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CELEBRATE THE POWER OF IMAGING: THE EUROPEAN DAY OF RADIOLOGY

Summaries of the two topics chosen for the press conference organized by the Royal Belgian Radiological Society (RBRS)

Computed tomography (CT) is the main source of radiation from diagnostic procedures

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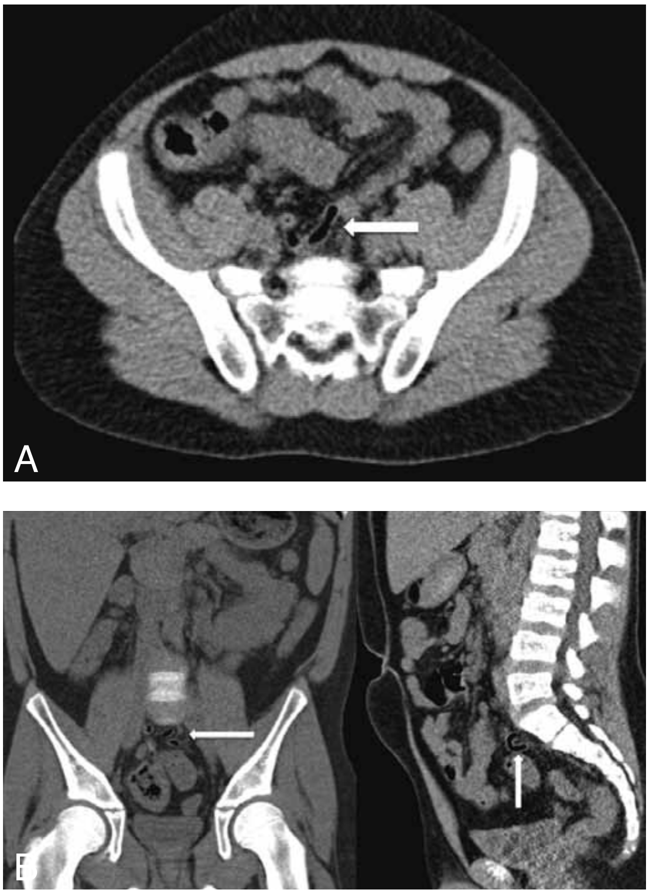
Approximately 1.800.000 CT examinations are performed every year in Belgium. With a mean dose 0,5 mSv, the annual collective dose from CT could induce up to 450 cancer. This number has to be compared to the 45 000 observed new cancers yearly. The deleterious effect of scanner radiation is thus undetectable among cancers induced by smoking, alcohol, and western diet. Risk from radiation is based on cancer mortality rates observed among atomic bomb survivors who underwent high level radiation. Overestimation of collective radiation risks in the filed of low level radiation (below 0,2 Sv) as used for CT is suspected first because a majority of patients undergoing CT are aged 60 years or more, and second because the numerous defense mechanisms that prevent cancer induction at low-doses in human bodies are not taken into account by the linear no threshold model of carcinogenesis used as legal rule for risk calculations.

On the other hand, CTis a rapid and efficient technique that providesaccurate diagnosis of various disorders such as acute appendicitis complete staging of severely injured patients, reliable monitoring of tumors and therapy guidance or planning. CT yields very high confidence in diagnosis that is required for treatment. The balance between radiation risk from CT and clinical benefit is thus almost always very high.



However, because of its success and performance, overuse of CT is suspected. This overuse has been addressed by RIZIV / INAMI in collaboration with the Consilium Radiologicum. Objective is to promote guidelines for an appropriate use of medical imaging tests and to reduce the rate of unjustified examinations. The expected effect should be a collective dose reduction but also financial.

When a CT is performed, according to guidelines, radiologists are in duty of limiting the delivered radiation dose by optimizing the CT technique. This is the practical application of the ALARA principle (As Low As Reasonably Achievable). The process of optimization is under the control of the Federal Agency for Nuclear Control (FANC/AFCN). The method for dose limitation is based on surveys. With the collaboration

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and approval of radiologists, the FANC will conduct surveys on CT on annual basis instead of every three to five years.

