UTILITY OF T1-PETRA SEQUENCE IN THE EVALUATION OF NEONATAL AIRWAYS

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Target audience Radiologists, pediatricians, neonatologists and MR technologists

Purpose The PETRA sequence [1] only requires very limited gradient activity and allows for inaudible scanning. We reported a prototype T1-weighted PETRA sequence [2] produced less acoustic noise and provided good image quality, and can be reliably substituted for MPRAGE in pediatric brain [3]. The purpose of this study was to clarify the clinical efficacy of a prototype T1-PETRA sequence in neonatal airway system.

Methods *Patients* In neonatal patients who underwent routine brain MRI, we tried to run T1-PETRA after routine examinations without applying additional sedation. They were wrapped using a vacuum immobilization bag and their heads were fixed. Their bodies were in various positions allowing for minimal motion. If necessary, intravenous sedation was added for their brain examination. Our IRB approved this prospective study, and written consent was obtained from parents. *MR Imaging* All studies were performed on a 3T clinical scanner (MAGNETOM Verio, Siemens, Erlangen, Germany) using a 32-channel head coil. T1-weighted prototype PETRA protocols are shown in Table 1. T1-PETRA was adjusted to be as short as possible while maintaining sufficient spatial resolution. A large FOV was used to shorten the scan time. As a consequence, neonates' thoraces were visualized and 1mm thickness axial, coronal and sagittal MPR images of the chest were made. *Image analysis* The evaluation was performed using a four-point scale (i.e., excellent: score 3, good: 2, fair:1, and poor: 0) for the visualization of the branching of 1) the trachea, 2) right upper bronchus, 3) left upper and lower bronchi and 4) right middle and lower bronchi in the axial MPR images by the consensus of two pediatric radiologists. "Excellent" means that branching is clearly visualized. "Good" means that branching is visualized and can be evaluated radiologically. "Fair" means that branching is visualized but hard to evaluate. "Poor" means that branching is difficult to see.

Table 1 ***Prototype T1-PETRA***

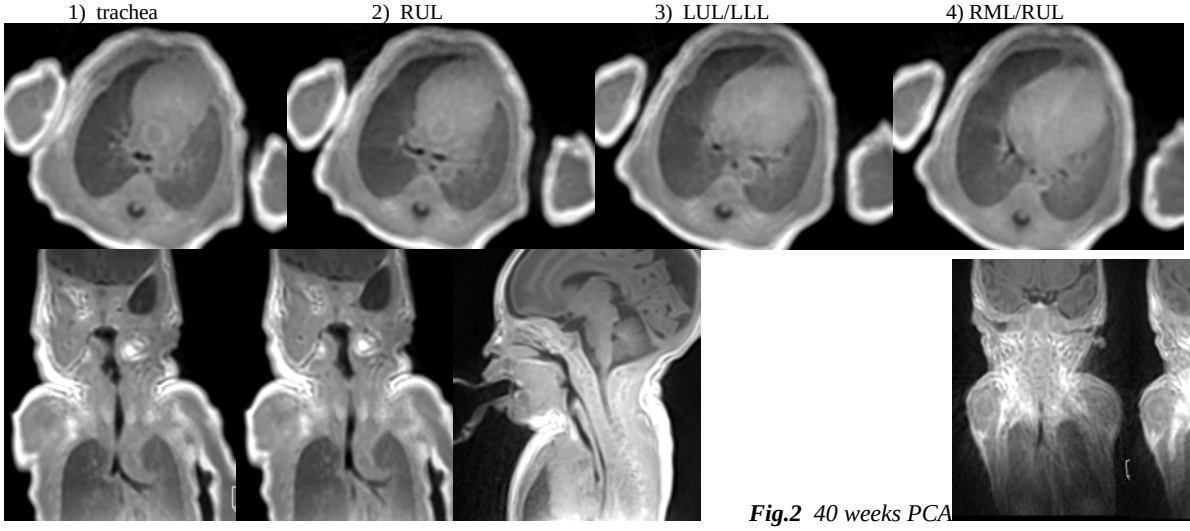
Orientation	Sagittal
FOV(mm)	285
TI(ms)	700
TR(ms)	2350
TE(ms)	0.07
1st TI	1800
echo space	3.75
slice thickness(mm)	0.8
flip angle(deg)	6
matrix	352*352*352
scan time	4:20

Results *Patients* 39 neonates (postconceptional age (PCA): 34-46 weeks, mean & median: 38 weeks) were enrolled for the airway evaluation. *Image analysis* Overall results are shown in Table 2. Airway branching was visualized 100% in the trachea, 79% in the right upper bronchus, 92% in the left upper and lower bronchi, and 74% in the right middle and lower bronchi. Image quality was suitable for radiological evaluation 74% in the tracheal branching, 43% in the right upper bronchus, 56% in the left upper and lower bronchi, and 33% in the right middle and lower bronchi.

Table 2	1) trachea	2) RUL	3) LUL/LLL	4) RML/RUL
3 excellent	16 (41%)	5 (12%)	11 (28%)	4 (10%),
2 good	13 (33%)	12 (30%)	11 (28%)	9 (23%)
1 fair	10 (25%)	14 (35%)	14 (35%)	16 (41%)
0 poor	0 (0%)	8 (20%)	3 (7%)	10 (25%)

Fig. 1 *A neonate boy (PCA: 35 weeks)* All bronchial branching are rated excellent (score 3) in the axial images.

1) trachea 2) RUL 3) LUL/LLL 4) RML/RUL



MPR coronal images An original sagittal image

Fig.2 *40 weeks PCA* Worst score case: all rated poor(0) but trachea as fair(1)

Discussion Of course all babies were breathing during the scan time of more than 4 minutes and some moved their arms, shoulders or thorax resulting in motion artifacts as shown in Fig.2. Lower part of the thorax was located peripheral of the coil and had low SNR. Nevertheless, visualization of the airway system was quite good and more than half bronchial branching were rated suitable for radiological evaluation. One of the reasons of such high percentages may attribute to "Cush Ball" sampling of the prototype T1- PETRA sequence which is not much affected by motion. This study shows that T1-PETRA demonstrates high potential for the pediatric neck and chest imaging including the airway system. In pediatric patients, we should avoid radiation exposure as much as possible. T1-PETRA could be an ideal substitute for 3D-CT of the airway system if we use proper MR coil for the neck/chest and appropriate sedation/immobilization systems for the children.

Conclusion The prototype T1-weighted PETRA sequence is useful and has a great possibility for the radiological evaluation of the airway system in neonates without radiation exposure.

References [1] Grodzki D et al. MRM 2012;67:510-18 [2] Grodzki D et al Proc. ISMRM 2013 [3] Aida N et al Proc. ISMRM 2014