

Pictorial Essay: Pulmonary Imaging for Children

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Introduction

To detect pulmonary metastasis a computed tomography (CT) scan is still the gold standard for adults as well as children. However, for children we try to keep the radiation burden as low as possible and use magnetic resonance imaging (MRI) for as many examinations as possible¹. Especially in children with oncologic diseases that can be treated curatively, we use MRI for the cervical and abdominal staging examinations and often also use the

¹ MR scanning has not been established as safe for imaging fetuses and infants under two years of age. The responsible physician must evaluate the benefit of the MRI examination in comparison to other imaging procedures.

MRI for the thoracic staging of the axillary, hilar, and mediastinal lymph nodes. However, to assess pulmonary metastases it is still necessary to perform a chest CT scan.

The examination we usually use for a thoracic MRI for children typically consists of a short T1 inversion recovery (STIR) sequence, a T2-weighted half fourier single-shot turbo spin echo (HASTE) sequence, a T1-weighted turbo spin echo (TSE) sequence, a true fast imaging with steady-state free precession (TrueFISP) sequence, dynamic volume interpolated breath-hold examination (VIBE) sequences, and a T1-weighted fast low angle shot (FLASH) 2D sequence. However in all of these sequences we have quite a few, especially motion artifacts and

can only safely assess pulmonary metastases when they have a diameter of at least 10 mm. For the staging in oncologic patients it is though also important to assess small pulmonary nodules, therefore we still rely on CT scans.

With FREEZEit, which includes the free-breathing radial MRI sequence StarVIBE we have less motion artifacts and may be able to assess pulmonary metastases.

Reference

H Chandarana, KT Block, MJ Winfeld, SV Lala, D Mazori, E Giuffrida, JS Babb, SS Milla. Free-breathing contrast-enhanced T1-weighted gradient-echo imaging with radial k-space sampling for paediatric abdominopelvic MRI. *Eur Radiol* (2014) 24:320-326.

Case 1

5-year-old male patient with an anaplastic large T-cell lymphoma with cervical and axillary lymphomas.

For staging purposes a contrast-enhanced MRI of the abdomen and neck was performed as well as a contrast-enhanced CT and MRI scan of the chest. The cervical MRI scan

showed cervical and axillary lymphomas; the CT and MRI scan of the chest showed left hilar lymphadenopathy with a consecutive dystelectasis of the left upper lobe.



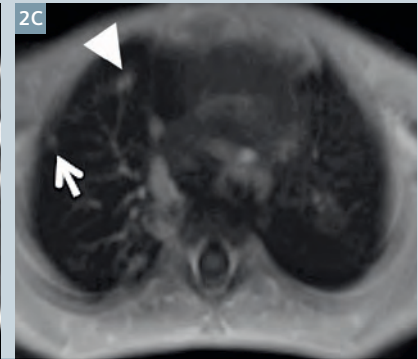
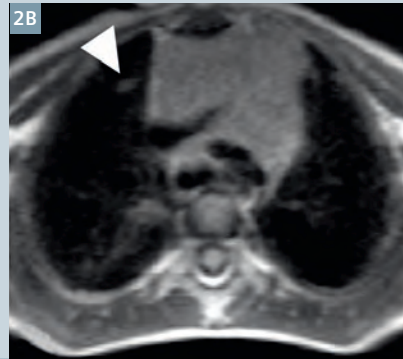
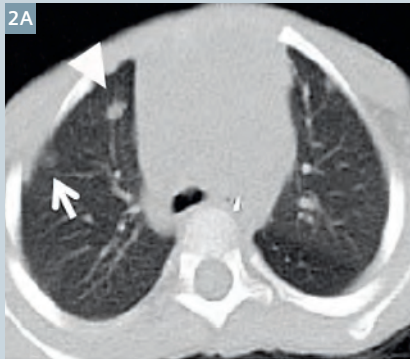
1 Contrast-enhanced CT scan in an arterial phase in (1A) lung window and (1B) ediastinal window (SOMATOM Definition Flash; 3 mm slice thickness) show mediastinal lymphoma and dystelectasis of the left upper lobe. (1C) The StarVIBE sequence (MAGNETOM Aera 1.5T; 3 mm slice thickness) displays the mediastinal and axillary (arrow) lymph nodes in the post-contrast phase at least as well as in the CT scan.

Case 2

3-year-old male patient with post-transplant lymphoproliferative disorder (PTLD) after kidney transplantation.

The patient initially presented as a premature baby with a renal vein thrombosis. This led to a consecutive kidney failure and kidney transplant. Four months after the kidney transplant the patient developed a PTLD with cervical,

mediastinal, mesenteric, retroperitoneal, pelvic and pulmonal lymphomas. An FDG-PET/CT scan without an intravenous contrast agent was performed as well as an MRI of the chest and abdomen.



