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Case Report

Incidental crossed fused renal ectopia in a low-resource setting: Lessons from Ghana on diagnostic accuracy and imaging practice ☆,☆☆

Gilbertson Allorsey, MPhil, MSc, BSc[a,b,*], *Albert Dayor Piersson, PhD*[c], *Nana Akua Konama Osei-Kwame, MBCHB*[a], *Shadrach Thompson, BSc*[a], *Patrick Osei Adu, BSc*[a], *Mark Amo Aikins, BSc*[a], *Ebenezer Sekyere Osman, BSc*[a], *Freda Appiah Asante, BSc*[a]

[a] *Radiology Department, Sunyani Teaching Hospital, P.O. Box 27, Sunyani, Ghana*
[b] *Marvelous Diagnostic Services, Imaging Department, Little Wood Avenue, Sunyani, Ghana*
[c] *School of Science, Technology & Health, York St John University, De Grey Building/Room DG 311, Lord Mayor's Walk, York, UK*

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ABSTRACT

Crossed fused renal ectopia (CFRE) is a rare congenital renal anomaly in which both kidneys are fused and located on the same side of the midline, often remaining clinically silent but carrying important implications because of aberrant vascular and ureteric anatomy. We report an incidental finding of CFRE in a 55-year-old Ghanaian woman who underwent routine abdominal ultrasound, which demonstrated bilaterally empty renal fossae and a lobulated reniform structure in the right iliac region. The mass showed preserved corticomedullary differentiation with a small cortical cyst, and subsequent contrast-enhanced computed tomography (CT) confirmed a right-sided lump-type CFRE with two distinct collecting systems, separate ureters crossing the midline to insert normally into the bladder, and anomalous renal arteries arising from the right common iliac and lower aortic branches. Multiphase abdominopelvic CT performed with optimized parameters (CTDIvol 17.12 mGy per series; estimated effective dose 33 mSv) provided comprehensive anatomic and vascular delineation, while laboratory evaluation revealed preserved renal function (eGFR 76 mL/min/1.73 m^2) with only trace leukocyturia. This case illustrates that CFRE may remain asymptomatic into

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* Corresponding author.
E-mail address: gallorsey@gmail.com (G. Allorsey).

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late adulthood and emphasizes the complementary role of ultrasound and CT in diagnosis, particularly in resource-limited settings. Awareness of the condition and its associated vascular variants is essential for accurate interpretation, radiation-justified imaging, and safe surgical or interventional planning.

Introduction

Congenital anomalies of the kidneys and urinary tract (CAKUT) represent a broad and heterogeneous group of developmental malformations encompassing defects in renal migration, rotation, fusion, and duplication. These anomalies account for a substantial proportion of structural congenital disorders identified in both pediatric and adult populations and often cause chronic kidney disease in later life [1]. Among the spectrum of congenital anomalies of the kidneys and urinary tract, crossed fused renal ectopia (CFRE) is a particularly rare but clinically significant anomaly characterized by the presence of both kidneys on the same side of the vertebral column, fused in variable configurations. The ureter of the ectopic kidney usually maintains its normal contralateral insertion into the urinary bladder trigone, preserving functionality despite an aberrant anatomic course [1,2].

Epidemiologically, CFRE has a reported incidence of 1 in 1000 to 1 in 7500 live births, with a slight male predominance and a tendency toward left-to-right fusion [3,4]. Though frequently asymptomatic and incidentally detected, the anomaly carries important clinical implications due to its potential association with urinary tract infection (UTI), nephrolithiasis, obstruction, and hypertension [5,6]. The atypical vascular and ureteric anatomy further complicates interventional and surgical procedures, emphasizing the need for precise preoperative delineation.

With recent advances in diagnostic imaging, particularly ultrasonography, computed tomography (CT), and magnetic resonance urography (MRU), detection and characterization of renal fusion anomalies have markedly improved. Ultrasound remains the preferred first-line modality in most clinical settings for its accessibility, noninvasiveness, and cost-effectiveness, while CT and MRU provide superior spatial and vascular definition [1]. However, in resource-limited environments such as sub-Saharan Africa, reliance on ultrasound persists, and documentation of CFRE cases remains sparse.

