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Case Report

Autosomal dominant polycystic kidney disease (ADPKD) with multiple complications: Management challenges

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Abstract

Autosomal dominant polycystic kidney disease (ADPKD) is the most common hereditary polycystic kidney disease characterized by renal enlargement, resulting in renal failure. In Indonesia, the exact prevalence of ADPKD is unknown due to limited reports on the disease. The aim of this study was to report a case of a patient with ADPKD with multiple complications. A 54-year-old male presented to the emergency room of Dr. Soetomo Academic General Hospital, Surabaya, Indonesia, with a chief complaint of dark-red-colored urine for one week. There was a progressive abdominal enlargement over the past five years, which had become more tense and rigid for the past one month. The patient had a history of fatigue and hypertension with routine follow-up. Physical examination on admission showed normal vital signs, and the abdominal assessment revealed a palpable hard mass approximately 4 cm in size in the right upper abdomen. Laboratory test indicated anemia, leukocytosis, lymphopenia, proteinuria, hematuria, leukocyturia, and elevated serum creatinine and urea levels. Abdominal imaging using ultrasonography, computed tomography (CT) scan, and magnetic resonance imaging (MRI) revealed bilateral kidney and liver enlargement containing multiple cysts, suggesting polycystic kidney and liver disease. There was a ruptured cyst in the middle of the left kidney pole with minimal ascites found in the CT scan. The MRI exhibited the presence of multiple cysts in both kidneys, partially filled with blood. The patient was diagnosed with ADPKD, gross hematuria, acute or chronic kidney disease (CKD), urinary tract infection (UTI), normochromic-normocytic anemia, and metabolic acidosis. Dietary control with high-calorie, high-protein, and low-salt diet; fluid balance; and other symptomatic medications were initiated. It is critical to be aware of risk factors associated with the rapid progression of ADPKD in order to be able to provide a favorable impact on the disease prevention and management.

Keywords: Polycystic kidney disease, ADPKD, hematuria, kidney enlargement, *PKD1* gene

Introduction

Autosomal dominant polycystic kidney disease (ADPKD) is a progressive systemic disorder characterized by multiple bilateral cysts in the renal parenchyma [1-4]. It is the most common hereditary kidney disease with a global prevalence ranging from 1:400 to 1:1,000 and affecting approximately 12 million people worldwide [1,5]. The progressive development of cysts may

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replace renal parenchyma and aggravate renal function, leading to the development of end-stage renal failure (ESRF) in the late phase of the disease that requires renal replacement therapy or hemodialysis [4,6,7]. Globally, ADPKD accounts for approximately 10% of ESRF cases [8].

The affected kidneys frequently grow to a larger size, causing compressive symptoms such as abdominal distension or pain, back pain, nausea, and early satiety. Complications include recurrent gross hematuria from hemorrhagic cyst, recurrent urinary tract infections (UTI) from infected cyst, nephrolithiasis, hypertension, and predisposition to malignancy. About 20% of patients eventually have their kidneys removed [8,9].

Several factors have been associated with rapid ADPKD progression in patients, including *PKD1* gene mutations, onset of kidney failure at the age of <55 years old, stage-3 chronic kidney disease (CKD) occurring at the age of <40 years, male gender, early decrease in glomerular filtration rate (GFR), early onset of hypertension, high total kidney volume (TKV), early onset or repeated episodes of gross hematuria, the presence of proteinuria, and overweight/obesity [9-12]. A good understanding of ADPKD and related risk factors will help in the prevention of the disease progression. Nevertheless, in Indonesia, although the incidence of ESRD has been reportedly increasing over time [13], the exact prevalence of ADPKD is unknown due to limited reports on this disease. The aim of this study was to present a case of ADPKD with multiple complications, along with possible management and therapies.

Case

In November 2022, a 54-year-old male presented to the emergency room of Dr. Soetomo Academic General Hospital, Surabaya, Indonesia, with a chief complaint of dark-red-colored urine for one week, but without dysuria. There was a gradual enlargement of the abdomen over the past 5 years, which had become more tense and rigid for a month prior to the hospital admission (**Figure 1A**). Occasional discomfort and abdominal bloating were also reported, whereas nausea, vomiting, abnormal vowel movement and low appetite were denied.