In patients with long life expectancy, typically in children and young adults suspected of benign disorders, the radiation dose of CT can be lowered down to the dose of radiographic examinations as illustrated in Figure 1.

Figure 1 A (axial view) and B (coronal view) illustrate low-dose abdominal CT in a 11-year old boy who had previous inconclusive ultrasound examination and suffered from right iliac fossa pain. Dose report from CT examinations shows DLP value at 51 mGy.cm, equivalent to one plain abdominal film. Arrow: normal aerated appendix. Technical parameters: Unenhanced abdominal 64 (2 x 32) MDCT scanner (Se,sation 64 Siemens Medical Healthcare; 100 KV and 37 effective mAs. Tube current modulation activated. Index of image quality = 70 mAs Eff. Mean CTDIvol at 1,68 mGy.

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NEURORADIOLOGY PLAYS A CRUCIAL ROLE IN THE MANAGEMENT OF STROKE PATIENTS

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Stroke is a clinical syndrome defined as a focal neurologic deficit of sudden onset. The event can be triggered by a sudden reduction of the blood supply to the brain ("ischaemic stroke"), or by a cerebral haemorrhage ("haemorrhagic stroke"). Table 1 provides a classification of different stroke types. In Europe, stroke is the third most common cause of death and the leading cause of permanent disability. Each year, an estimated 1.1 million people suffer strokes in the European Union, while 15 million people suffer a stroke worldwide, resulting in 5 million deaths and 5 million people permanently disabled, according to the World Health Organization.

Table 1. — Classification of stroke.

1. Haemorrhagic stroke
   1. Intracerebral haemorrhage (e.g. due to hypertension or amyloid angiopathy)
   2. Subarachnoid haemorrhage
      2.1. Aneurysm rupture
      2.2. Rupture of an arterio-venous malformation (AVM)
2. Ischaemic stroke
   1. Thrombotic stroke
      1.1. Internal carotid artery distribution ("anterior circulation")
      1.2. Vertebrobasilar distribution ("posterior circulation")
      1.3. Lacunar infarcts (due to occlusion of penetrating branches)
   2. Embolic stroke
      2.1. Middle cerebral artery distribution
      2.2. Anterior cerebral artery distribution
      2.3. Posterior cerebral artery distribution
      2.4. Vertebrobasilar distribution
   3. Increased coagulability (including veno-occlusive disease)
      3.1. Primary (e.g. protein S- or protein C-deficiency, antitrombine III-deficiency, ...)
      3.2. Secundary (e.g.. anti-phospholipid syndrome, paraneoplastic, ...)

With the arrival of promising new therapies aimed at re-establishing blood flow, reducing the size of the infarction and protecting the surrounding brain at risk, the traditional role of neuroimaging has changed dramatically in recent years. Neuroradiology contributes significantly, not only to the early diagnosis of stroke, but also to the initiation of appropriate treatment, thereby improving patients' chances of survival and full recovery. New developments in neuroimaging have considerably improved our understanding of the pathophysiology of acute stroke. Multimodal and multiparametric imaging techniques now play a crucial role in the diagnosis, clinical management, therapy and outcome prediction of patients with an acute stroke.

Magnetic resonance imaging (MRI), a modality that uses magnetic fields to reveal contrast between the different soft tissues of the body, is of great value in the early diagnosis of ischaemic brain tissue when combined with diffusion-weighted imaging, a method that produces in

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vivo images of biological tissues by measuring water diffusion. Within the 3 to 4.5 hour therapeutic time window after onset of symptoms, many patients with an ischaemic stroke can be treated with thrombolysis, i.e. the dissolution of a blood clot with intravenously administered drugs. So far, it is the only specific treatment option for acute ischaemic stroke that has proven effective. Ischaemic stroke accounts for about 80 to 85% of cases while the remainder are related to intracerebral hemorrhage, mainly caused by arterial hypertension or blood vessel malformation – aneurysm, arteriovenous malformation, etc. Clots can also be removed through endovascular procedures such as endovascular fibrinolysis or thrombolysis and/or thrombectomy, which are performed by interventional neuroradiologists.

