



Paediatric imaging in Norway

An interview with Lise Heiberg, consultant paediatric radiologist at Oslo University Hospital.

European Society of Radiology: What is paediatric imaging? What age are the patients, and how is it different from regular imaging?

Lise Heiberg: Paediatric imaging is imaging of children from newborns, including prematurely born babies, until the age of 18. Children have a different spectrum of diseases than grown-ups and often have multi-organ involvement. The normal growth process influences the anatomy and the physiology of children. Age-related normal appearances of a growing child are extremely important to take into account when interpreting the radiological studies. The youngest children are not able to cooperate well with breathing instructions, for example. We have to communicate well and relate to both patients and their parents. We are often dependent on a good collaboration with paediatric anaesthesiologists, especially for magnetic resonance imaging (MRI) examinations and interventions.

ESR: Since when has paediatric imaging been a specialty in its own right?

LH: In Norway it is not formally acknowledged as a subspecialty of radiology, but the Norwegian Association of Paediatric Radiology was established in 1987 and is regarded as a separate entity within the Norwegian Society of Radiology.

ESR: Which imaging modalities are usually used to examine paediatric patients? Does this change depending on the age of the patient?

LH: Radiation protection is crucial, because children are more susceptible to adverse effects from ionising radiation. Ultrasound is the most important modality, together with conventional radiography. Ultrasound is an excellent tool for imaging children; it is radiation-free, readily available and exhibits very good tissue contrast due to the relatively sparse body fat in children compared to adults. MRI has almost completely replaced computed tomography (CT), apart from imaging of the lungs. CT angiography is still used in selected cases, especially in newborns and when optimal geometric resolution is required. Conventional angiography is now only used immediately prior to interventional treatment.

ESR: Some imaging techniques, like x-ray and CT, use ionising radiation. What risk does this radiation pose to paediatric patients? What kinds of safety measures are in place to protect children?

LH: As is also the case for adults, a lot is still unknown about the exact risks from being exposed to ionising radiation. Children are more sensitive and have a longer remaining life expectancy than adults, so they have more time in which any eventual adverse effects of ionising radiation might appear. Paediatric radiologists have been aware of this for a long time and therefore we always highlight the importance of dedicated paediatric imaging protocols, where we aim to reduce the radiation dose as much as possible without losing diagnostic information. The most important thing is to avoid unnecessary exams, which means that all examinations must be indicated, and always use radiation free techniques like ultrasound or MRI when possible and appropriate. But the radiation doses used for diagnostic imaging are generally low and there is no need for concern if your child requires a radiological examination as part of their work-up.

ESR: Do general radiologists always use lower radiation doses when imaging children; are there any guidelines to follow?

LH: Unfortunately, we sometimes see children, and especially teenagers and young adults, being exposed to protocols designed for adults. Usually this occurs in small general district hospitals where they do not have radiologists and radiographers with special training in paediatric radiology. They tend to overuse CT instead of ultrasound or MRI, and without tailor-made protocols for children. There are guidelines to follow, but unfortunately they are mostly general guidelines that may be difficult to apply in an acute situation. Another challenge is that there are very different CT scanners and versions of both hardware and software, so it is complicated to keep up to date and have state-of-the-art protocols, even in specialised paediatric radiology units. That is why paediatric radiologists stress the importance of having dedicated radiologists and radiographers in charge of protocols in all centres where children are scanned.

ESR: How aware are parents and relatives about the risks of radiation exposure? How do you address the issue with them?

LH: Very few parents ask about the radiation doses and associated risks. When asked, we explain why we need the exam, and why ionising methods can be used. When indicated, the benefit of the exam outweighs the disadvantages of radiation exposure.

ESR: Undergoing an imaging examination, especially a long procedure like MRI, can be an uncomfortable and sometimes frightening experience for some children. How can it be made more bearable?

LH: We produce information material so that children and their parents can read and look at pictures of the scanners, to prepare themselves before the exam. They may also come and see the MRI scanner. The most important thing is to have qualified radiographers who are confident when receiving the patients, give age-appropriate information and most importantly are experts in scanners so that the exam is performed as quickly as possible with good diagnostic images. We also have scanners where the child can watch movies whilst being scanned, so that the time passes more quickly or at least more pleasantly for the child. Modern scanners have programmes that make it less necessary for patients to hold their breath, which can facilitate the exams – although they usually take longer. Sometimes we rely on the anaesthesiologists to put the child to sleep if the exam is very long or the patient is unusually anxious.

ESR: How many imaging exams are performed on paediatric patients in Norway each year?

LH: There is no national registry for paediatric imaging, but according to the most recent reports from the Norwegian Radiation Protection Authority, an average of 900 radiological examinations were performed per 1,000 citizens in 2008, including MRI and ultrasound. According to previous surveys, approximately 10% of these exams were done on patients under 15. The demographics have changed little and from updated population data we can estimate that around 470,000 paediatric radiological exams are performed each year in Norway.

