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Title:
Improvement in lung health in primary ciliary dyskinesia

Date:
2022-03-01

Citation:
Schofield, L. M., Chetcuti, P., Maitra, A., Moya, E. & Robinson, P. (2022). Improvement in lung health in primary ciliary dyskinesia. Journal of Paediatrics and Child Health, 58 (3), pp.526-528. https://doi.org/10.1111/jpc.15550.

Persistent Link:
https://hdl.handle.net/11343/298552

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Background

Primary Ciliary Dyskinesia (PCD) is a rare, autosomally inherited, progressive condition in which structural and or functional defects within the airway cilia cause impaired mucociliary clearance. Over time retained secretions and repeated lower respiratory tract infections lead to the development of bronchiectasis. Earlier diagnosis, and subsequent introduction of airway clearance techniques is associated with a lower incidence of bronchiectasis[1]. Physiotherapy interventions known as airway clearance techniques aim to facilitate the clearance of secretions from the airways in conditions where normal mucociliary clearance is impaired. Airway clearance techniques are commonly recommended to people with PCD[2] although the evidence to support their use is limited[3]. This case report of a 13-year-old female (XY) with PCD provides insight into how effective and timely management of PCD can not only preserve lung health but improve the appearance of pre-bronchiectatic changes on CT scans.

Case description

XY was born at full term and had respiratory distress during the neonatal period. An aunt who visited the infant while in neonatal ICU raised the possibility of PCD as she herself had PCD however, the infant was not referred for testing following discharge. During infancy XY developed early onset otitis media with hearing impairment, persistent rhinorrhoea, a daily wet cough and recurrent chest infections. At age 10 she was referred to a tertiary centre for diagnostic testing after her parents, who are first cousins of Pakistani origin, again questioned the possibility of PCD consistent with the family history. At the initial presentation, no finger clubbing or chest wall deformities were evident. A chest X-ray identified radiological abnormalities in the right lung base. A referral was made for nasal ciliary sampling and on light microscopy high speed video analysis all cilia were shown to be dyskinetic with a slow,

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/jpc.15550

circular or elliptical beat pattern. Ciliary beat frequency was calculated at between 8.7-10.0 Hz and 11.1-11.6 Hz on confirmatory retesting. Electron Microscopy identified central microtubular defects in 23% (12.7% on confirmatory retesting) of the cilia. In the confirmatory test complete disappearance of the central pair was seen in 10% of cilia.

Whilst awaiting diagnosis, XY was commenced on oral prophylactic azithromycin, nebulised salbutamol, nebulised 3% saline and required several courses of oral antibiotics. After 5 months on this treatment regimen an initial HRCT chest scan showed mucus plugging with bronchial wall thickening and near complete collapse/consolidation of the right middle lobe, patchy nodular consolidation in the left lower lobe and tree-in-bud appearances in the right upper lobe suggestive of endobronchial spread (Figure 1). During this period streptococcus pneumonia was isolated in her sputum. Following the CT she was commenced on a regimen of a 2 week course of intravenous ceftriaxone every 3 months.

When a formal diagnosis of PCD was made, XY was referred to a tertiary multidisciplinary PCD treatment service. She was reviewed by a physiotherapist and a daily airway clearance regimen including positive expiratory pressure, breathing techniques and positioning were used in conjunction with her nebulised 3% saline to promote airway clearance. Daily sinonasal irrigation with 0.9% saline using a Jala Neti pot was instituted to help clear her upper airway secretions. A trial of 7% nebulised saline (4mls) was poorly tolerated due to high sputum load and bronchospasm. Despite pre-medication with 400ug of Salbutamol, inhalation of 7% nebulised hypertonic saline resulted in a significant reduction in FEV1 (90% to 64% predicted). A bronchoscopy found normal airway anatomy with thick mucus which grew scanty gram positive coccus.

Following 2 years of the described active treatment, improvements were notable. No further bacteria were isolated on repeated sputum samples. A repeat CT scan of her chest showed minimal inflammatory change and peribronchial thickening in the medial segment of right middle lobe. Minimal inflammatory changes were also seen in the medial basal segment of the left lower lobe with no features of bronchiectasis (Figure 2). Lung function also improved (FEV1 106%). At her last review she continue to improve symptomatically and describes a less regular cough however she is still troubled by nasal congestion and significant rhinorrhoea.