In ischaemic stroke, most experts agree that MRI is the most sensitive imaging modality, since it allows early visualisation of ischaemic brain tissue. However, in most European hospitals, for practical and logistical reasons, computed tomography (CT) remains the first-stop imaging technique to exclude a haemorrhagic stroke. CT, which uses x-rays combined with computer software to provide 3-dimensional and transaxial images of the brain, has been shown to be fast, reliable, and effective in excluding intracranial haemorrhage in an emergency setting. Unfortunately, CT is not sensitive enough to show the ischaemic brain tissue in the first hours after onset of symptoms. Thanks to recent developments in CT technology, and improved data processing software, several methods exist to overcome the sensitivity limitations of CT, such as perfusion imaging. Perfusion CT is a technique which enables visualisation of the passage of blood – and contrast material – through the brain over time. Perfusion CT is of great value for identifying patients who are good candidates for thrombolytic treatment, even beyond the standard treatment time window of three hours, thereby increasing the numbers of patients that can be treated.

Imaging enables the gathering of necessary information to differentiate diagnoses and to apply the required therapy. The fundamental goals of neuroimaging in acute stroke remain to rule out intracranial haemorrhage, demonstrate ischaemic brain tissue (cytotoxic edema), reveal tissue blood flow and identify areas of potentially salvageable brain tissue (penumbra), and assess the patency of the intra and extracranial vessels.

Most university hospitals and large community hospitals in Belgium have all the necessary radiological equipment. However, there is a shortage of neuroradiologists and radiologists in general within these hospitals. A successful stroke service is very labour-intensive, since a 24/7 on-call system must be organised, and emergency examinations must be performed and interpreted quickly and accurately. There is a shortage of academically trained radiologists and neuroradiologists who are able and willing to participate in a 24/7 on-call service for stroke patients. Concerning interventional neuroradiologists, there would be an absolute shortage of manpower if all ischaemic strokes would be considered for endovascular treatment in the future.

Haemorrhagic stroke is widely considered as a medical emergency, and prompts primary care physicians and emergency room doctors towards undertaking swift action. Unfortunately, a patient with an acute neurologic deficit without intracranial haemorrhage – an ischaemic stroke – is often not considered as an emergency. Ischaemic stroke does not hurt, unlike, for example, a myocardial infarction. And yet, a brain infarct, commonly called stroke, must be considered like a heart attack and requires immediate and aggressive treatment, to prevent permanent neurologic deficit.

Stroke is now, thanks to new therapeutic options, a potentially reversible and curable disease, provided that treatment is started soon enough. There should be a large-scale information campaign to educate both the general public and radiologists.

Everybody knows that a sudden and severe constrictive pain in the chest, jaw and left arm can be an indicator of an acute heart attack. Similarly, when a patient experiences an acute neurologic deficit, this should be interpreted as the sign of an acute brain attack, and the patient should be treated within 3 to 4.5 hours of symptom onset. That is one of the major issues if we want to improve the treatment of ischaemic strokes. Another issue concerns the organisation of local hospitals. Emergency room physicians and paramedics must be familiar with the signs and symptoms of acute stroke, and should react quickly when they are identified.

Last but not least, it is important to emphasize that endovascular treatment of ischaemic stroke is still not reimbursed in Belgium. We have the tools to offer this type of treatment but we can't use them in daily practice. We strongly believe that our politicians need to be informed about this problem, and we are convinced that the general public, as well as our colleagues, need to informed about the new treatment options for acute ischaemic stroke. Stroke remains the only neurologic disorder for which physicians are potentially able to completely reverse disabling deficits, provided that patients are treated within the so-called therapeutic time window (3 to 4.5 after symptom onset).