Case Report

Successful Management of Multiple Obstructing Renal Calculi in a 30-Year-Old Patient with Autosomal Dominant Polycystic Kidney Disease using Frequency-Doubled Double-Pulse Neodymium: Yttrium – Aluminium Garnet Laser Lithotripsy

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Abstract

Autosomal dominant polycystic kidney disease (ADPKD) is the most prevalent genetic disorder that results in end-stage renal disease. Although ADPKD patients experience long disease trajectories, factors such as hypertension, proteinuria and renal calculi have been observed to lead to rapid renal function impairment in patients with ADPKD. Furthermore, due to the distorted anatomy that makes access to stone difficult, the management of nephrolithiasis in ADPKD patients is one of the several special situations in which urinary lithiasis presents management challenges. We report the case of a 30-year-old male with ADPKD and renal function impairment as a result of multiple obstructive calculi who was treated in Dialyser Medical Centre, Oshodi, Lagos, with Frequency-Doubled Double-Pulse Neodymium: Yttrium − Aluminium Garnet laser (FREDDY laser) lithotripsy, highlighting the possible advantage of FREDDY laser over other types of laser procedures given the minimal tissue-damaging potential of the laser type.

Keywords: Autosomal dominant polycystic kidney disease, case report, Frequency-Doubled Double-Pulse Neodymium: Yttrium − Aluminium Garnet laser, lithotripsy, nephrolithiasis

Introduction

The most common genetic disorder associated with end-stage renal disease is autosomal dominant polycystic kidney disease (ADPKD). The hallmark of the disease is the progressive formation of multiple renal cysts, which destroys the renal parenchyma. At a median age of 56 years, approximately 70% of ADPKD patients will develop renal failure.[1]

ADPKD patients have long disease trajectories. However, factors such as hypertension, proteinuria and renal calculi have been observed to lead to rapid renal function impairment in the course of the disease.[2] Renal calculi are five to ten times more common in patients with ADPKD than in the general population. This is thought to be due to the combined effect of anatomical abnormalities and metabolic risk factors hypocitraturia, hyperoxaluria, hyperuricosuria and low urine pH in these patients.[3,4]

The management of nephrolithiasis in ADPKD patients is one of the several special situations in which urinary lithiasis presents management challenges. This is due to the distorted anatomy that makes access to stone difficult and the high risk of complications from the procedure.[3,4] Hence, the need for a careful selection of a therapeutic modality with minimal tissue destruction.

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We report the case of a 30-year-old male with multiple obstructive calculi and renal function impairment, who presented at Dialyser Medical Centre, Oshodi, Lagos, in January 2019 and was successfully managed with stone fragmentation using Frequency-Doubled Double-Pulse Neodymium: Yttrium − Aluminium Garnet (FREDDY) laser lithotripsy with improvement in his renal function despite 3 years of symptomatic flank pain before presentation.

Case Report

The patient is a 30-year-old man who presented at Dialyser Medical Centre, Oshodi, Lagos, on the 19th of January 2019, with a 3-year history of recurrent abdominal pain and worsening renal function. His pain was most severe in the right flank; he had no haematuria, fever, or lower urinary tract symptoms. He was not uraemic at the presentation.

He was a known hypertensive, diagnosed 4 years before presentation, on lisinopril 10 mg daily and amlodipine 10 mg daily. The aetiology of his hypertension and renal function impairment is ADPKD. Medication compliance was poor initially, but he claimed an improvement in the preceding weeks before his presentation. His mother had died 7 years earlier of chronic kidney disease secondary to ADPKD.

Except for an elevated blood pressure of 140/100 mmHg at presentation, the physical examination was unremarkable.