Discussion

The inherent defect in PCD is impairment of effective airway clearance both from the lower and upper airway. These impairments, without aggressive treatment, produce mucus retention and subsequent damage to the lower airway resulting in progressive airway inflammation and bronchiectasis. Similar impairment in the upper airway results in chronic sinusitis and hearing loss.

This case demonstrates the effectiveness of an aggressive management regimen and the sensitivity of HRCT to illustrate resultant improvement in structural changes in the lung[4]. The abnormalities seen on the case's first HRCT are in keeping with structural changes described in PCD, specifically segmental collapse consolidation and tree in bud mucus plugging[5]. The move to 3 monthly intravenous antibiotics and the inclusion of effective airway clearance alongside nebulised 3% saline was associated with improvements in both clinical symptomatology and radiological changes on HRCT. Although the use of repeated HRCT in children is guarded due to the exposure to radiation, the use of sequential imaging may provide insight into treatment efficacy, disease severity and prognosis, particularly with the use of newer imaging protocols reducing radiation exposure.

This case illustrates how timely and effective management can halt and reverse changes caused by impaired mucociliary clearance. The institution of this aggressive program of therapy, while showing obvious clinical and radiological improvements in this singular case, is not as yet backed by conclusive evidence from properly conducted clinical trials. What are the actual benefits and contributions of IV antibiotics compared to increased airway clearance associated with periods of intensive in-hospital therapy? With a paucity of evidence on airway clearance in PCD, research is needed to support and understand how we ensure mucus clearance can be optimised clinically in this patient group.

Conclusion

With the introduction of effective management, improvements in symptoms, lung function and appearances on CT scan can be achieved in people with PCD. Further evidence is needed to continue to guide and improve care in patients with progressive lung diseases.

References:

1. Ellerman A, Bisgaard H. Longitudinal study of lung function in a cohort of primary ciliary dyskinesia. Eur Resp J. 1997 Oct 1;10(10):2376-9.
2. Strippoli MP, Frischer T, Barbato A, et al. Management of primary ciliary dyskinesia in European children: recommendations and clinical practice. European respiratory journal. 2012 Jun 1;39(6):1482-91.
3. Schofield LM, Duff A, Brennan C. Airway clearance techniques for primary ciliary dyskinesia; is the cystic fibrosis literature portable?. Paed resp rev. 2018 Jan 1;25:73-7.

4. Maglione M, Bush A, Montella S, Mollica C, Manna A, Esposito A, Santamaria F. Progression of lung disease in primary ciliary dyskinesia: is spirometry less accurate than CT?. Pediatric pulmonology. 2012 May;47(5):498-504.
5. Tadd K, Morgan L, Rosenow T, Schultz A, Susanto C, Murray C, Robinson P. CF derived scoring systems do not fully describe the range of structural changes seen on CT scans in PCD. Pediatric pulmonology. 2019 Apr;54(4):471-7.

Figure legends:

