, MRI can also help detect congenital brain lesions.
b. Trauma lesions, such as intraparenchymal or extra-axial haematoma, traumatic subarachnoid haemorrhage, contusions.
c. Inflammatory lesions, infectious or not, for instance multiple sclerosis, meningitis, encephalitis caused by herpes, cysticercosis, HIV or related infections such as toxoplasmosis.
d. Vascular lesions: ischaemic stroke detection, brain infarct, non-traumatic intraparenchymal haemorrhage, aneurysm, arteriovenous malformations and other vascular lesions that can be diagnosed and confirmed with non-invasive angiographies such as computed tomography (CT) angiography, MRI angiography, and can be treated with interventional radiology procedures.
e. Toxic lesions: central nervous system compromise through alcohol abuse.
f. Metabolic lesions such as hepatic encephalopathy.
g. Immunological lesions: primary or secondary vasculitis of the central nervous system that can be diagnosed with MRI and angiography.

ESR: How useful is imaging in brain disease management? Does it improve the understanding of disease or improve patient prognosis?
SB: It is very useful. In the management of diseases such as tumours, diagnostic imaging is the way to control and know if treatment is working or not, and if some complications linked with treatment have occurred. In cerebrovascular disease, imaging is key to deciding on treatment with thrombolysis, a therapy that changed disease course by enabling us to save at-risk nerve tissue and improve patient outcome. In addition, imaging enables us to identify the disease's cause and offers the possibility to treat it. With Doppler or CT angiography, we can determine the presence of carotid disease that may be related to the ischaemic event.

ESR: What kind of technology and techniques do radiologists use to image the brain? Are there any specific techniques for particular diseases?
SB: MRI and CT are the most widely used diagnostic techniques. CT's advantage is its wide availability, rapidity and ease of use even in moving patients. It is relatively cheaper than MRI. Its main disadvantage is that it uses radiation, which can have more serious effects on children, pregnant women or women of childbearing age. CT is the first-line technique in brain trauma and acute stroke assessment, and in hydrocephalus treatment and follow-up.
MRI is more useful and is the first-line modality in the study of epilepsy patients and in suspected demyelinating disease, neoplasia, and degenerative, inflammatory and congenital disease. MRI's advantage is that it doesn't use radiation. However, it takes longer than CT, and because it uses a wide magnetic field, operating monitors to control critical patients is more complicated as one needs machines compatible with the magnet. Patients with pacemakers, insulin pumps, implants and other

devices that are not compatible with the magnet cannot be examined with MRI, as well as a non-negligible number of claustrophobic patients, unless they are previously sedated or in some cases anaesthetised.
Angiography can be performed in a non-invasive way with either CT or MRI; it is a fast way to examine the patient with minimum risk (with contrast product if required). Catheter angiography and digital subtraction are the gold standard in the detection of vascular lesions such as aneurysms and arteriovenous malformations, which can also be diagnosed with non-invasive angiography. But in patients with suspected vasculitis, the first-line technique is catheter angiography. It carries the risks of an invasive exam, but in expert hands and with better and safer equipment today risks have diminished.
Transfontanellar ultrasound is the first-choice method in intracranial haemorrhage diagnostic in neonates, a common complication in premature babies. Transcranial ultrasound is mainly used in diagnosis and follow-up of vasospasm, a common complication in patients with subarachnoid haemorrhage and cranioencephalic trauma.
Doppler ultrasound is the first-line technique in arteriosclerotic carotid disease evaluation.
Positron emission tomography (PET) has specific applications. One is epilepsy patient evaluation when searching for epileptogenic zones, for example mesial sclerosis undetected by other imaging techniques in patients unresponsive to conventional drug treatment and candidates for epilepsy surgery. PET is also pretty useful in discriminating between tumour and radio necrosis in treated patients with high-grade cerebral gliomas. PET's field of applications in the diagnosis of dementia is very large with the development of new radio drugs, especially those related to amyloid-beta.
Advanced techniques such as MR spectroscopy, diffusion, perfusion and tractography have enabled us to better understand some pathologies, and, in some of them, allowed us to get a better differential diagnosis, for instance tumoural and pseudotumoural brain lesions.
Functional MRI using the bold oxygen level dependent (BOLD) technique, with or without tasks, enables us to know the anatomic site where visual, auditory and language cerebral motor functions are generated, and from here many fields of investigation are opening. First of all, this exam has replaced other invasive studies in determining patient brain laterality, an important factor in presurgical evaluation of certain lesions.

