

International Day of Radiology 2014
Interview on brain imaging
Bosnia and Herzegovina / Dr. Zulejha Merhemic



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Zulejha Merhemic, assistant professor at Sarajevo University, medical director of the General Hospital Sarajevo and president of the Association of Radiology of Bosnia & Herzegovina, talked to the ESR about the brain diseases imaging can help detect and the risks involved with ionising radiation.

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?

Zulejha Merhemic: New, modern and sophisticated diagnostic methods are standard in the diagnosis and detection of brain diseases. Neurological imaging, and especially magnetic resonance imaging because of its excellent tissue differentiation, is useful for detecting vascular diseases of the brain, such as intracranial haemorrhage, aneurysm, vascular malformations and stroke, but also trauma, including general, primary and secondary brain and spine injury; primary and secondary brain and spine tumours; degenerative and white matter disease (white or grey matter disease, basal ganglia disorders), infections (bacterial, fungal, parasitic and viral infections) and congenital diseases (neural tube closure defects, cerebral hemisphere defects, migration and sulcation abnormalities, phakomatoses). Imaging also helps to detect hydrocephalus and to perform differential diagnoses of abnormal enhancement, basal ganglia signal, and neurodegenerative diseases.

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

ZM: Not one imaging modality can serve all purposes; each modality has unique strengths and weaknesses. Imaging has played a variety of roles in the study of Alzheimer's disease (AD) over the past four decades. Initially, computed tomography and magnetic resonance imaging were used diagnostically to rule out other causes of dementia. More recently, a variety of imaging modalities, including structural and functional MRI, and positron emission tomography studies of cerebral metabolism have become available. Magnetic resonance imaging of the brain is useful in the diagnosis and treatment of multiple sclerosis (MS), an inflammatory, demyelinating condition of the central nervous system (CNS) that is generally considered to be autoimmune in nature. Within radiology, the use of MRI is revolutionising the investigation, diagnosis, and even the treatment of MS. Usually, MRI is the only imaging modality needed for imaging patients with MS, and it surpasses by far all other tests with respect to its positive predictive value.

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

ZM: Medical imaging is the technique, process and art of creating visual representations of the interior of a body for clinical analysis and medical intervention. Neuroimaging includes the use of various techniques to either directly or indirectly image the structure and function/pharmacology of the brain. Neuroimaging falls into two broad categories: structural imaging, which deals with structure and diagnosing intracranial diseases, tumours, injuries, haemorrhage, and functional imaging, which is used to diagnose metabolic diseases and lesions on a finer scale, and in neurological and cognitive psychology research, for instance in Alzheimer's disease. The types of brain imaging techniques are magnetic resonance imaging (MRI) and functional magnetic resonance imaging (fMRI), computed tomography (CT), positron emission tomography (PET), magnetoencephalography (MEG), and near-infrared spectroscopy (NIRS).

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

ZM: Advances in technology along with the expansion of radiology departments throughout the country continue to create a strong demand for professionals educated in radiography. Radiographers combine the high technology of diagnostic medical imaging with their patient care skills to create x-ray images called radiographs. These radiographs are then used by radiologists and other physicians in the detection, diagnosis and treatment of disease and injury. The radiographer's role in the healthcare team demands the ability to make timely decisions on a daily basis and accept responsibility for those decisions. Most people enter the profession because they are motivated to help others who are ill or injured, while others may envision a degree in radiography as a stepping stone to further education within a medical profession. Physicians who specialise in the performance and interpretation of imaging in the clinical setting are radiologists. Medical nurses are a very helpful and valuable part of the staff performing imaging exams; nurses apply contrast products and take care of patients.

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

ZM: It is not easy to give an answer to this, since there is no unified database on the number of exams in general, and certainly no data on the number of exams for brain imaging in Bosnia and Herzegovina. My personal guess is that brain imaging exams represent about 30% to 40% of all imaging exams.

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

ZM: The assumption is that Bosnia and Herzegovina has less than 15 MRI machines and less than 30 CT machines for more than three and a half million inhabitants. It is clear then that most towns and suburban areas have no direct and available neuroimaging services.

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?

ZM: Like in many other countries, there are waiting lists, and usually the wait for an MRI exam is six to eight months. Waiting lists for private practices are much shorter, sometimes just a few days. An MRI exam is very expensive, and represents more than half of the average monthly salary in Bosnia and Herzegovina.

