Case Report

Kartagener's syndrome in a young female: A rare diagnosis in a resource-limited facility

Yusuf Lawal, Muhammed Abba Suwaid, Mansur Adamu Yahuza, Hadijat Oluseyi Kolade-Yunusa[1]

Department of Radiology, Faculty of Clinical Sciences, Bayero University, Kano, [1]Department of Radiology, University of Abuja, University of Abuja Teaching Hospital, Gwagwalada, Abuja, Nigeria

Abstract

Kartagener's syndrome (KS) is a subset of a larger group of ciliary motility disorders called primary ciliary dyskinesia. It is a genetic disease with an autosomal recessive inheritance characterized by inefficient or absent mucociliary clearance. It is a very rare congenital malformation comprising a classical triad of situs inversus, bronchiectasis, and sinusitis. A 22-year-old single female Nigerian came to our health facility with complaints of recurrent productive, non-foul-smelling cough, nasal discharge, and occasional shortness of breath since early childhood. She had a positive history of recurrent hospital visitations and chronic use of antibiotics but with few hospitalizations for recurrent chest infection. Chest examination revealed a maximally audible apex beat on the right side of her chest. Chest radiograph showed dextrocardia, while a chest computer tomography scan revealed cystic and varicose bronchiectatic changes with peribronchial thickening and multiple tiny interstitial nodules, mainly in the bilateral middle and lower lung fields. The patient had a fair response on inhaled steroids, nasal steroid spray, antibiotics, mucolytics, and bronchodilators. She is on follow-up clinic visits and close monitoring for potential complications. Patients with KS exist in resource-poor settings like northern Nigeria, largely being managed as cases of chronic sinusitis, pneumonia, or asthma. Although there is no rapid, reliable, non-invasive diagnostic test for KS, accurate diagnosis is crucial if the risks of complications from advanced disease and reduced quality of life are to be averted.

Keywords: Bronchiectasis, chronic sinusitis, Kartagener's syndrome, situs inversus

Address for correspondence: Dr. Yusuf Lawal, Department of Radiology, Faculty of Clinical Sciences, Bayero University, Kano, Nigeria.
E-mail: lyusuf.rad@buk.edu.ng

Submitted: 20-Jul-2020 **Revised:** 10-Aug-2020 **Accepted:** 18-Jan-2021 **Published:** 22-Apr-2021

INTRODUCTION

Kartagener's syndrome (KS) is a subset of a larger group of ciliary motility disorders called primary ciliary dyskinesias (PCDs). It is a genetic condition with an autosomal recessive inheritance characterized by inefficient or absent mucociliary clearance.[1] It is a very rare congenital malformation comprising a classical triad of situs inversus, bronchiectasis, and sinusitis.[1,2] Although Siewart first described this condition in 1904, it was Manes Kartagener, an internist in Zurich, who recognized the etiological correlation between the elements of the triad and reported four cases in 1933.[1]

In KS, the ultrastructural genetic defect leads to impaired ciliary motility which causes recurrent chest, ear/nose/throat (ENT), sinus infections, and infertility.[1,3] The typical

Access this article online	
Quick Response Code:	Website: www.wajradiology.org
	DOI: 10.4103/wajr.wajr_24_20

How to cite this article: Lawal Y, Suwaid MA, Yahuza MA, Kolade-Yunusa HO. Kartagener's syndrome in a young female: A rare diagnosis in a resource-limited facility. West Afr J Radiol 2021;28:27-30.

clinical picture of PCD is a chronic productive cough which can usually be traced back to early childhood or infancy, chronic rhinitis often with nasal polyposis, chronic or recurrent maxillary sinusitis, and frequent ear infections in childhood.[4]

The respiratory epithelium is lined with cilia that normally carries out an integrated and coordinated mechanism called mucociliary clearance, but in patients with KS, this epithelium is defective resulting in impaired upper airway clearance of pathogens, allergens, debris, and toxins.[3]

The estimated prevalence of PCD is about 1 in 30,000 though it may range from 1 in 12,500 to 1 in 50,000.[1] Most cases have been reported in male patients who are usually almost invariably infertile because of immotile spermatozoa.[2] The nonmotility is due to a variety of ultrastructural defects in respiratory cilia and sperm tail microtubules/axoneme.[5] Diagnosis of this condition is usually clinically accompanied by imaging studies. However, a definitive diagnosis can be made by tests to prove impaired cilia functions following biopsy and genetic studies.[6] Although in a lot of resource-limited facilities as they obtain in most sub-Saharan African countries, radiological evaluation and findings remain relevant in pinning down the diagnosis of KS.