This report presents an incidentally detected CFRE in an asymptomatic 55-year-old Ghanaian woman, illustrating the diagnostic capability of routine ultrasonography and confirmatory CT in a low-resource context. The case contributes to the limited African literature on renal fusion anomalies and highlights the importance of awareness, accurate diagnosis, and longitudinal follow-up.

Case presentation

A 55-year-old Ghanaian woman was referred from a private health facility to a private diagnostic center in Sunyani, Ghana, for a routine laboratory and abdominal ultrasound examination as part of a general health assessment. She was asymptomatic at presentation and reported no history of flank or abdominal pain, dysuria, hematuria, urinary frequency, or lower abdominal swelling. There was no prior history of renal disease, nephrolithiasis, trauma, or abdominal surgery. She had a known history of peptic ulcer disease and intermittently elevated blood pressure, for which she was on routine follow-up. There was no known history of diabetes mellitus or autoimmune disease, and her family history was non-contributory for congenital renal or urological anomalies. On physical examination, she was afebrile, with a stable blood pressure of 128/82 mmHg and pulse rate of 78 beats per minute. Abdominal examination was unremarkable; there was no tenderness, palpable mass, or organomegaly, and bowel sounds were normal. An interview with the patient revealed that she was gravida 5, para 5, with all deliveries via spontaneous vaginal delivery and without any known complications. She had no history of major illnesses or previous surgical interventions.

Ultrasound findings

A comprehensive abdominopelvic ultrasound examination was performed using a curvilinear transducer (3.5-5 MHz) on a GE Logiq E9 ultrasound system. Both renal fossae were noted to be empty, with neither kidney visualized in its expected anatomical location. Instead, a lobulated reniform soft-tissue structure was identified within the right iliac region, measuring $9.3 \times 4.5 \times 7.9\ cm^3$ (estimated volume ≈ 170.9 mL). The structure demonstrated a characteristic reniform configuration with preserved corticomedullary differentiation, consistent with renal parenchyma. A well-defined cortical cyst measuring $1.8 \times 1.3\ cm^2$ was observed at the upper pole. There was no evidence of hydronephrosis or renal calculi.

The liver was normal in size, measuring 12.3 cm along the mid-clavicular line, with homogeneous echotexture, smooth margins, and no focal lesions. The gallbladder demonstrated normal wall thickness without intraluminal calculi or masses. The spleen was normal in size (9.3 cm in length) and exhibited a homogeneous parenchymal echotexture. The urinary bladder showed normal wall thickness and contour, with no intraluminal abnormalities detected.

These findings were highly suggestive of a CFRE of the right-sided lump type, where both kidneys are fused and located on the same side of the midline. The uterus and ovaries were unremarkable. Based on the ultrasound report, a contrast-enhanced abdomino-pelvic CT scan was requested to further examine the patient (Figs. 1 and 2).

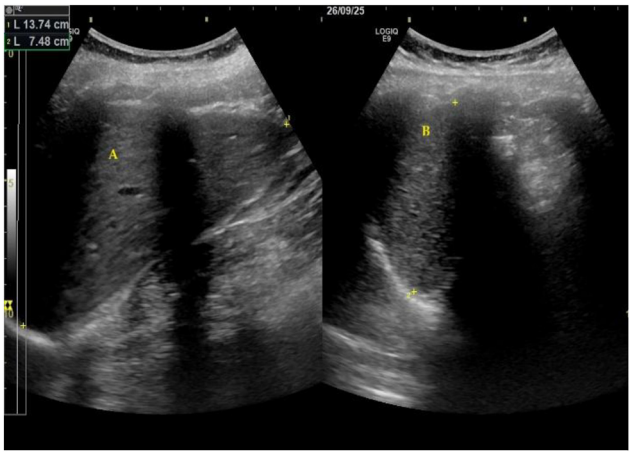

Fig. 1 – 2D abdominal ultrasound image showing the liver on the left (A) and the spleen on the right (B), with absence of kidneys in their respective fossae.