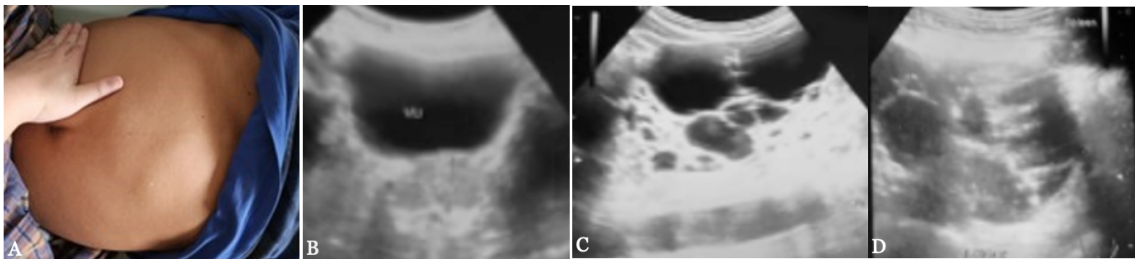

Figure 1. Physical observation of abdomen (A) and urology ultrasound (B-D) of the patient. The clinical shows enlarged, tense, and rigid abdomen (A) and urology ultrasound showed bilateral kidney enlargement (A) with multiple cysts (B) and calcifications (C).

The patient had a history of getting fatigued easily and hypertension since 2014. A previous abdominal ultrasound at Kodam Brawijaya Hospital, Surabaya, Indonesia, showed multiple cysts in the liver and kidneys, but no specific management was provided. Two years later, the patient was referred to Dr. Soetomo Academic General Hospital, Surabaya, Indonesia, due to persistent symptoms and increased fatigue. Starting in 2022, the patient underwent routine follow-up at the kidney and hypertension polyclinic of Dr. Soetomo Academic General Hospital and received sodium bicarbonate 1×500 mg, nifedipine 1×30 mg, bisoprolol 1×2.5 mg, allopurinol 1×100 mg, and folic acid. There was no history of trauma, weight loss, diabetes mellitus, heart disease, liver disease, or autoimmune disorders. A family history of similar illness was also denied.

Physical examination on admission revealed a good general condition, compos mentis, Glasgow coma scale (GCS) of E4V5M6, and stable vital signs (blood pressure of 110/80 mmHg, heart rate of 86 x/min, respiratory rate of 20 x/min, peripheral saturation of 99% without oxygen supplementation, and axillary temperature of 36.5°C). Examinations of the head and neck, chest, lungs, and extremities suggested normal results. The abdominal assessment revealed a slightly distended stomach without collateral veins or caput medusae dilatation and a palpable hard mass of approximately 4 cm in size in the right upper quadrant (RUQ) of the abdomen, with a soft consistency and smooth surface.

Initial laboratory investigations indicated anemia, leukocytosis, lymphopenia, and elevated serum creatinine and urea levels. The hepatitis B surface antigen (HBsAg) and HIV tests were negative. Urinalysis showed proteinuria, hematuria, and leukocyturia, whereas glucose and ketone were negative (**Table 1**). The results of the chest x-ray exhibited normal heart and lungs. Urology ultrasound revealed kidney enlargement (right: 4.1×4.9×9.8 cm and left: 5.4×6.9×10.8 cm), multiple bilateral kidney and liver cysts, suggesting features of polycystic kidney and liver diseases (**Figure 1B-D**). The results of the bladder or prostate examinations were within normal limit.