The correct clinical and radiological diagnosis of this rare congenital autosomal recessive disorder in suspected cases is important in the overall prognosis of the syndrome, as many of the complications can be prevented if timely management is instituted despite nonavailability of genetic testing in our resource-limited setting.

CASE REPORT

A 22-year-old single female Nigerian came to the chest clinic with complaints of recurrent cough productive of thick, nonfoul smelling mucoid yellowish–whitish sputum, often associated with positional change. Sputum volume was about 10–15 ml per cough episode; associated recurrent sneezing and nasal discharge; and also has occasional shortness of breath. In addition, she has exaggerated intolerance to fumes and dust. She noticed worsening of her symptoms, 3 months prior to presentation. Symptoms have been recurrent since early childhood. She has had recurrent hospital visitations and chronic use of antibiotics but with few hospitalizations for recurrent chest infection.

The patient was a moderately built dark young lady, who was not dyspneic or coughing and was not short of breath. She was afebrile, conscious, and oriented. No pallor or icterus. Jugular venous pressure was not raised and no feet edema. Nasal evaluation showed boggy, bluish mucosa over bilateral inferior turbinates with yellowish mucoid nasal discharge. On chest examination, there were occasional rhonchi in both lung fields, with no crepitation. Cardiovascular examination was normal except for absent apex beat at the left precordium with the heart sounds maximally audible on the right side of her chest. The rest of the physical and systemic examinations were not remarkable.

Hematological and chemistry laboratory evaluations were not remarkable. Sputum microscopy, culture, and sensitivity with sputum acid-fast bacilli were negative. Chest radiograph showed dextrocardia, while a chest computer tomography (CT)-scan revealed cystic and varicose bronchiectatic changes. It also has peribronchial thickening and multiple tiny interstitial nodules, mainly in the bilateral middle and lower lung fields [Figure 1]. It also shows dextrocardia. Abdominal CT scan reveals abdominal organ adopting mirror images of their normal arrangement [Figures 2 and 3]. Ultrasound scan at this time showed left-sided liver, gallbladder, inferior vena cava, and head of the pancreas. Similarly, a right-sided spleen was demonstrated [Figure 2], Hence, the diagnosis of situs inversus totalis was made. Chest radiographs also showed the two lung fields, heart outline and apex on the right side in keeping with dextrocardia, a right-sided aortic arch, and stomach fundal gas shadow beneath the right hemidiaphragm. There are inhomogeneous opacities with air bronchogram signs noted in the mid and lower lung zones bilaterally due to pneumonitis [Figure 1]. An electrocardiogram also showed inverted P- and T-waves

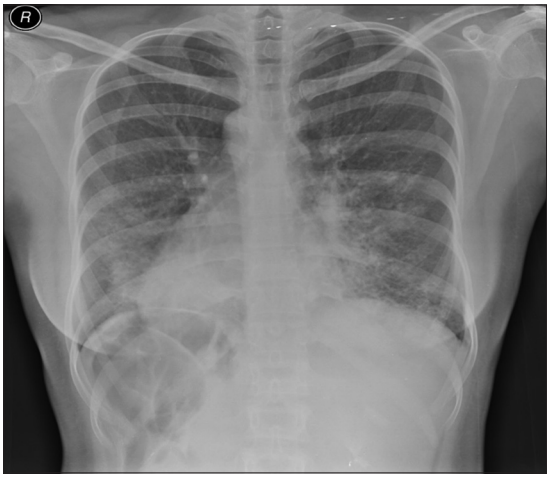

Figure 1: Chest X-ray (PA View) showing cardiac apex on the right side (dextrocardia), a right-sided aortic arch and stomach fundal gas shadow beneath the right hemidiaphragm. There are features of alveolar opacities in the mid and lower lung zones due to pneumonitis

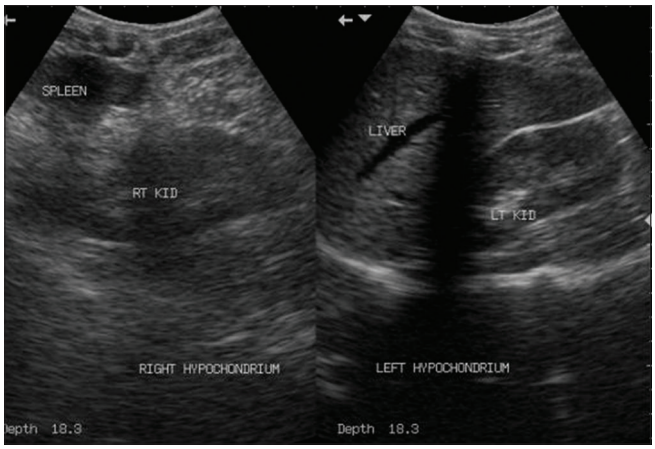

Figure 2: Abdominal ultrasound showing the liver above the left kidney and spleen on the right side (situs inversus)