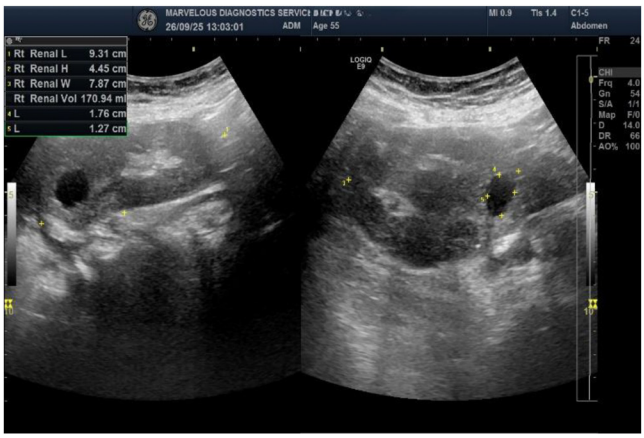

Fig. 2 – 2D abdominal ultrasound image demonstrating crossed fused renal ectopia (CFRE) located in the right iliac region, with a small cortical cyst visible.

CT correlation

A contrast-enhanced CT scan of the abdomen and pelvis was subsequently performed for confirmation. The study demonstrated fusion of both kidneys in the right iliac fossa, forming a single lobulated renal mass with distinct upper and lower moieties. Each moiety possessed a separate collecting system and independent ureters that descended and crossed the midline to insert into the bladder in normal anatomical positions. A small cortical cyst was identified, with no evidence of calculus formation or pelvicalyceal dilatation. The renal vessels originated anomalously from branches of the right common iliac and lower abdominal aorta. The remaining abdominal organs, including the liver, pancreas, spleen, and gallbladder, appeared normal (Figs. 3–6).

In relation to scan acquisition parameters and patient exposure, the CT dose report for this examination detailed

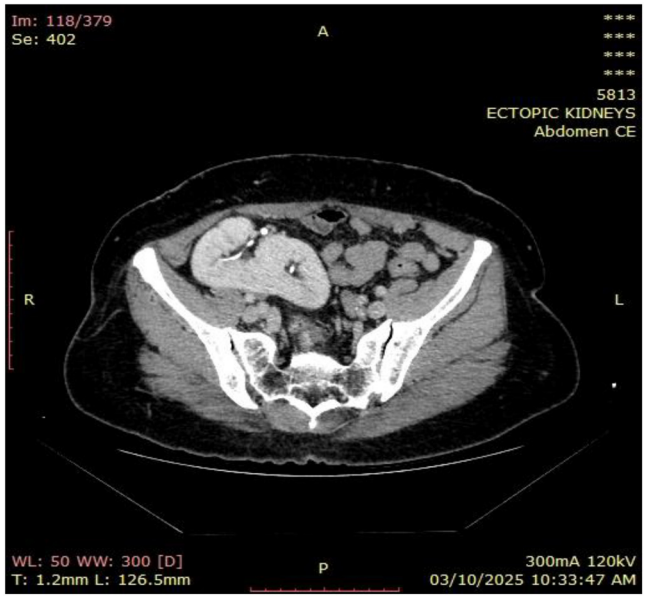

Fig. 3 – Contrast-enhanced axial computed tomography (CT) image of the abdomen (nephrogenic phase) demonstrating crossed fused kidneys in the right iliac region, each with a distinct ureter.