Table 1. Serial laboratory test of the patient

Lab parameters (unit)	Results				
	First admission			Second admission	
	Day 1	Day 4	Day 7	Day 1	Day 4
Blood analysis					
Hemoglobin (g/dL)	8.7	7.8	8.4	7.2	10.2
Hematocrits (%)	25.7	24.5	26.1		
Mean corpuscular volume (fL)	89.2	89.1	90.0		
Mean corpuscular hemoglobin (pg)	30.2	28.4	29.3		
Leukocytes (/µL)	19,920	10,790	11,260		
Platelets (/µL)	237,000	247,000	290,000		
Neutrophils (%)	86.9	79.3	79.0		
Lymphocytes (%)	5.9	10.7	10.3		
Aspartate aminotransferase (U/L)	27.8	25.0	17.8		
Alanine transaminase (U/L)	32.4	32.0	17.8		
Blood urea nitrogen (mg/dL)	53.5	55.0	40.6	52.8	15.0
Serum creatinine (mg/dL)	6.75	6.2	5.39	4.8	1.2
Albumin (g/dL)	3.4	2.7	2.8		
Sodium (mmol/L)	130.0	142.0	135.0		
Potassium (mmol/L)	4.2	4.6	4.3		
Chloride (mmol/L)	106.0	102.0	113.0		
Random blood glucose (mg/dL)	191.0				
Partial thromboplastin time (seconds)	11.2				
Activated partial thromboplastin time (second)	31.7				
Total bilirubin (mg/dL)	0.6	0.3	0.3		
Direct bilirubin (mg/dL)	0.4	0.1	0.1		
Hepatitis B surface antigen	Non-reactive				
HIV test	Non-reactive				
Uric acid (mg/dL)		7.47	6.9		
Procalcitonin (ng/mL)		9.44	4.97		
Calcium (mg/dL)		8.01			
Phosphate (mg/dL)		3.41			
Urine analysis					
pH					
Protein	3+			1+	
Leukocyte	3+			3+	
Red blood cell	3+				
Glucose	Negative				
Ketone	Negative				
Nitrite				Positive	
Blood gas analysis					
pH	7.34				
pO_2 (mmHg)	80.0				
pCO_2 (mmHg)	26.0				
HCO_3 (mmol/L)	14.0				
Base excess (mmol/L)	11.8				
SO_2 (%)	95.0				

Based on all the anamnesis, physical examination, and additional workups, the patient was diagnosed with abdominal mass suspected ADPKD, gross hematuria, acute kidney disease or CKD with suspected multiple cysts on bilateral kidney, UTI, normochromic-normocytic anemia, and metabolic acidosis. Initial treatments included a high-calory, high-protein, and low-salt diet 2100 kcal/day; fluid balance; IV ceftriaxone 2×1 g; IV metronidazole 3×500 mg; IV tranexamic acid 3×500 mg; oral paracetamol 3×500 mg, oral folic acid, oral N-acetylcysteine 3×200 mg, and

oral nifedipine 1×30 mg. The patient was then advised to undergo an abdominal CT scan, blood test workups (calcium, phosphate, uric acid, complete blood count, and renal function), urinalysis, and blood culture tests every three days.

On the third day of admission, hematuria was resolved. The patient was compos mentis (GCS score: 456) with normal vital signs (blood pressure of 110/82 mmHg, heart rate of 90 x/min, respiratory rate of 20x/min, temperature of 36.5°C, and oxygen saturation of 98%). On the following day, the patient was hypertensive (blood pressure 122/91 mmHg), and the results of blood tests were indicative of anemia, hypocalcemia, leukocytosis, lymphopenia, and hypoalbuminemia. Elevated serum creatinine, urea nitrogen, and procalcitonin levels were recorded. Allopurinol tablets (3×100 mg orally) were then given as an additional therapy along with previously prescribed medications.

The abdominal CT scan, performed on the fifth day of treatment, showed bilateral kidney enlargement, with the sizes of 9.0×7.7 x 18.9 cm (right) and 7.8×9.7×14.2 cm (left). Multiple cysts were detected in both kidneys and liver, suggesting polycystic kidney and liver diseases. There was also a ruptured cyst in the middle of the left kidney pole with minimal ascites. Other conditions, such as hepatomegaly (midclavicular-craniocaudal length of ±32 cm), bilateral nephrocalcinosis, right pleural effusion, aortosclerosis, and lumbar spondylosis were also discovered (**Figure 2**).

On the seventh day of admission, the patient exhibited a good general condition (GCS 456) with normal vital signs (blood pressure 110/78 mmHg; heart rate 86 x/min; respiratory rate 20x/min; temperature 36.7°C; and SpO_2: 98% without oxygen supplementation). Although anemia, lymphopenia, and hypoalbuminemia persisted, and elevated procalcitonin (4.97 ng/mL), urea (40.6 mg/dL), and creatinine (5.39 mg/dL) levels had not completely been resolved, the patient condition improved. Thus, the patient was discharged from the hospital and the current medications were continued.