Laboratory results

Serum biochemistry of 19th January 2019 revealed; Urea: 55.2 mg/dl, Creatinine: 3.1 mg/dl, Na+: 136 mmol/L, K+: 3.6 mmol/L, Cl-: 104 mmol/L, HCO3-: 23 mmol/L, Ca2+: 2.24 mmol/L, Uric acid: 0.48 mmol/L, Albumin: 44 g/L, Epidermal growth factor receptor (CKD-EPI): 29.62 ml/min/1.73 m2 and packed cell volume: 37%. Electrocardiography showed Left ventricular hypertrophy. Computed tomography scans are shown in Figures 1 and 2.

A urology consult was scheduled, during which the decision on intracorporeal ureteroscopic lithotripsy intervention was taken. The patient had lithotripsy on the 2nd of February 2019. He was stone-free post-lithotripsy with no recurrence 2 years post-urological procedure [Figure 3]. In addition, his renal function has continued to remain stable 2 years after lithotripsy [Table 1].

Discussion

Nephrolithiasis is common in patients with ADPKD, with a reported prevalence of approximately 3%–59%.[5] Nephrolithiasis exacerbates renal damage and accelerates renal function deterioration. Computerised tomography is the preferred radio-imaging modality for diagnosing lithiasis in patients with ADPKD because renal ultrasound may not detect stones due to difficulties imposed by parenchymal or cyst wall calcifications.[6]

The case presented had multiple obstructing calculi causing moderate calyceal clubbing and ureteral dilatation. The patient's chronic flank pain was probably caused by both nephrolithiasis and ADPKD. The absence of ureteric colic

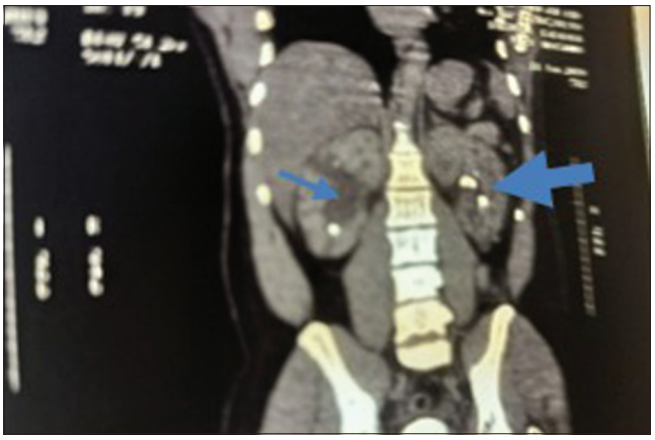

Figure 1: Abdominal computed tomography showing multiple renal calculi (thick arrow) in the left kidney and hydronephrosis (thin arrow) in the right kidney, which also has calculus in its inferior pole

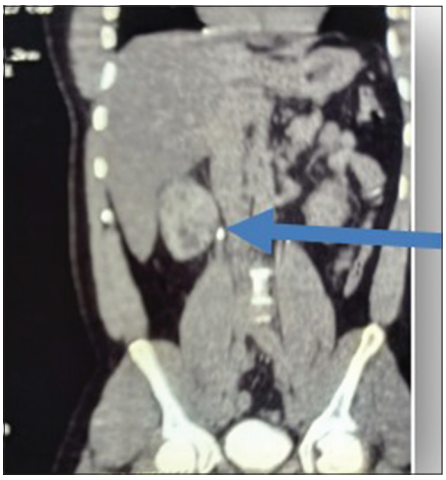

Figure 2: Abdominal computed tomography showing an obstructing ureteral calculus (thick arrow) in the right ureter

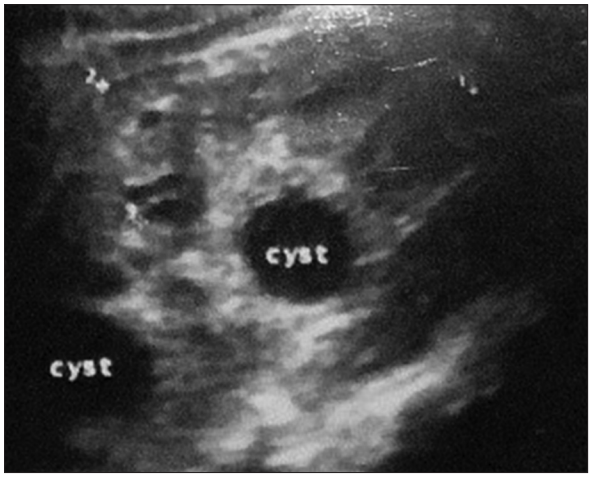

Figure 3: Abdominal scan (13/3/2020) of the right kidney showing multiple cysts in the right kidney. There was no radiological evidence of hydronephrosis and no renal calculus