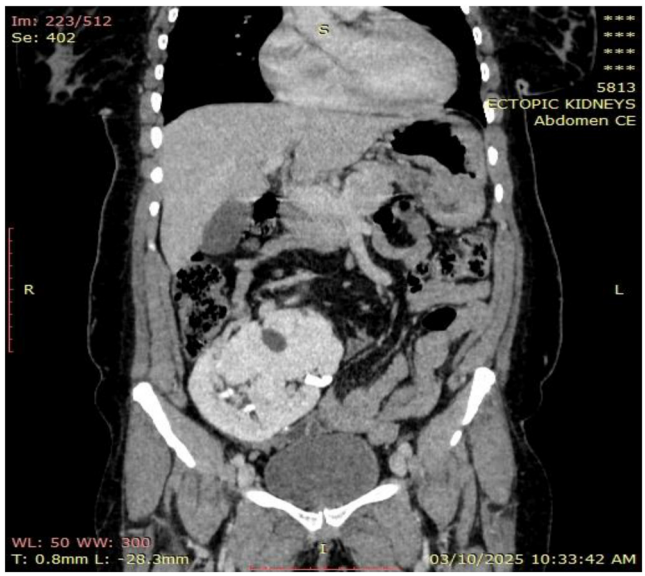

Fig. 4 – Contrast-enhanced coronal computed tomography (CT) image of the abdomen (nephrogenic phase), demonstrating crossed fused renal ectopia (CFRE) situated in the right iliac region, with a small cortical cyst.

a multiphase contrast-enhanced abdominopelvic study performed for comprehensive evaluation of the ectopic kidneys using a SINO VISION InsitumCT 338, 32-slice machine. The protocol comprised five series: two scout images and three helical acquisitions, all conducted at 120 kVp. The helical scans were performed with a tube current of 210 mA, yielding a con-

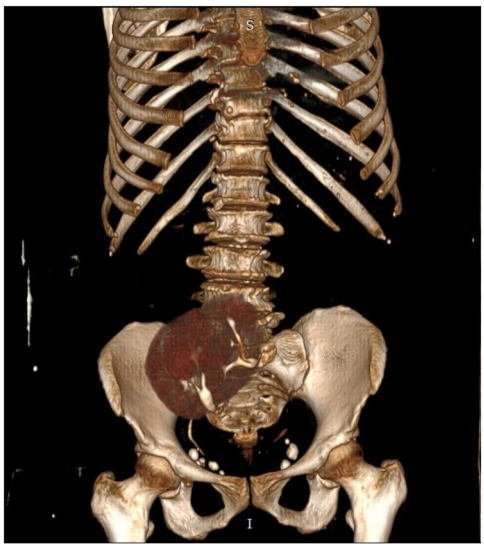

Fig. 5 – 3D volume-rendered computed tomography (CT) image of the abdomen (nephrogenic phase), demonstrating crossed fused renal ectopia (CFRE) in the right iliac region, with each moiety exhibiting a separate ureter.

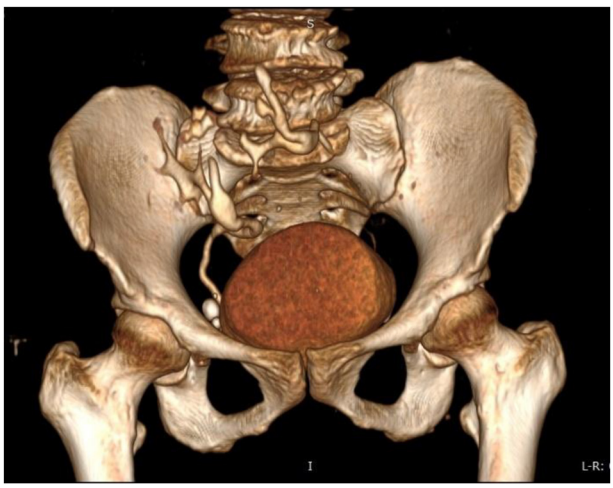

Fig. 6 – 3D volume-rendered computed tomography (CT) image of the pelvis (excretory phase), demonstrating crossed fused renal ectopia (CFRE) in the right iliac region, with each moiety exhibiting a separate ureter.

sistent CT dose index volume (CTDIvol) of 17.12 mGy per series and corresponding dose-length products (DLPs) of 860.51, 868.54, and 486.41 mGy·cm, respectively. The total study dose-length product amounted to 2213.47 mGy·cm, based on the 32 cm body phantom standard for adult patients. Using the standard abdominal conversion factor (k = 0.015 mSv/mGy·cm), the estimated effective dose for the entire examination was approximately 33 mSv, a value consistent with typical multiphase renal CT protocols optimized for detailed anatomic and vascular characterization.

