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Radiology should play a more prominent role in tracheobronchomalacia evaluation

OPINIONS

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Although 4D-CT cannot replace bronchoscopy in the evaluation of tracheobronchomalacia, it serves as a valuable adjunct, enabling faster diagnosis, reducing the need for general anaesthesia and potentially shortening waiting times for bronchoscopy.

Diagnostic bronchoscopy under general anaesthesia is considered the gold standard for tracheobronchomalacia (TBM) evaluation in children. Bronchoscopy is an invasive procedure with potential complications, and at present, only Rikshospitalet in Oslo performs the procedure in paediatric patients. At Akershus University Hospital, low-dose 4D dynamic CT is used without anaesthesia in spontaneously breathing children, in accordance with international guidelines for non-invasive evaluation (1, 2) (Figure

1). 4D dynamic CT (4D-CT) adds a temporal dimension to 3D CT, enabling real-time imaging and measurement of structures. For patients with a complex clinical picture, this can be a good alternative to bronchoscopy.

Rapid diagnosis is crucial

Primary TBM is characterised by unusually compliant airways that partially collapse during breathing. The 2019 European Respiratory Society Task Force report defines malacia as an arbitrary reduction in cross-sectional lumen of more than 50 % during expiration under quiet respiration. Malacia can affect the trachea (tracheomalacia) and/or the bronchi (bronchomalacia) (1). TBM can also be secondary to compression of the trachea by external structures (e.g. a vascular structure).

> ***«For patients with a complex clinical picture, this can be a good alternative to bronchoscopy»***

As previously described in the Journal of the Norwegian Medical Association, symptoms in children with TBM can overlap with those seen in asthma, enlarged adenoids or tonsils and other respiratory conditions, such as reduced exercise tolerance, cough and increased mucus retention (3). Rapid diagnostic clarification can therefore be crucial to prevent inappropriate treatment and ensure optimal follow-up, which may include airway clearance, CPAP and/or surgery.

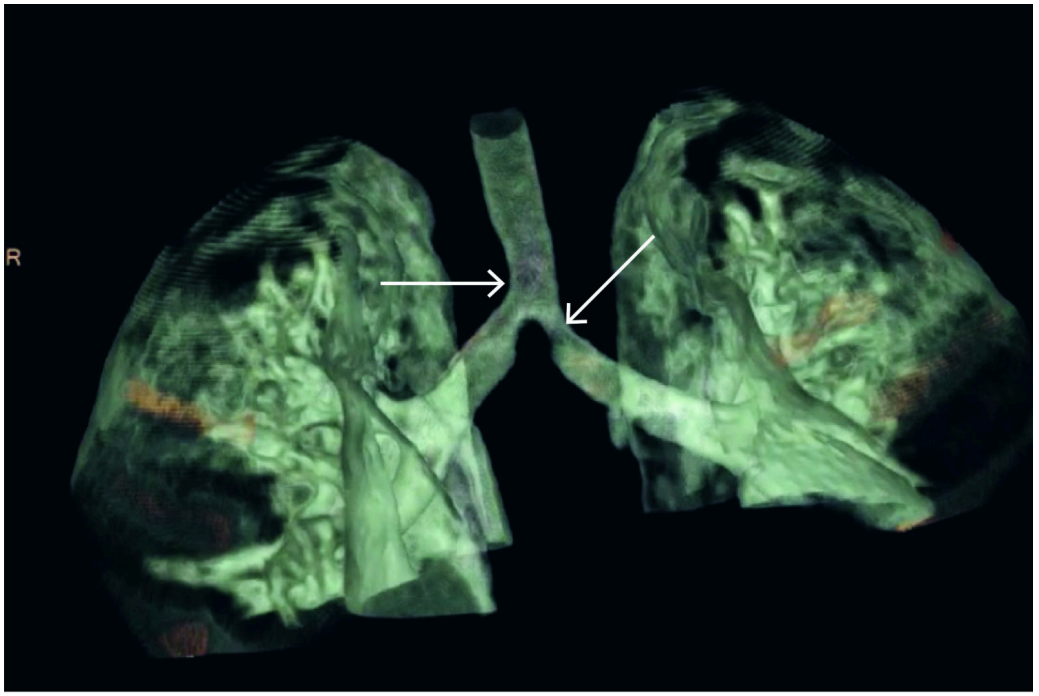

Figure 1 Example of a 4D-CT volume image in the frontal plane. The arrows indicate external compression of the trachea and left main bronchus, as seen in secondary TBM (online video)

Why 4D-CT?