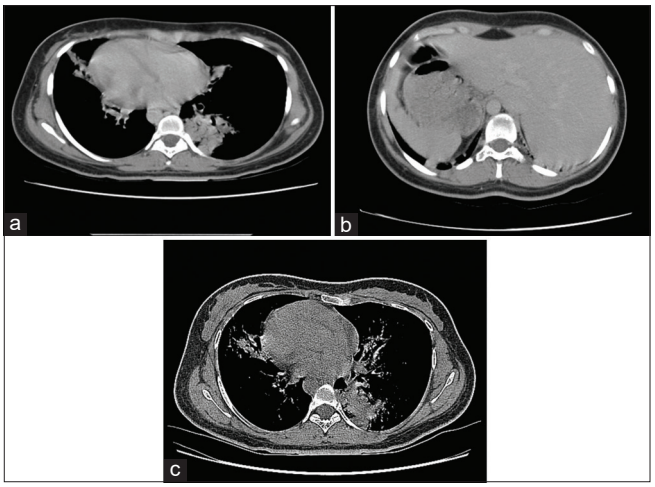

Figure 3: (a) The heart and apex is on the right with well-defined irregularly marginated hypodense lesions noted in the posterior aspect of the mid and lower lung zones sparing the basal region. The bronchioles are seen within the lesions with thickening and dilatation. (b) The liver and inferior vena cava on the left side, while the spleen, stomach gas, and aorta are seen on the right. (c) The bronchioles are seen within an area of consolidation with adjacent pleural thickening posteriorly. There are thickening and dilatation of the bronchioles bilaterally

in lead I, negative deflection of QRS complex, and poor progression of R-wave in the left side chest leads suggestive of dextrocardia. She has a normal audiometry test, while a lung function test showed obstructive lung pattern.

On account of these, a diagnosis of KS was made on the basis of clinical presentation and imaging features [Figures 1-3]. The patient was placed on inhaled steroids, nasal steroid spray, antibiotics, mucolytics, and bronchodilators. She had a fair response to treatment and still comes for follow-up clinic visits and she is being monitored for possible complications.

DISCUSSION

KS is a rare, autosomal recessive ciliopathic disorder characterized by the clinical triad of chronic sinusitis, bronchiectasis, and situs inversus. Its estimated incidence is approximately 1 in 30,000 live births.[1,7] Normal ciliary function is critical for respiratory tract host defense, sperm motility, and normal visceral orientation during embryogenesis.[7] However, cilia may be immotile or may show uncoordinated and inefficient movement patterns. Camner[8] and coworkers first suggested ciliary dyskinesia as the cause of KS in 1975. In their report, they described two patients with KS who had immotile cilia and immotile spermatozoa in addition had poor mucociliary clearance because the cilia that lined their upper airways were not functioning. Normal ciliary function is crucial for respiratory tract host defense, sperm motility, and normal visceral orientation during embryogenesis.[9]

Lack or dysfunction of dynein arms, radial spokes, and microtubules of cilia are recognized structural and functional abnormalities of ciliary ultrastructures, encoded by the mutated genes DNAI1 and DNAH5. These defective genes cause the cilia to be the wrong size or shape or move in the wrong way, making ciliary motility defective and inefficient.[9,10]

The lower respiratory tract contains ciliated epithelium from the trachea to the respiratory bronchioles. Each ciliated cell gives rise to approximately 200 cilia that vary in length from 5 to 6 μm and decrease in size as the airway becomes smaller.[2] Patients with PCD exhibit a wide variety of defects in ciliary ultrastructure and motility, which ultimately impairs ciliary beating and mucociliary clearance. The most common defect, first described by Afzelius, is a reduction in the number of dynein arms, which decreases the ciliary beat frequency.[11] Sturgess *et al*.[12] described how the radial spoke, which serves to translate outer microtubular sliding into cilial bending, was absent in some patients with PCD and also impaired ciliary motility during embryogenesis predisposes to left–right laterality defects like situs solitus (that is, dextrocardia only) or situs inversus totalis where transpositions of thoracic and abdominal organs are noticed.[9,10,13] More recently, Abilo *et al*.[7] reported KS in a 24-year-old Ethiopian adult male who presented with the triad of more than a decade of recurrent episodes of sinonasal symptoms, situs inversus, and imaging features of severely impaired tracheobronchial clearance.

