

## **5. Clinical and performance parameters: MSCT in paediatric patients**

### *Indication*

The appropriate selection of paediatric patients who need MSCT is the first important step, because alternative cross sectional imaging techniques, such as ultrasound and MRI, are often sufficient to make the diagnosis without radiation exposure. In order to make intelligent use of the potential of MDCT, i.e. to determine the optimal scan techniques and reconstruction parameters, it is necessary to define clearly the diagnostic questions for the CT examination. In addition, it is still advisable in the individual patient to perform preliminary simple examinations, i.e. an actual chest radiograph or ultrasound. Thereby, the CT can be modified or even cancelled in some patients. In other cases, especially when the chest radiograph is inconclusive, an echocardiography can completely change the MSCT-protocol, for example. Incongenital heart disease associated tracheo-bronchial and vascular anomalies frequently occur. It is then necessary to investigate the chest and the upper abdomen (whole liver) to delineate the vessels, which can cross the diaphragm, (sequestration complex), and the rare cases of anomalous pulmonary vein connections and portal vein absence etc.. In addition, tracheal and bronchial pathology can be concurrently viewed, using MPR and 3-D reconstruction to show the exact anatomical relations.

### *Patient preparation*

Of utmost importance is appropriate patient preparation, may be essential to have a large intravenous line in infants and small children to administer contrast media (CM) at a high flow rate. Secondly, for abdominal CT, adequate bowel opacification is obligatory but difficult to achieve in young patients. Sometimes oral CM can only be applied in paediatric patients by a nasogastric tube; the administration time is shorter because peristalsis is faster than in adults. Attention should be given to simple, often forgotten metal items; e.g. metallic buttons in baby clothes, metallic wires of medical monitoring devices and electrodes or other cables. These can cause massive artefact and should be removed before scanning. Correct positioning is important, but this can sometimes be a difficult task in patients with severe scoliosis.

### *Higher Speed*

This is a very important feature of MSCT, especially using 16 row detectors, compared to single slice scanners. Spatial resolution in the xandy-planes is better because slice thickness is much smaller. Another important aspect is rotation time, which is twice as fast compared with single detector scanners. Faster tube rotation is important avoiding blurring of moving structures, for example when examining small pulmonary structures (bronchi, vessels, septa) which are in close contact to the beating heart or diaphragm. This is most advantageous for the smaller patient, because their heart rate and respiratory movement are much faster than in

more cooperative older children (after the age of eight), who can generally hold their breath. The better resolution in the z-axis is independent of age. However, nurses and anaesthesiologist who care for the small patient must take the faster table movement into account.

MSCT not only has the potential for better spatial and contrast resolution but also allows reduction of tube current and tube voltage in young patients. In the future, automatic modulation of the tube current will become possible and should be used not only to keep the image quality high (noise reduction), but should allow, dependent of the patient thickness, dose or noise- reduced protocols, respectively. However, tube current can be calculated after the scan projection radiograph is obtained by measuring the patient's thickness (absorption) and thereby correctly changed before CT scanning. Thereby, dose optimised paediatric protocols can be achieved. This is important for high resolution CT (HRCT), which is being more frequently requested. In contrast to adults, optimal HRCT in children is difficult to perform, because breath holding is needed to avoid misinterpretation of motion artefacts as pathologic findings. Therefore, more research is necessary to define optimal scan techniques, especially for paediatric chest CT examinations.

### *Contrast medium*

The amount and the speed of intravenous contrast medium administration have to be based on patient's weight and the type of the examination.

More contrast medium is needed in trauma patients or when trunk CT angiography is necessary. Only low osmolar CM should be given to a paediatric patient. Faster table movement (less administration time) must be taken in to account when intravenous contrast is applied in paediatric patients. Therefore, the correct delay in different age groups must be exactly defined and bolus tracking technique should be preferably used despite the extra dose it requires. Only very rarely is multiple scanning indicated in paediatric patients. Probably the only indication for multiple scanning is in selected cases of complex liver lesions.

### *Outlook*

Despite unavoidable radiation exposure, the benefit of optimal MSCT in paediatric patients is very high. Exact knowledge of pathology of critically ill patients allows earlier diagnosis, more specific treatment and, therefore, better clinical outcome. The main indications for MSCT in paediatrics in the future will be severe trauma, complex malformation syndromes and rare pulmonary diseases.

*Please refer to the quality criteria as:*

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