Children with TBM often present with a complex clinical picture. Many have bronchopulmonary dysplasia, heart defects or other conditions that increase the risk associated with general anaesthesia. During expiration, the airways collapse in a caudocranial direction (4). It is therefore useful to obtain a complete 3D volumetric image of the central airways for the entire duration of the scan (2). 4D modalities achieve precisely this, in contrast to bronchoscopy, which visualises one segment at a time.

The risk of false-positive findings is low with 4D-CT, as the patient breathes spontaneously and no positive pressure is applied, unlike during bronchoscopy. Studies have reported 4D-CT sensitivity of 82–100 % and specificity of 68–100 % (5). Imaging with 4D-CT is performed over two respiratory cycles, and many children are able to complete the procedure with quiet breathing without medication. If necessary, light sedation can be administered in the form of dexmedetomidine nasal spray, which does not require additional monitoring in the CT suite. Coughing or rapid breathing can reduce image quality, and scan length can be a limiting factor.

> ***«4D-CT in children was previously regarded with scepticism due to the exposure to radiation, but this is now considered minimal»***

Reduced radiation exposure

4D-CT in children was previously regarded with scepticism due to the exposure to radiation, but this is now considered minimal. We calculated an average effective dose of 0.53 mSv for children examined at our centre (unpublished data), which is equivalent to approximately 10–12 weeks of background radiation (6). The estimated risk of developing cancer from this dose is around 1 in 500,000 to 1 in 100,000 and depends on the child's age and the body region exposed (6). The dose should also be viewed in the broader context of decreasing radiation exposure from diagnostic imaging in general. The average dose from 4D-CT corresponds to the radiation exposure from 2–3 chest X-rays in the year 2000.

> ***«In our experience with over 50 patients, some children do not subsequently require bronchoscopy, and the findings can facilitate a more targeted bronchoscopic procedure»***

Clinical utility and accessibility

At Akershus University Hospital, 4D-CT is used to assess whether children as young as 18 months may have primary malacia or airway compression from other structures. In our experience with over 50 patients, some children do not subsequently require bronchoscopy, and the findings can facilitate a more targeted bronchoscopic procedure.

Access to bronchoscopy is poor outside the Oslo area; children and their parents need to take several days off school and work for examinations in Oslo. Several university hospitals could implement 4D-CT by adapting existing hardware and employing dose-reduction techniques. In addition to providing a safe, minimally invasive and accessible method of assessment, wider adoption of 4D-CT could enable faster access to bronchoscopy for selected children with pulmonary and respiratory disorders.

REFERENCES

1. Wallis C, Alexopoulou E, Antón-Pacheco JL et al. ERS statement on tracheomalacia and bronchomalacia in children. Eur Respir J 2019; 54. doi: 10.1183/13993003.00382-2019. [PubMed][CrossRef]

2. Liszewski MC, Ciet P, Winant AJ et al. Pediatric large airway imaging: evolution and revolution. Pediatr Radiol 2022; 52: 1826–38. [PubMed][CrossRef]

3. Vaula S, Øymar K, Hovland V et al. Trakeobronkomalasi hos barn. Tidsskr Nor Legeforen 2024; 144. doi: 10.4045/tidsskr.24.0116. [PubMed][CrossRef]

4. Greenberg SB. Dynamic pulmonary CT of children. AJR Am J Roentgenol 2012; 199: 435–40. [PubMed][CrossRef]

5. Ullmann N, Secinaro A, Menchini L et al. Dynamic expiratory CT: An effective non-invasive diagnostic exam for fragile children with suspected tracheo-bronchomalacia. Pediatr Pulmonol 2018; 53: 73–80. [PubMed][CrossRef]

6. Direktoratet for strålevern og atomsikkerhet. Helserisiko ved røntgendiagnostikk. https://www.dsa.no/medisinsk-stralebruk/helserisiko-ved-rontgendiagnostikk#Nytte%20og%20risiko Accessed 18.1.2026.

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