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

ZM: The number of requests for neuroimaging is increasing as patients get older. Due to its complexity and high cost, imaging is not available to everyone. MRI imaging is not a screening method, but CT imaging is sufficiently sensitive and inexpensive, compared with the cost of an MRI exam, for these patients. Therefore, I think that investing in this diagnostic method is cost-effective when this population is being targeted. An effective way to solve this increasing problem is to have several regional centres, with newer equipment, and with that move we could take the pressure off major centres such as Sarajevo, Tuzla, and Banja Luka.

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?

ZM: The effect of ionising radiation on our bodies differs according to its type and energy. Scientists have known for more than 80 years that large doses of ionising radiation can damage human tissues. As more was learned, experts became increasingly concerned about the potentially damaging effects that exposure to large doses of radiation can cause. The creation of the International Commission on Radiological Protection (ICRP) in 1928 has generated a consistent and international approach to radiation protection. Today the ICRP recommends that any exposure above the level of natural

background radiation should be kept as low as reasonably achievable and below the individual dose limits. The individual dose limit for the general public is one millisievert (mSv) per year.

These dose limits are based on a cautious approach, by assuming that any level of exposure can have a negative effect. This means that there is a corresponding increase in the health risk with any additional dose. As mentioned previously, the unit of measurement used for the biological effect of radiation on the human body is the mSv. The average global exposure to natural radiation is 2.4mSv per year. We know that very large doses of over 5,000mSv, received by the entire body over a short time result in death within a few days. We know, however, that some of the effects of exposure to radiation do not appear unless a certain large dose has been absorbed. Doses over 100mSv can have a harmful effect on humans, such as a higher incidence of developing cancer. At even lower doses of radiation, below 100mSv, there is a lot of uncertainty about the overall effects. What we do know is that the risk of adverse effects in this dose range is very low. To be on the safe side, we assume that there is a risk even in this low dose range and this risk is proportional to the dose by the same amount as in the high dose ranges. Special measures for protection are taken for pregnant patients and children during diagnostic medical exposure to ionising radiation.

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

ZM: In the past few years, several major studies have been launched aimed at predicting who will develop Alzheimer's disease (AD), with the ultimate goal of providing a platform for therapeutic intervention with disease modifying therapies. Many of these studies have been designed to evaluate the role of neuroimaging and chemical biomarkers in assessing and predicting progression in cognitively normal individuals and subjects with mild cognitive impairment. Mild cognitive impairment refers to the intermediate clinical state in which individuals have acquired memory impairment beyond what would be expected for their age, yet they do not meet the criteria for dementia. This research is aimed at characterising and hopefully treating individuals in the pre-dementia phase of AD. Similar patterns are used in the evaluation of white and grey matter diseases.

ESR: In general, patients don't see the radiologist. A patient will discuss the image with the neurologist, neurosurgeon, or oncologist. When they ask question, they are often told: "I'm not a radiologist". Why don't radiologists discuss the image with patient first?

ZM: Maybe this is not the best explanation, but radiologists have developed a special medical vocabulary, which is sometimes unclear to other doctors. Radiologists should be more involved in discussing images of their patients.

ESR: How expensive are radiological examinations to the health services 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?

ZM: Due to a lack of financial resources, the possibility of developing different scenarios is unavoidable. We need to anticipate all the possible ways of developing situations. One of the possible ways to solve problems is the direct involvement of patients through co-financing.

Zulejha Merhemic is assistant professor at Sarajevo University, medical director of the General Hospital Sarajevo, and president of the Association of Radiology of Bosnia and Herzegovina. Her clinical activities include CT, MRI and digital subtraction angiography (DSA) of the brain and spine. She has vast experience in teaching both nationally and internationally with an emphasis on MRI and neuroradiology, and organised the regional School of MRI in Sarajevo. Dr. Merhemic is an honorary member of the Slovenian Society of Neuroradiology, the Serbian Society of Radiology and Serbian Society of



Neuroradiology, and a member of the European Society of Neuroradiology. She was a member of the European Society of Radiology's Scientific Programme Committee from 2010 to 2013. She has given 42 invited lectures at national and international congresses, and published 125 abstracts, 20 papers and two bookchapters.