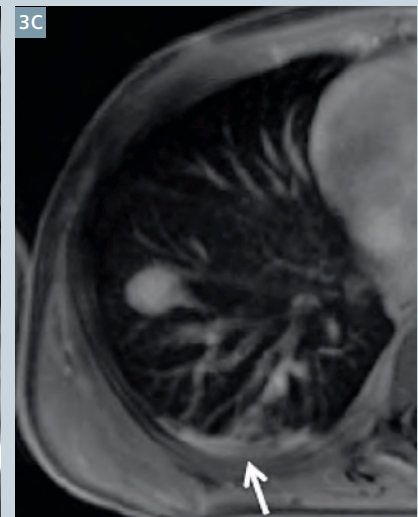
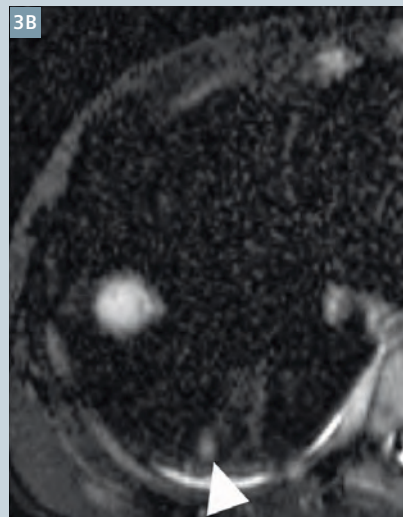
- 2** (2A) The non-contrast CT scan (3 mm slice thickness) in lung window shows pulmonary and mediastinal lymphoma manifestations. (2B) In a T2-weighted HASTE sequence (MAGNETOM Aera 1.5T; 5 mm slice thickness) only the bigger pulmonary lesion can be detected (arrowhead), while (2C) StarVIBE (MAGNETOM Aera 1.5T; 3 mm slice thickness) is able to show additional lung lesions (arrow).

Case 3

9-year-old male patient with a peripheral t-cell lymphoma.

The patient presented with cervical, thoracic, and abdominal lymphomas. Staging was done by a ^{18}F -FDG-PET/CT without intravenous

contrast agent and a contrast-enhanced cervical, thoracic, and abdominal MRI.



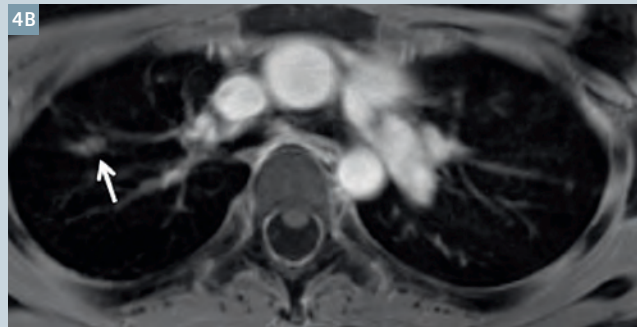
- 3** (3A) Non-contrast CT scan in lung window (3 mm slice thickness) shows two pulmonary lymphoma manifestations, which are also shown by (3B) the T2-weighted HASTE sequence however with less spatial resolution than (3C) the StarVIBE. In the StarVIBE sequence the second pulmonary lymphoma manifestation is masked by a dystelectasis (arrow). In our protocol, StarVIBE is the last sequence, which can lead to dystelectasis, especially after a quite extensive imaging protocol for whole-body staging. Therefore, it would be advisable to perform this sequence as early as possible.

Case 4

14-year-old female patient with acute lymphatic leukemia (ALL) and aspergillosis.

Patient presented with invasive aspergillosis after receiving chemotherapy with aspergillosis

manifestations in the lungs as well as the liver.



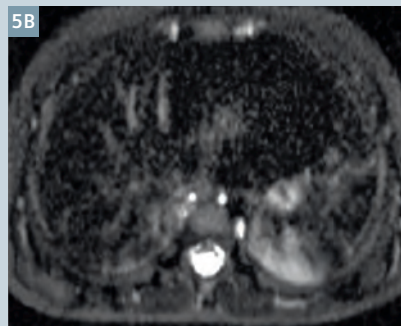
4 Single aspergillosis lesion in the upper right lobe in (4A) the non-contrast CT scan, with the same lesion shown in (4B) the StarVIBE sequence.

Case 5

2-year-old male patient with PTLD.

Patient presented with liver cirrhosis, and hepatocellular carcinoma (HCC). He received a liver transplant, and shortly after developed PTLD. An FDG-PET/CT

was performed, as well as a cervical, thoracic, and abdominal MRI. Pulmonary lymphomas were not detected, however infiltrates were diagnosed.



5 (5A) The CT scan and (5C) the StarVIBE sequence show the infiltrates in both lower lobes. (5B) The T2-weighted HASTE sequence does not offer as much spatial resolution as the CT scan and the StarVIBE.

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