The diagnostic criteria recommended for this syndrome are the history of chronic bronchial infection and rhinitis

from early childhood, combined with one or more of the following features: (a) situs inversus or dextrocardia in a patient or a sibling, (b) living but immotile spermatozoa, and (c) tracheobronchial clearance, which is absent or nearly so.[2,13] In our patient, the diagnosis of KS was made by the presence of chronic sinopulmonary infection and imaging findings of situs inversus totalis with bronchiectasis; however, immotile spermatozoa could not be demonstrated because she was a female.

Laboratory screening tests include exhaled nasal nitric oxide level determination and saccharin test for assessing nasal epithelial mucociliary function. High-speed video microscopy for assessing ciliary beat frequency and pattern, transmission electron microscopic for detecting ultrastructural ciliary defect, and genetic testing for DNAI1 and DNAH5 mutations are confirmatory laboratory tests. Abnormal laboratory findings in KS include reduced nasal nitric oxide level (~10% of normal), prolonged saccharin clearance time (>1 h), reduced ciliary beat frequency (<11 Hz/s), absent ciliary ultrastructure (dynein arms), and mutated DNAI1 and DNAH5 genes.[10,13] Our patient presented with recurrent episodes of sinopulmonary infections from childhood. Imaging findings revealed bronchiectasis, dextrocardia, and situs inversus, which met the diagnostic criteria for KS. Laboratory screening and confirmatory tests, which required a better clinical setup, were not done due to the resource limitation of our facility.

Treatment of this rare congenital disorder includes chest physiotherapy, mucolytics, and antibiotics. A long-term intravenous/oral, intermittent, or continuous prophylactic antibiotics are used to treat upper and lower airway infections in patients with frequent exacerbation of bronchiectasis (≥3 times/year). Influenza and pneumococcal vaccination should be routinely given.[7,13] There is a role for inhaled antibiotics, inhaled and oral corticosteroids, and recombinant DNAs though evidence is largely anecdotal.[2]

On follow-up, our case had a significant response to therapy and the incidence of recurrent infections reduced remarkably.

CONCLUSION

Patients with KS exist in Nigeria, largely being managed as cases of chronic sinopulmonary infections or asthma. Although there is no rapid, reliable, noninvasive diagnostic test for KS, accurate diagnosis is crucial if the risks of complications from advanced disease and reduced quality of life are to be averted. A high degree of suspicion for KS among physicians is of great importance and fertility problems should be tackled once KS is diagnosed.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Palange AM, Shahid M, Sisode MS, Vaishnav B. Kartagener's Syndrome: Case report. Int J Healthc Biomed Res 2013;2:67-9.
2. Sanjay G, Kumud KH, Ravi RK, Pankaj B. A case of Kartagener's syndrome: Importance of early diagnosis and treatment. Indian J Hum Genet 2012;18:263-7.
3. Akita M. Primary Ciliary Dyskinesia/Kartagener Syndrome- Clinical and Genetic Aspects. Available from: https://www.infotechopen.com. [Last accessed 2018 Feb 15].
4. Dabhi AS, Chaudhari SR, Thorat PB, Pandya HB, Shah MC, Meswani UN, *et al*. Kartagener's syndrome: A triad of bronchiectasis, situs inversus, and chronic sinusitis. JIACM 2005;6:241-3.
5. Mari SL, Anu S. Formation and function of sperm tail structures in association with sperm motility defects. Biol Reprod 2017;97:522-36.
6. Shukla V, Fatima J, Karoli R, Chandra A, Khanduri S. An unusual presentation of Kartagener syndrome. JAPI 2011;59:266-7.
7. Abilo T, Hailemariam A, Mezgebu S, Yonathan G. Kartagener's syndrome: A case report. J Med Case Rep 2018;12:1-4.
8. Camner P, Mossberg B, Afzelius BA. Evidence of congenitally nonfunctioning cilia in the tracheobronchial tract in two subjects. Am Rev Respir Dis 1975;112:807-9.
9. Chilvers MA, Rutman A, O'Callaghan C. Ciliary beat pattern is associated with specific ultrastructural defects in primary ciliary dyskinesia. J Allergy Clin Immunol 2003;112:518-24.
10. Lobo LJ, Zariwala MA, Noone PG. Ciliary dyskinesia: Primary ciliary dyskinesia in adults. Eur Respir Mon 2011;52:130-49.
11. Afzelius BA. A human syndrome caused by immotile cilia. Science 1976;193:317-9.
12. Sturgess JM, Chao J, Wong J, Aspin N, Turner JA. Cilia with defective radial spokes: A cause of human respiratory disease. N Engl J Med 1979;300:53-6.
13. Rafi MK. Kartagener's syndrome – A rare case series in female patients. Indian J Med Case Rep 2016;5:33-40.