**TITLE PAGE**

TITLE: BETWEEN A ROCK AND AN AIR-SPACE: PNEUMOTHORAX FOLLOWING EXTRACORPOREAL SHOCK-WAVE LITHOTRIPSY FOR RENAL STONES IN A PATIENT WITH CYSTIC FIBROSIS.

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FIRST/CORRESPONDING AUTHOR:

Dr Freddy Frost BMBS

Respiratory Department

Liverpool Heart and Chest Hospital

Liverpool, L14 3PE, UK

[Freddy.Frost@lhch.nhs.uk](mailto:Freddy.Frost@lhch.nhs.uk)

01512543055

CO-AUTHORS:

Dr Freddy Frost BMBS1

Dr Paul Griffiths MBChB1

Dr Chris Brockelsby MBChB1

Mr Ciaran Lynch MBBCh2

Professor Martin J Walshaw MD1

Dr Dilip Nazareth MBBS1

1= Respiratory Department, Liverpool Heart and Chest Hospital, Liverpool, L14 3PE, UK

2= Urology Department, Royal Liverpool & Broadgreen University Hospital, Liverpool, L14 3PE, UK

**Abbreviation list**

CF Cystic fibrosis

CFRD Cystic fibrosis related diabetes

ESWL Extracorporeal shockwave lithotripsy

FEV1 Forced expiratory volume in 1 second

**Introduction**

Lithotripsy is the preferred treatment in nephrolithiasis and is rarely associated with pulmonary complications. People with cystic fibrosis (CF) are at an increased risk of nephrolithiasis, but pulmonary complications have not previously been described in these individuals following lithotripsy. For the first time, we report the development of a pneumothorax in a person with CF soon after lithotripsy and discuss the potential mechanism of injury. This case highlights one of the hazards of managing patients with advanced pulmonary disease and nephrolithiasis.

**Case report**

A 51 year old man with CF and chronic *Pseudomonas aeruginosa* infection causing severe pulmonary disease (Forced Expiratory Volume in one second 0.94 litres, 34% predicted), underwent extracorporeal shockwave lithotripsy (ESWL) for symptomatic right sided renal calculi. A few hours after an uneventful procedure (3300 shocks) he developed right sided pleuritic chest pain and shortness of breath. A chest radiograph (figure 1) demonstrated a right pneumothorax, confirmed to be loculated to the apex and base on a subsequent CT scan (Figure 2). After 6 days of conservative management the pneumothorax improved and he was discharged home. At follow-up one week later the pneumothorax had completely resolved.

**Discussion**

Symptomatic nephrolithiasis occurs in up to 6% of the CF population, due to a combination of low urine volume, salt depletion and the loss of oxalate-degrading bacteria in the gut secondary to repeated antibiotic use. Lithotripsy is preferred to surgical treatment in CF since it is well tolerated and avoids general anaesthesia. Lithotriptors produce an acoustic field where a high amplitude shock wave results in direct stress dissipated in an elliptical focal zone along its axis, which can be up to 10cm in length. In thin individuals a significant acoustic field may be applied to lung in the costo-phrenic angle and ESWL has been associated with a number of pulmonary complications including haematoma, pulmonary contusion and urinothorax. [1] Although pneumothorax is listed as a theoretical complication, this is the first case report of an ESWL-induced pneumothorax in humans.

Animal studies have shown shock waves to cause emphysema, haemorrhage and structural distortion in the rabbit lung, [2] and significant parenchymal damage including alveolar rupture and haemorrhage in rats [3]. Sound, a propagation of forward energy in the form of pressure waves, has been implicated in humans who developed pneumothoraces whilst listening to loud music at concerts, although whether this is a direct blast effect or related to a particular frequency band of the acoustic pressure wave spectrum is unknown. [4] Our patient had significant underlying lung disease with associated architectural disturbance and hyperinflation presumably predisposing the pulmonary tissue to shock wave damage.

Risk factors for pneumothorax in CF include age, severe lung disease, and *P. aeruginosa* colonisation and it could be argued that our patient was high risk for a spontaneous pneumothorax such the temporal association with ESWL is coincidental. However, the renal stone targeted by ESWL was situated in the upper pole of the right kidney which as an anatomical variant was situated closer to the lungs and diaphragm than usual (figure 3). We suggest this close association further increased lung susceptibility to local tissue damage from shockwaves directed towards the kidney stone.

In summary we present the first case of pneumothorax following ESWL in a patient with CF. This case serves to highlight the pulmonary architectural disturbance seen in CF and should remind clinicians that interventions with normally rare or minor pulmonary complications may well be riskier in this patient group.

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**Figure legends**

Figures

**1 – Plain chest radiograph on presentation demonstrating right sided pneumothorax with background bronchiectatic and consolidative changes**

**2** - Computed tomography demonstrating apical (2a) and basal (2b) aspects of pneumothorax.

**3** – Previous contrast enhanced CT scan demonstrating orientation of right kidney superior to left and abutting the diaphragm. RK = Right kidney, LK = Left Kidney