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

LH: Yes, we are fortunate to live in a country where we generally have modern equipment. But the technological development makes it hard to have adequate machinery, even in a country like Norway. There is very little private healthcare here, especially for children, so the large majority of exams are done in our good public hospitals. But we have to compete with other needs in the hospitals, and also machines get worn out and out-dated so there is always a wish list for radiological equipment on the hospital's priority lists. However, again, to have dedicated paediatric protocols and facilitate a dedicated paediatric radiology service is more important than having the most modern equipment. A fool with a tool is still a fool.

ESR: What has changed in paediatric radiology during your lifetime?

LH: The biggest change is digitalisation of all radiological exams. Also, CT scans have been more or less replaced with good ultrasound scanners and MRI. Medical treatment has improved for a lot of patients, so we have more follow-up exams. There is also a lot of on-going research, especially in cancer patients with multicentre studies, which often include standardised imaging. Surprisingly often, radiologists are not included when these protocols are established, and sometimes we end up doing examinations that may not always seem indicated in the individual patient but must be done in order to compare different treatment protocols. For example, a child may have a chest x-ray, a CT scan of the chest, an MRI, and also a PET/CT within a few days, sometimes repeated several times during their treatment.

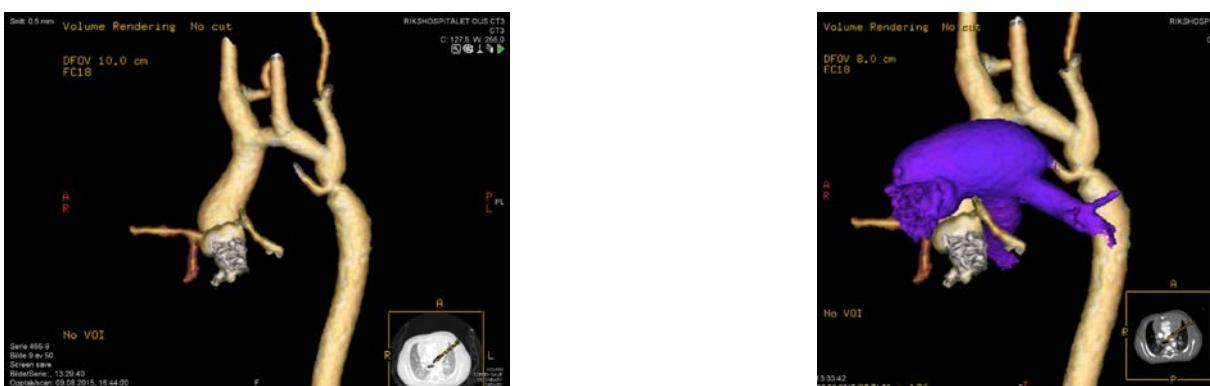
ESR: Where do you see the next developments in your field?

LH: It is not easy to see what the future will bring, but I think there will be closer collaboration with nuclear medicine and radiology, and functional imaging and individualised treatment and scanning will come. Hopefully and probably, data engineering will continue to reduce scan times and radiation exposure. The fast development of new techniques is also challenging. Paediatric radiologists must continuously work hard on establishing dedicated paediatric protocols and, also very importantly, establishing normal reference standards for interpreting images of children. Paediatric radiologists must continue to be visible and fight to remain a separate subspecialty within radiology. Experience gained from the adult population can not automatically be extrapolated for use in children, because children are not just small adults.



Lise Heiberg is a consultant paediatric radiologist at Oslo University Hospital (OUH), which is the national referral centre for both children and grown-ups with congenital heart disease and organ transplantation. OUH's unit of paediatric radiology is the largest unit of its kind in Norway and it has the largest neonatal intensive care unit in the country. Dr. Heiberg's special interests are congenital heart disease both in children and adults, paediatric lung diseases, and paediatric computed tomography.

Dr. Heiberg is chair of the Norwegian Society for Paediatric Radiology and a member of the Norwegian Medical Association, Norwegian Society of Radiology, European Society of Paediatric Radiology and European Society of Radiology.



Both images are from the same patient, a newborn girl, 12 days old, 3.7 kg with 4ml contrast media, from a 3D reformat of a CT angiography of the thorax. There is a general hypoplasia of the aortic arch, and a coarctation/ localised stenosis at the level of the ductus arteriosus.

The first image is a 3D of the aorta, the second of the aorta and pulmonary artery with the patent ductus arteriosus.



Abdominal x-ray of a newborn boy (6 days old, 1.24 kg) with duodenal web, after contrast media for a small bowel follow-through. There is air in the dilated ventricle and proximal part of duodenum, and the contrast media can now be seen in the 'unused'/small calibre colon. There is also a nasogastric tube and a peripheral iv-line.