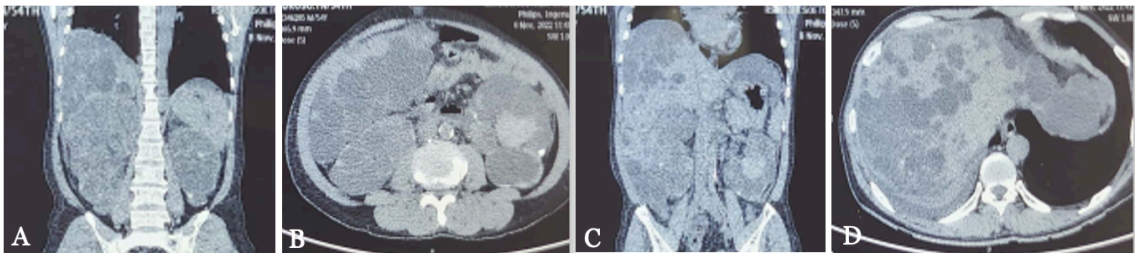

Figure 2. Abdominal CT scan revealed bilateral kidney enlargement with multiple cyst lesions. Calcifications are seen in the upper to lower poles of both renal parenchyma, along with a hyperdense lesion in the middle pole of the left kidney (A-B). An enlarged liver with a kissing sign appearance, containing multiple multiloculated cystic lesions in the right and left lobes are also observed (C-D).

Two weeks after the hospital discharge, the patient returned to the nephrology clinic of Dr. Soetomo Academic General Hospital, Surabaya, Indonesia, with the complaint of fatigue for three days. Urine color and volume (1500 cc/day) were observably normal, but the patient reported fluctuating pain and burning sensation during micturition. Blood pressure on admission indicated hypertension (140/100 mmHg), whereas other vital signs were within normal limits (GCS of 456, heart rate of 86 x/min, temperature of 36.7°C, respiratory rate of 20 x/min, and SpO_2 of 98% without oxygen supplementation). Laboratory test exhibited anemia and elevated blood urea and serum creatinine levels. Complete urinalysis showed positive nitrite, leukocytes of 3+ and protein of 1+, leading to the diagnosis of polycystic kidney disease, acute or CKD, normochromic normocytic anemia, and UTI. The patient was then referred to the urology division and scheduled for an MRI scan. NaCl 0.9% infusion 500cc for 24 hours, ceftriaxone 2×1 g, and packed red cell (PRC) transfusion were given. On the fourth day of admission, the patient was discharged from the hospital as the condition improved (hemoglobin 10.2 g/dL, blood urea 15 mg/dL, and serum creatinine 1.2 mg/dL). The MRI suggested polycystic kidney and liver disease. Both kidneys were observably enlarging consisting of multiple cysts, which were partially filled with blood. The largest size of the cysts were 6.2×6.7×7.3 cm and 3.8×4.6×6.0 cm in the right and

left kidney, respectively. In addition, enlarged liver with multiple cystic lesions in the right and left lobes were also found, with the largest cystic size of 6.5×6.3×5.4 cm on the segment V of the right lobe (**Figure 3**). The patient was treated asymptomatically and the UTI, hematuria and the hypertension were treated as previously mentioned. On December 8, 2023, the patient started hemodialysis due to severe metabolic acidosis with high serum creatine. The transplantation was not done due to resource limitation.

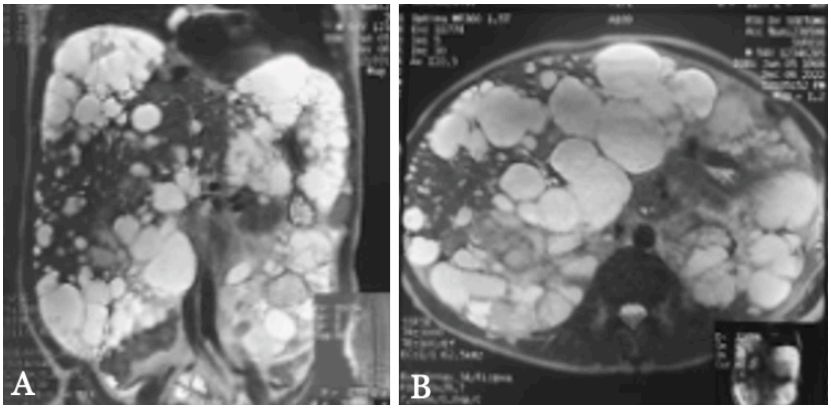

Figure 3. Abdominal magnetic resonance imaging (MRI) suggests an enlargement of both kidneys, containing multiple cysts partially filled with blood (A). Hepatomegaly with multiple cysts in the right and left liver lobes are also observed, with the highest cyst (6.5×6.3×5.4 cm in size) found in the segment V of the right lobe (B).