Laboratory evaluation

Routine laboratory investigations were performed to assess metabolic and renal function. The renal function test results were within normal range:

- *Urea*: 3.5 mmol/L (reference: 2.1-8.2 mmol/L)
- *Creatinine*: 86 μmol/L (reference for females: 53-106 μmol/L)
- *eGFR*: 76 mL/min/1.73 m^2, corresponding to CKD Stage 2 (mild reduction).

Liver function tests revealed normal total protein (64 g/L), albumin (41 g/L), and transaminase levels (aspartate aminotransferase—27 U/L, alanine transaminase—32 U/L). Lipid profile showed a mildly elevated total cholesterol level (5.41 mmol/L) but normal triglyceride, high-density lipoprotein, and low-density lipoprotein values.

Urinalysis demonstrated trace leukocytes and erythrocytes, yeast cells (+), and no proteinuria, glucosuria, or nitrites. The urine was straw-colored and slightly hazy in appearance. Blood film for malaria parasites and typhoid (IgG/IgM) tests were negative. HbA1c was 5.9% (nondiabetic range).

Clinical impression

The collective sonographic, CT, and laboratory findings confirmed a diagnosis of CFRE (type C—lump kidney) in the right iliac region with a small incidental simple cortical cyst and preserved renal function. The patient was counseled on the benign nature of the anomaly and advised periodic follow-up for renal function monitoring and infection surveillance.

Discussion

Epidemiology and clinical significance

CFRE constitutes approximately 0.05%-0.1% of congenital renal malformations [7]. Despite its rarity, its recognition has grown due to expanded imaging utilization. The predominance of left-to-right fusion and male preponderance reported across studies [3,4] contrasts with the present case of a middle-aged female, indicating that demographic variability exists beyond classical patterns. The “lump” or “cake” kidney type observed aligns with Type C CFRE in standard classifications [1,8]. Such configurations are prone to vascular and drainage anomalies that may predispose to complications if not accurately recognized (Fig. 7).

Embryologic and pathophysiologic considerations

The embryogenesis of CFRE is attributed to aberrant migration and rotation of the metanephric blastemas during the fourth to eighth week of gestation [7–9]. A leading hypothesis proposes that one metanephric blastema crosses the midline and fuses with its contralateral counterpart before ascent,