Figure 1: HRCT images at age 10.5

Figure 2: HRCT images at age 12.5

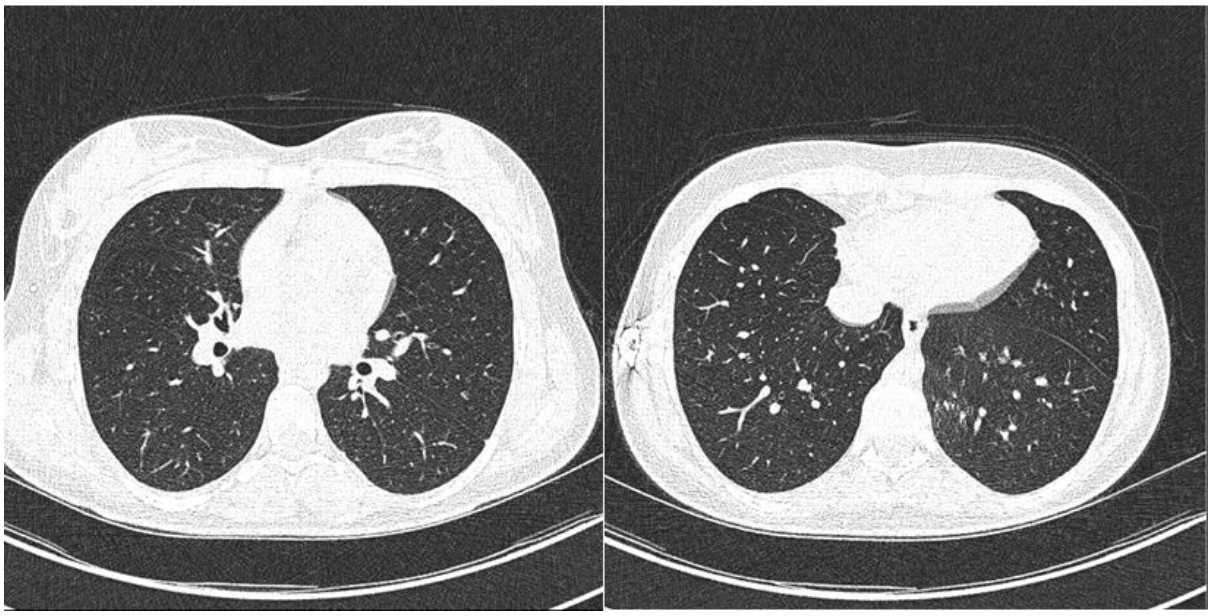

Figure 2: HRCT images at age 12.5

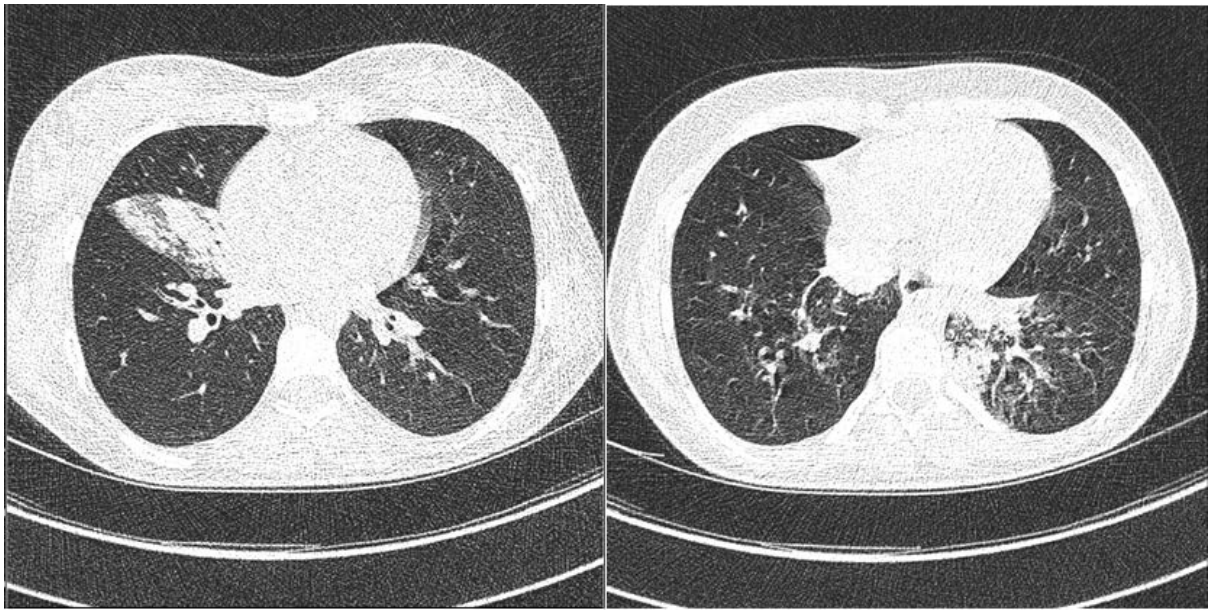

Figure 1: HRCT images at age 10.5

Manuscript title:

Improvement in lung health in PCD through institution of effective treatment regime.

Running title: Improvement in lung health in PCD

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Acknowledgement: The authors would like to thank the patient and their family for their support, input and consent for this case report.

Conflict of interest: None