Controlled ventilation CT scanning of the chest in infants

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Sop CT infants
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Background
For optimal evaluation of a chest CT scan it is important to obtain a motion free investigation at total lung capacity volume and at functional residual volume level. The inability of children below 4 years of age to cooperate with breath holding limits the usefulness of chest CT (motion artefacts, images not at full-inflation or end exhalation, high radiation). For lung diseases such as cystic fibrosis (CF), congenital lung diseases, and bronchopulmonary dysplasia it is important to obtain information on lung structure at a young age, for clinical management. Full-inflation and endexhalation controlled-ventilation chest CT (CV-CT) has been developed for infants and young children (Long et al, Radiology 1999). For CF a routine CV-CT is aimed for at the age of two years.
The only way to do a CV-CT in young children is under general anaesthesia. A major disadvantage of this CT procedure, however, is the risk of developing temporary atelectasis. Children with more severe lung disease have a higher risk of developing
atelectasis within minutes. Shallow breathing and absence of deep breath increases the risk. Atelectasis substantially reduces the information obtained from the CT investigation. In addition it might put the child at risk for persisting atelectasis. With help of the CV-CT atelectasis can be avoided. In addition CV-CT provides the opportunity for imaging using low radiation dose with good image quality at standardised inflation level.

**Target population for protocol**

CT scanning in non-cooperative young children. For CF the CV-CT will in general be of an elective nature and should be done while the child is in a stable condition. In case of a severe common cold, or an evident pulmonary exacerbation the procedure can better be postponed to a later date.

**Technique of scanning:**

1. Induction of the child is done in the induction room
2. Intubation preferable with a endotracheal tube to avoid overextension of the stomach with air and secondary pulmonary atelectasis. Use pressure monitoring close near the patient.
3. Anaesthesia in such a way that spontaneous breathing continues. The preferred method is propofol.
4. FiO2 in the range of 30 to 40% should be used to reduce the risk for the development of atelectasis.
5. A SO2 of 92% or higher during the procedure is considered adequate. During spontaneous breathing a normocapnic end tidal CO2 is aimed for
6. Transfer child to the CT table Hyperventilate the child in synchrony with the spontaneous breathing pattern giving 4 to 6 inflations with a peak inspiratory pressure of 25 cm H2O so a respiratory pause will occur during CT scanning.
7. Next induce breath hold at a constant peak pressure of 25 cm H2O.
8. Inspiratory Scan is made during the breath hold at a pressure of 25 cm H2O.
9. Next give an extra bolus of propofol to allow breath hold at end expiration.

10. Repeat step 7 until and release all pressure (0 cm H2O) Expiratory Scan is made during the end expiratory breath hold at a pressure of 0 cm H2O.

11. During the procedure there should be verbal contact with the CT technician, when to start and when to stop scanning. This communication is crucial to obtain respiratory motion free images. After a start signal it takes at least 3sec for the scanner to start and it takes from 5 to 15 seconds to scan the child. The technician should indicate when the scan has been made.

12. After the CT procedure, perform blind aspiration of airway secretions for microbiological culture. A completed labform will be filled in by the CF team Protocol inspiratory CV-CT

Inspiratory CT is made during breath hold
Protocol expiratory CV-CT

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Additional information
- The lowest possible dose with the current scanner is used. DLP, CTDI etc are registered to do dose calculations
- Length of the respiratory pause, amount of pressure, end-tidal CO2, dose exposure of the anaesthesiologist is monitored.
- The anaesthesiologist will use adequate shielding (vest and thyroid protection. Gloves for the hands are considered not necessary when care is taken to keep distance from the scanned area.

Literature (artikelen aan protocol toegevoegd)