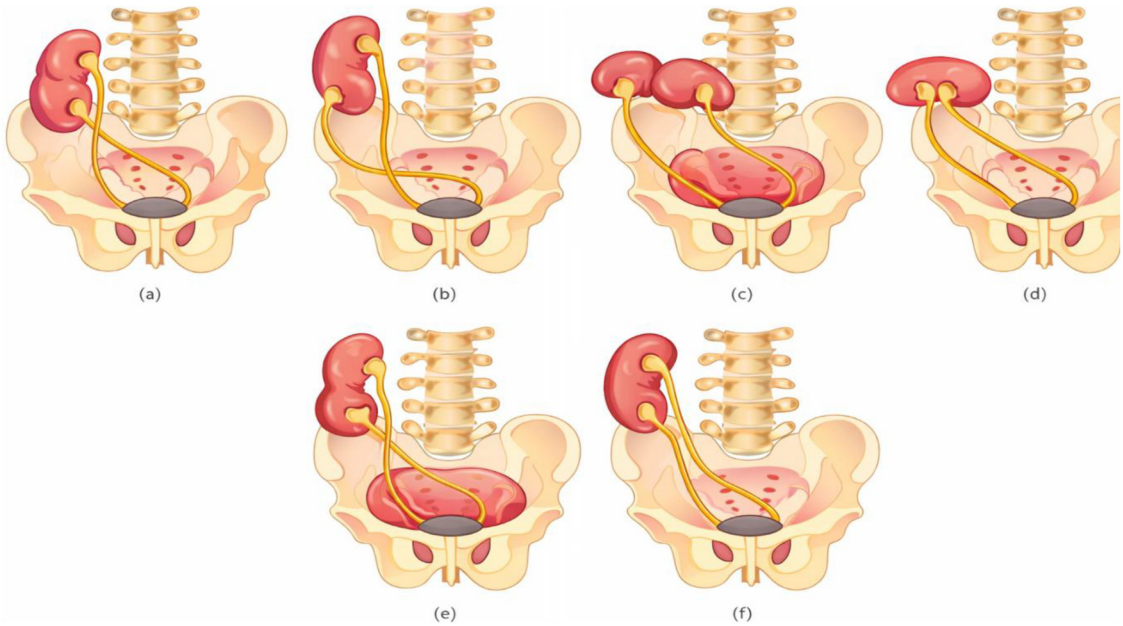

Fig. 7 – Six anatomical variations (types) of crossed fused renal ectopia: (A) inferior crossed fused renal ectopia, (B) sigmoid or S-shaped kidney, (C) lump kidney, (D) disc kidney, (E) L-shaped kidney, (F) superior crossed fused renal ectopia.

influenced by mechanical pressure, teratogenic insult, or disrupted vascular signaling [7,10]. The presence of anomalous renal arteries originating from the common iliac or lower aortic branches, documented in this case, is consistent with early vascular fixation and has major surgical relevance [7,11–13]. Such aberrations highlight the need for meticulous vascular mapping before abdominal or pelvic interventions [11,12].

Diagnostic imaging and differential diagnosis

Ultrasonography remains the diagnostic cornerstone for CFRE, especially in low-resource settings. It allows detection of empty renal fossae and identification of a reniform mass across the midline, as demonstrated in this case. Literature consistently supports its high sensitivity for renal morphology and cyst detection [13–16]. Nevertheless, CT urography offers superior delineation of collecting systems, vascular anatomy, and parenchymal fusion, establishing the anomaly's exact type and laterality [8,17].

Although the radiation exposure for this procedure was relatively high, the estimated effective dose of 33 mSv aligns with values typically reported for multiphase renal CT protocols, which involve several sequential acquisitions to evaluate renal morphology, vascular anatomy, and excretory function [18]. The exposure parameters indicate that the protocol was carefully optimized for diagnostic accuracy, including non-contrast, nephrographic, and excretory phases to ensure comprehensive characterization of the renal anomaly.

Overall, the radiation dose remains within acceptable diagnostic thresholds for such multiphase studies but highlights the ongoing need for dose optimization through patient-specific protocol adjustments, automatic tube current modulation, and the use of iterative reconstruction algorithms [18–21]. These measures are particularly important when follow-up imaging may be anticipated. The report reflects a well-executed examination that effectively balances diagnostic necessity and radiation safety in evaluating a complex congenital renal abnormality.

It is worth noting that MRU is often the preferred modality for functional assessment and pediatric evaluation, as it eliminates ionizing radiation while providing superior soft-tissue contrast and functional information. In addition, nuclear medicine techniques such as technetium-99m–labeled dimercaptosuccinic acid and mercaptoacetyltriglycine (MAG3) scintigraphy play an important role in assessing differential renal function, cortical integrity, and drainage patterns in congenital renal anomalies, including CFRE. However, in many developing countries, including parts of sub-Saharan Africa, the limited availability and high operational cost of MRI [22] and nuclear medicine techniques restrict access, making multiphase CT urography a practical and valuable alternative for comprehensive renal assessment.