Discussion

ADPKD is a monogenic inherited kidney disease characterized by the progressive development and growth of numerous bilateral renal cysts, leading to renal dysfunction. Clinical symptoms may include early-onset hypertension, abdominal bloating and pain, hematuria, UTIs, and renal failure [1,4,9]. ADPKD can be diagnosed using imaging such as ultrasonography, MRI, or CT scan [14-17]. Individuals with multiple bilateral kidney cysts without manifestations of other cystic kidney diseases; having cysts in other organs, including the liver in particular, seminal vesicles, pancreas, and arachnoid membrane; showing kidney or liver enlargement on physical examination; having hypertension before the age of 35 years; having an intracranial aneurysm; and having a family history consistent with autosomal dominant inheritance should be suspected of developing ADPKD [4,14,18-21].

In the present case report, the patient presented with a chief complaint of dark-red-colored urine for a week with progressively enlarging abdomen over the past five years, which had become more tense, rigid, and bloated for the last one month before the hospital admission. A palpable hard mass with a smooth surface, approximately 4 cm in diameter, was found in the upper abdomen on physical examination. The patient had a history of hypertension with routine follow up. The imaging studies (ultrasound, CT scan, and MRI) revealed bilateral kidney and liver enlargement due to the presence of multiple cysts, suggesting polycystic kidney and liver diseases. Some of the cysts in the right and left kidney were filled with blood. There were also bilateral nephrocalcinosis, right pleural effusion, and aortosclerosis. These clinical manifestations in the patient were indicative of ADPKD.

The progression of ADPKD is typically monitored through changes in serum creatinine and estimated glomerular filtration rate (eGFR), particularly in patients with impaired kidney function [1]. Measurement of TKV, reflecting the gradual expansion of renal cysts in ADPKD, is also considered a valuable biomarker for treatment effects in clinical trials and is more sensitive for the evaluation of the disease progression compared to serum creatinine or GFR [22]. The US Consortium for Radiologic Imaging Studies in Polycystic Kidney Disease (CRISP) has evidenced that kidney enlargement is the first manifestation of the disease, and a higher TKV has been associated with several ADPKD complications including proteinuria, microalbuminuria, hypertension, gross hematuria, and progressive loss of kidney function [1].

The patient in the present case had elevated serum creatinine levels throughout the period of treatment (**Table 1**). Other conditions, such as hypoalbuminemia, proteinuria, hematuria, and

leukocyturia, were also recorded during the blood test workup. Based on TKV measurement, the patient was classified into Mayo class 1C, with a TKV score of 685.3 cm^3, suggesting a rapid disease progression to end-stage kidney diseases (ESKD). Several factors, such as *PKD1* gene mutations, age, male gender, early decrease in GFR, early onset of hypertension, high TKV (Mayo classification 1C-1E), early onset or repeated episodes of gross hematuria, hypertensive women with ≥3 pregnancies, proteinuria, microalbuminuria, elevated serum copeptin levels, and overweight/obesity have been associated with rapid progression of ADPKD [9-12,23-25]. However, PKD1 mutations in this patient are unknown since the test was done due to resource limitations.

Current treatment strategies for patients with ADPKD are divided into two major categories: lifestyle change measures and pharmacological therapies. Supportive measures aim to reduce morbidity and mortality associated with ADPKD manifestations, which include strict blood pressure control, increased water consumption to reduce vasopressin level [26,27], lipid control to delay ESKD, moderation of dietary phosphorus and caloric intake, avoiding smoking and alcohol consumption, and engaging in regular exercises [5]. In terms of pharmacological treatment, tolvaptan is the only medication for ADPKD demonstrating beneficial disease-modifying properties in adults [1]. In this study, the patient was treated both lifestyle measures and pharmacological therapies with favorable outcome. The five-year survival rate of the patient is expected 56–68% based on the available study [28].

Conclusion

We reported a case of a 54-year-old male with a progressively enlarged abdomen, gross hematuria, and bilateral kidneys enlargement containing multiple cysts, partially filled with blood. The patient was diagnosed with ADPKD with some complications. Therapeutic regimens encompassed diet control, fluid balance, and several medications targeting the treatment of symptoms in the patient. It is prominent to be aware of risk factors associated with the rapid progression of ADPKD for it could give a great impact on the disease prevention and management.

Ethics approval

The patient provided written informed consent for publication as a case report.

Competing interests

The authors declare that there is no conflict of interest.

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Underlying data

All data are available as part of the article.

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