Table 1: Serial serum urea and creatinine levels at follow-up visits

	03 February 2019	02 March 2019	07 September 2019	19 October 2019	07 March 2020	08 August 2020	04 January 2021
Serum creatinine (mg/dl)	2.4	1.7	2	1.8	1.9	1.2	2
Serum urea (mg/dl)	56	40	35	48	41	20	24

in the patient made the determination of the duration of hydronephrosis difficult. The aggressive disease presentation in the patient (early occurrence of hypertension at the age of 26 years and significant renal function impairment at 30 years) makes ADPKD-1 the most likely genotype. Therapeutic intervention was indicated in the patient to relieve the multiple obstructions caused by the calculi and stop the damage to the renal parenchymal by hydrocalycosis and hydronephrosis.

Approaching nephrolithiasis in ADPKD patients presents many management challenges resulting from the distorted anatomy, making access to stones difficult. In addition, there is a high risk of complications from the procedure.[4] In the last three decades, minimally invasive stone treatments have become more widely available, replacing open surgical approaches almost entirely. Currently, available treatment options for nephrolithiasis include percutaneous nephrolithotomy, extracorporeal shock-wave lithotripsy, laparoscopic ureterolithotomy, lithotripsy and retrograde intrarenal surgery. Opinion, however, varies concerning the efficacy and safety of the various therapeutic modalities.[7] Furthermore, there are inconsistencies in current clinical guidelines regarding the efficacy of these treatment options when compared to one another. Consequently, there is a need for choosing a treatment modality that is effective as well as safe.

The FREDDY and Holmium: YAG lasers are two laser lithotripsy devices commonly used for endoscopic treatment of renal and ureteral calculi. In comparison to older lithotrites, both offer satisfactory stone-free rates and less ureteral injury.[8]

The FREDDY laser was developed specifically for endoscopic lithotripsy and is not suitable for any other urologic procedure. It is a short-pulsed, double-frequency solid-state laser with wavelengths of 532 nm (green light −20%) and 1064 nm (red light −80%). The absorption of the green light results in the formation of a plasma bubble at the stone surface that completely absorbs the infrared component of the laser. Infrared laser energy enhances this plasma to form a rapidly collapsing bubble, which produces a strong shock wave that fragments the stones without any thermal effects.[8]

The potential benefit of the FREDDY laser is that the laser wavelength is preferentially absorbed by stones, while the surrounding tissue absorbs very little energy, limiting injury to the ureteral wall or renal parenchyma.

Although FREDDY laser has been shown to have lower efficacy with uric acid, cystine and calcium oxalate monohydrate stones when compared with Holmium laser due to their absorption characteristics at various wavelengths of energy. FREDDY laser is, however, cost-efficient.[9] It has high safety and rapid fragmentation characteristics and potentially reduces the treatment times required for complete stone removal, especially for large stones.[10]

The patient had laser fragmentation of his multiple stones with FREDDY laser. He experienced no complication during the procedure; he was stone-free after the procedure and remained clinically stable with stable renal function and no stone recurrence 2 years after the procedure.

In conclusion, the cost-effectiveness, high safety and rapid fragmentation characteristics of the FREDDY laser make it an excellent therapeutic modality for consideration in the management of nephrolithiasis in patients with ADPKD, especially in resource-constrained climes such as ours, where the management of complications from endoscopic procedures could make treatment cost unacceptably high.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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