Differential diagnoses include horseshoe kidney, solitary ectopic kidney, duplex collecting system, and renal ptosis. The presence of two distinct collecting systems and ureters crossing the midline excluded solitary ectopia, while the absence of an isthmus anterior to the aorta differentiated CFRE from horseshoe kidney [3,6,14]. These distinctions are critical to prevent misclassification and surgical misadventure.

Clinical presentation and functional outcomes

Consistent with existing literature, this patient was asymptomatic, with preserved renal function [3,7,8,10,23–28]. Most asymptomatic CFRE cases are incidentally detected during imaging for unrelated conditions, whereas symptomatic presentations often include recurrent urinary tract infections, nephrolithiasis, or obstructive uropathy [1,4–6,15,29]. Mild

hematuria and leukocyturia, when present, are typically secondary to subclinical infection. Comparative studies from Africa, such as a recent report from Nigeria [29], reflect similar trends but remain scarce, highlighting the persistent under-recognition and under-reporting of CFRE across the region.

Management, prognosis, and follow-up

Management of CFRE is primarily conservative unless complications arise. There are no standardized therapeutic protocols; decisions are individualized based on symptomatology and renal function [11,12]. Asymptomatic individuals with normal functions are best managed through observation and periodic surveillance [4]. Symptomatic cases involving calculi, infection, or obstruction may require endourological or surgical intervention, with laparoscopy and robotic approaches showing favorable outcomes [11,12,26,27]. Longitudinal studies recommend annual monitoring of renal function and blood pressure to detect late-onset complications [14].

Given the abnormal vasculature, comprehensive preoperative imaging is imperative to prevent inadvertent vascular or ureteral injury during unrelated pelvic or colorectal surgeries [11,12]. In this case, the patient was appropriately counseled and placed on conservative follow-up, emphasizing infection prophylaxis and renal surveillance.

Implications for practice

1. *Incidental yet clinically significant:* CFRE may remain undetected into late adulthood; its recognition during routine imaging emphasizes the expanding diagnostic role of radiographers, sonographers, and radiologists in preventive health screening.
2. *Diagnostic relevance in resource-limited settings:* Skilled ultrasonography remains indispensable for CFRE detection where CT and MRU are inaccessible, reaffirming its value in sub-Saharan imaging practice.
3. *Surgical implications:* Awareness of aberrant vasculature is essential for safe abdominal or pelvic surgery.
4. *Regional data gaps:* Limited African literature necessitates systematic reporting and collaborative registries to inform prevalence and clinical patterns.

Limitations

This case lacked long-term follow-up and CT angiographic mapping of renal vasculature due to financial constraints, which could have provided deeper insights into vascular architecture and functional evolution. Nonetheless, the combined sonographic and CT findings sufficiently characterized the anomaly.

Conclusion

CFRE remains a rare congenital renal fusion anomaly, most frequently identified incidentally in otherwise asymptomatic individuals. Enhanced clinical vigilance and systematic case reporting are vital to addressing existing regional data deficiencies, improving diagnostic accuracy, and promoting safer surgical and interventional planning. Furthermore, continuous professional education and training of imaging practitioners will strengthen early recognition of CFRE and similar anomalies, contributing to better nephrological outcomes across sub-Saharan Africa.

Author contributions

GA: Conceptualization, supervision, data collection, imaging interpretation, laboratory data interpretation, manuscript drafting, formatting, figure labeling, and final approval. **ADP**: Supervision, data verification, final review. **NAKOK**: Image interpretation and critical manuscript review. **ST**: Literature review, data organization, and image preparation. **POD**: Manuscript editing, reference validation, and academic coordination. **MAA**: Data acquisition, literature review. **ESO**: Literature review, data organization, and proof-reading. **FAA**: Administrative support, data verification, and final review. All authors read and approved of the final manuscript and agree to be accountable for all aspects of the work.

Ethical approval

Confidentiality and anonymity were strictly maintained in accordance with established ethical principles outlined in the Declaration of Helsinki (2013 revision).

Patient consent

Written informed consent was obtained from the patient, granting permission for the use of her clinical information and imaging findings for research and publication purposes.

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