ESR: What is the difference between a radiologist and a radiographer? Who else is involved in performing brain imaging exams?
SB: The radiographer or radiology technician carries out the examinations and the radiologist does their interpretation. In my country, the radiologist performs the ultrasound examinations, unlike other countries where they are performed by the technician.

ESR: Access to modern imaging equipment is important for brain imaging. Are hospitals in your country equipped to provide the necessary exams?
SB: Yes, most hospitals in the regional capitals are equipped with CT and ultrasound machines; some also have MR scanners. The healthcare system enables hospitalised or ambulatory patients to access MR scanners outside of their hospitals quite easily, thanks to a high number of MR machines. Small towns and first level hospitals probably don't have CT imaging and the only way to have access to this or most advanced techniques is to refer the patient.

ESR: In many countries there are waiting lists for MRI exams. How long can patients typically expect to wait for an exam in your country?
SB: The equipment is available so patients shouldn't have to wait too long; patients must wait to receive the authorisation from their paying authority to undergo the examination. If patients pay themselves or have a good insurance company, then they can have an appointment for the next day or week, at the latest.

ESR: And how long must a patient who cannot pay or doesn't have an insurance company wait?

SB: According to other specialists such as child neurologists, it can take up to three months if the patient is an outpatient. Things definitely go faster if the patient is hospitalised.

ESR: As the global population gets older, the risk of developing neurocognitive and neurodegenerative disorders increases. How can imaging help in this issue?
SB: Imaging can help:

- In the diagnosis of treatable lesions which present with cognitive symptoms, such as meningiomas or other frontal tumours, subdural haematomas, normal pressure hydrocephalus or chronic adult hydrocephalus.
- In dementia diagnostic approximation. MRI can help to differentiate between Alzheimer's disease dementia and frontotemporal dementia. It also helps to diagnose vascular dementia.
- PET studies using FDG (a fluorine marker) help to differentiate between different types of dementia. But PET with amyloid-B imaging is much more specific. In Colombia we only have PET-FDG.

ESR: Some imaging techniques, like x-ray and CT, use ionising radiation. What risk does this radiation pose to the patient and what kind of safety measures are in place to protect the patient?
SB: We have reduced factors of milliamperage and kilovolts in CT protocols, both in localised image acquisition and volumetric axial acquisition. We register technical factors including DLP in the images used in the radiological report, and this way we can calculate the dose used for each examination and write them down in the report. We use Dosis Care equipment tools and educate doctors, in particular paediatricians, to use these examinations moderately, respecting the as low as reasonably achievable (ALARA) concept.

ESR: What kind of role can imaging play in preventing and predicting brain diseases?
SB: Diagnosing arteriosclerotic disease with either Doppler or non-invasive CT or MR angiography plays a role in preventing ischaemic stroke. Amyloid-B imaging used in an appropriate context could predict the development of Alzheimer's disease. We don't have this technique yet.

ESR: In general, patients don't see the radiologist. A patient will discuss the image with the neurologist, neurosurgeon or oncologist. When they ask a question, they're often told: "I'm not a radiologist". Why don't radiologists discuss the image with the patient first?
SB: The operational standard of the study and radiological report takes into account the concept of a report written by the radiologist, not oral communication with the patient. This type of communication is neither practical nor logistically adequate. But when patients undergo an interventional radiology procedure, they will of course talk to the radiologist.

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