

International Day of Radiology 2014
Interview on brain imaging
Serbia / Dr. Miloš Lučić



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Miloš Lučić, associate professor of radiology at the School of Medicine, University of Novi Sad, chairman of the Diagnostic Imaging Centre and C.E.O. of the Oncology Institute of Vojvodina in Sremska Kamenica, Serbia, talked to the ESR about the kind of technology used for brain imaging and its role in understating brain diseases.

European Society of Radiology (ESR): Imaging is known for its ability to detect and diagnose diseases. What kind of brain diseases can imaging help to detect and diagnose?

Miloš Lučić: Actually, there are very few brain diseases that can't be diagnosed by modern imaging techniques nowadays. Thanks to the extraordinary breakthroughs in imaging technology in the last decades, neuroradiologists have been offered the outstanding capacity to not only visualise and assess a broad variety of different diseases and pathological conditions, including brain ischaemia and infarcts, tumours, inflammation and infections, and metabolic disorders, but also to get insights into the foetal brain, as well as both the structural and functional organisation of the brain; gradually entering into the molecular imaging era. Great improvement has also been achieved in understanding the brain organisation and interconnectivity networks, in diagnosing brain ageing processes and neurodegenerative diseases, as well as psychiatric disorders, using a broad spectrum of novel radiological techniques.

ESR: How useful is imaging in brain disease management? Does it improve the understanding of disease or improve patient prognosis?

ML: In my opinion everything starts with imaging of the brain, and on the other hand, in many cases it also finishes with it, in cases where an accurate diagnosis on the basis of imaging is established. In our country, neurologists and neurosurgeons heavily depend on imaging examinations, and most of them consider the information from neuroradiological imaging examinations to be crucial to further decision-making. Since this concept increases the individualisation of therapy for each single patient, it is obvious that neuroradiology and radiology in general are largely contributing to the benefit of patients. Though there are diseases that we cannot treat with satisfactory efficacy, even today, and the patient's prognosis may not always be substantially improved, for instance in cases of highly malignant tumours, neuroimaging certainly brings the necessary confidence to improve the patient's treatment in the best manner, both in the pre-treatment phase and during follow-up, especially in patients with for example acute brain infarcts, epilepsy and multiple sclerosis. Of course, by increasing our knowledge and understanding of the pathophysiological mechanisms of different brain diseases with neuroimaging we are creating the conditions for the most adequate therapeutic approach, but we are also creating the space for further advances in the development of a potential treatment.

ESR: What kind of technology and techniques do radiologists use to image the brain? Are there any specific techniques for particular diseases?

ML: Advances in neuroradiology have completely opened up new concepts of brain imaging, by raising it to a more advanced level; the level of reading and interpreting multiparametric maps instead of images. Apart from morphoanatomical imaging provided by computed tomography (CT) and magnetic resonance imaging (MRI), which allowed us to visualise and depict the lesions within neural structures, the introduction of tissue characterisation brought neuroradiology, for the first time, into both diagnostic and clinical focus. Now we have the ability to observe both physiological and pathological tissue architecture and characteristics and analyse blood and cerebrospinal fluid (CSF) flow. We can also estimate the perfusion patterns in order to visualise intratumourous

angiogenesis, both with CT and MRI in brain tumour patients. On top of that we can estimate the distribution of free water molecules within different brain tissues by using diffusion-weighted and kurtosis imaging in patients with brain ischaemia, and scrutinise micro haemorrhages with susceptibility weighted imaging in patients with vasculitis. We have the tools to get insight into the metabolic profiles of both normal and pathologically altered tissues by using magnetic resonance spectroscopy and chemical shift imaging that allows us to accurately estimate the malignancy grade of a tumour, for example. Using functional magnetic resonance imaging (fMRI) based on blood oxygen level dependent (BOLD) technique, we can visualise normal and abnormal brain activities, while with diffusion tensor imaging (DTI) the structural changes in neural pathways can be unveiled. Since neurodegenerative diseases are increasingly arousing public interest, neuroradiology now has the ability not only to estimate the volume reduction, but also to determine a degree of extension, and to differentiate between different neurodegenerative entities, such as vascular, frontotemporal, Lewy Body dementia, and Alzheimer's dementia by use of hybrid imaging, i.e. positron emission tomography (PET) coupled with CT or PET/MRI with the application of different radiotracers. And this is only a short reminder of the variety of advanced technical tools that are really opening the broad spectrum of possibilities for diagnosing the vast majority of brain pathological conditions and diseases.

ESR: What is the difference between a radiologist and a radiographer? Who else is involved in performing brain imaging exams?

ML: Like many other medical disciplines, neuroradiology is based on teamwork. Considering the fact that by definition a successful team is not a group of people performing the same job, but a group of people doing different jobs, yet at the same time looking in the same direction, it could be said that the joint efforts of radiologists and radiographers present a model of a good and successful team. Though both radiologists and radiographers must have a university degree in our country, radiographers are the team members who perform the examinations, under or without the supervision of radiologists, depending on the radiological technique. On the other hand, diagnostic radiologists are medical doctors who define the structure of the examination required, deciding on additional necessary examinations and, finally, reading the images and writing the report. In interventional neuroradiology the division of duties and responsibilities is different. Both described tasks in diagnostic radiology are highly interconnected, for if the image quality is below what is requested, the reading process cannot be performed. Therefore, good professional communication based on knowledge and skills is of the utmost importance for the best result, and of course for the benefit of the patient. One of the major problems is that the visibility of both radiologists and radiographers in the health system is very low, and often remains at the level of the report given to the patient. Therefore, it would be important to increase the visibility of radiological teams, for the importance of neuroimaging in the clinical decision making process is unquestionable.

ESR: How many patients undergo brain imaging exams in your country each year?

ML: Though we don't have precise data available, it is roughly estimated that more than 100,000 different brain imaging exams are performed per year in Serbia. Of course, these data are not fully precise, and the number varies from year to year, depending on the indication lists for state-owned diagnostic centres.

ESR: Access to modern imaging equipment is important for brain imaging. Are hospitals in your country equipped to provide the necessary exams?

ML: Keeping in mind the effects of the global crisis, the situation in our country generally does not differ from other countries in the region. Though new equipment is highly needed in many hospitals, there are several well-equipped diagnostic centres that are performing state-of-the-art brain imaging techniques, ensuring our patients the highest level of diagnostic brain imaging.

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?

ML: Waiting lists for MRI exams exist in Serbia as well. The waiting lists and indications are regulated at the national level. Based on the available data of the Ministry of Health, which is doing its best to reduce waiting times, the wait ranges from four to ten months, and the average waiting period is around six months. Of course, it depends highly on the different centres' workflow as well. Still, installing new MRI equipment and employing more radiologists may be one of the inevitable requirements to definitely solve the problem.

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

ML: As I previously mentioned, brain imaging may help not only to determine the volume changes in an atrophic brain, using exact 3D MRI volumetric measurements, but could also provide information on earlier signs of neurodegenerative disease presence, by use of PET/CT or PET/MRI techniques. Since the world's population, including our country, is getting older, many of our elderly citizens are seriously worried about Alzheimer's disease, the most famous among all other types of dementia. Brain imaging plays an important role in answering many of the questions in regard to neurodegenerative diseases.

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?

ML: It is true that some of the imaging techniques pose a risk due to ionising radiation. The most important thing in diagnostic imaging is to stay within the borders of good decision-making by answering a simple question – would the information obtained by diagnostic imaging procedure crucially benefit further clinical treatment, and if so which method should be used? Generally, the risk of ionising radiation for the patient is rather low, and is guided by the as low as reasonably achievable (ALARA) principle, yet patient fears may remain. In our country, we often face the situation in which many of the patients who should undergo CT examinations are referred to diagnostic centres to be examined by MRI instead of CT, only because of the fear of ionising radiation. Therefore, I am certain that providing correct and accurate information both to the patients and clinicians would help to understand why it is sometimes better to perform CT than MRI in specific clinical indications. Hence, I think that the EuroSafe Imaging campaign launched by the ESR earlier this year may significantly contribute to understanding the risks.

ESR: What kind of role can imaging play in preventing and predicting brain diseases?

ML: Imaging could provide important information for predicting the outcome of certain diseases, including the before mentioned neurodegenerative processes, epilepsy, multiple sclerosis, and even depression. On the other hand, diffusion tensor imaging (DTI) can provide accurate information on damaged brain pathways in trauma patients, while functional MRI (fMRI) could help determine brain plasticity. Allowing functional analysis of the brain, fMRI may play an important role in the future, regarding the prevention and prediction in a wide range of pathological conditions of the brain, including unconsciousness. We are already aware of the fact that fMRI research has demonstrated a correct response to yes-or-no questions in vegetative patients unable to communicate, and considered as brain-dead, but also there are some reports that fMRI may predict our behaviour intentions and activity.

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?

ML: This question raises the topic of the position of radiologists in modern clinical medicine. Of course, it would be great for radiologists to communicate with the patient, not only after, but also before the examination, in order to obtain all important information from the patient. Yet, it is true that the general public visibility of radiologists in clinical medicine is rather low. Quite often in our daily work we hear this sentence from our patients: "My doctor sent me to you to take the pictures,

and I'll go back to my doctor", meaning that radiologists, including neuroradiologists are, for many patients, not even considered as real doctors, but only as support staff for clinicians.

ESR: How expensive are radiological examinations to the health service and is there a risk that some of these examinations could be blocked by health technology assessment agencies deeming them to be not cost-effective (especially in relation to screening)? If so, how can patients help to ensure that these examinations are made available?

ML: Even though state-owned health insurance provides all basic medical services in our country, it would not be impossible to imagine some radiological services to be revoked anywhere in the time of global economic crisis. Therefore it is of utmost importance to maintain the evidence-based concept, especially in radiology, and to explain clearly to the health authorities that the cost-effectiveness of each life saved or better assured life-quality is really of utmost value. In order to recognise the importance of neuroimaging, any patient's initiative would be more than welcomed.



***Miloš Lučić** is associate professor of radiology at the School of Medicine, University of Novi Sad, Serbia. He is also chairman of the Diagnostic Imaging Centre and C.E.O. of the Oncology Institute of Vojvodina in Sremska Kamenica. His special interests are neuroradiology, paediatric neuroradiology, foetal MRI, and oncologic and neuro-oncologic imaging using MRI and PET/CT. He is the founder and chairman of the Serbian MRI School and a permanent member of the Radiology Certification Board at the University of Novi Sad. Prof. Lučić is the past president of the Radiological Society of Serbia and a member of the European Society of Radiology's (ESR) Leadership Institute.*