Percutaneous Drainage of Renal Subcapsular Fluid Collections: A Two-Case Series

Adryan Kalya Ndraha Khairindra[1], Sakti Ronggowardhana Brodjonegoro[1*], Raden Danarto[1], Yanuar Wicaksana Sumasta[2]

[1]Division of Urology, Department of Surgery, Faculty of Medicine, Nursing, and Public Health, Universitas Gadjah Mada/Sardjito General Hospital, Yogyakarta, Indonesia
[2]Division of Urology, Department of Surgery, Abdul Moeloek General Hospital, Bandar Lampung, Indonesia

*Email correspondence: saktibrodjonegoro@ugm.ac.id

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Abstract

Renal subcapsular fluid collections may compress the renal parenchyma, impair cortical perfusion, and contribute to secondary hypertension. Evidence guiding management remains limited, particularly where advanced laparoscopic approaches are unavailable. Case 1 was a 26-year-old man with steroid-sensitive nephrotic syndrome, blood pressure of 145/92 mmHg, creatinine of 1.2 mg/dL (estimated glomerular filtration rate, 75 mL/min/1.73 m²), albumin of 2.2 g/dL, and bilateral subcapsular collections measuring 8 cm on the right and 5 cm on the left. Case 2 was a 63-year-old woman with end-stage renal disease secondary to cervical-cancer-related bilateral ureteric obstruction, blood pressure of 160/100 mmHg, blood urea nitrogen of 85 mg/dL, creatinine of 6.8 mg/dL, bilateral non-functioning kidneys, grade II hydronephrosis, and bilateral 6-cm collections. Both patients underwent ultrasound-guided bilateral percutaneous drainage using an 8-Fr pigtail catheter and Seldinger technique under local anesthesia with 160 mg of 2% lidocaine per side. Case 1 yielded 5,000 mL of whitish fluid from the right and 2,500 mL of clear fluid from the left. Case 2 yielded 2,000 mL from each side, with cultures reportedly growing Escherichia coli susceptible to ciprofloxacin. Oral antimicrobial therapy was administered, and prednisone was restarted in Case 1. One-month ultrasonography showed complete resolution without documented re-accumulation. Post-drainage blood pressure was 125/85 mmHg in Case 1 and 142/92 mmHg in Case 2. Serial blood pressure and laboratory assessments were unavailable; fluid biochemical, cytological, and microbiological analyses were not performed. Ultrasound-guided percutaneous drainage may be a feasible, minimally invasive, resource-sparing option for selected renal subcapsular fluid collections. Microbiological evaluation is important when infection is suspected. Further studies should incorporate standardized fluid analysis and objective pre- and post-drainage clinical assessment.

Keywords: Subcapsular Renal Fluid Collection, Percutaneous Drainage, Ultrasound-Guided Drainage, Renal Compression, Interventional Radiology

INTRODUCTION

In this report, the term “floating kidney” refers to the radiologic appearance resulting from a large renal subcapsular or perirenal fluid collection that separates and compresses the renal parenchyma, rather than nephroptosis, which is characterized by the positional downward displacement of the kidney. Perirenal fluid accumulation has also been described as the “kidney sweat” sign, whereas more recent reports have used the term “floating kidney” to describe extensive perirenal fluid collections associated with renal parenchymal disease (Yildirim & Guz, 2021). Although the published literature remains limited and heterogeneous, recent reports have expanded the recognized spectrum of this condition beyond nephrotic syndrome

to include spontaneous or idiopathic collections and other causes of external renal compression (Mehedra et al., 2024).

The clinical significance of a large subcapsular collection is related primarily to the pressure it exerts rather than to its terminology alone. Extrinsic compression can reduce cortical perfusion and induce the Page kidney phenomenon through activation of the renin-angiotensin-aldosterone system, resulting in secondary hypertension. In severe cases, sustained compression may also impair renal function (Dadan et al., 2026; Rahman et al., 2022). Recent Doppler ultrasound studies have reported elevated intrarenal resistive indices and absent or reversed diastolic flow in cases of severe Page kidney. However, these hemodynamic markers have been investigated predominantly in transplant- and biopsy-related subcapsular hematomas rather than sterile nephrotic effusions (Dadan et al., 2026; Fonseca de Jesus Silva et al., 2025; T. W. Lee et al., 2022). Contrast-enhanced ultrasound can assess renal microvascular perfusion without the use of nephrotoxic contrast agents and may prove valuable for selected patients with renal impairment. Nevertheless, its application in spontaneous subcapsular effusions remains investigational (Srivastava et al., 2024).

In nephrotic syndrome, severe hypoalbuminemia reduces plasma oncotic pressure, while renal sodium retention increases hydrostatic forces that favor interstitial fluid formation. When the potential subcapsular space becomes a low-resistance compartment and capsular or retroperitoneal lymphatic drainage is inadequate, fluid may accumulate around the kidney rather than being confined to the subcutaneous, pleural, or peritoneal spaces (Alp, 2023; Hacibey et al., 2022; Yildirim & Guz, 2021). In obstructive or malignant conditions, different pathophysiological mechanisms may predominate. Chronic ureteric obstruction, retroperitoneal fibrosis or malignancy, venous congestion, and impaired lymphatic drainage can increase interstitial hydrostatic pressure and hinder fluid clearance, even in the absence of severe hypoalbuminemia.

Management is particularly relevant in resource-constrained healthcare settings, where laparoscopic fenestration or capsulectomy may not be readily available. Ultrasound-guided drainage can often be performed using standard imaging equipment, local anesthesia, and pigtail catheters, potentially reducing the need for patient transfer and optimizing resource utilization. In contrast to the predominantly sterile transudative collections reported in previous studies (Alp, 2023; Hacibey et al., 2022; Mehedra et al., 2024; Yildirim & Guz, 2021). The present cases involved purulent-appearing fluid in Case 1 and culture-confirmed E. coli in Case 2. This report describes these distinct etiologies, compares them with the available literature, and evaluates the clinical and health-system feasibility of percutaneous drainage for

symptomatic or compressive renal subcapsular collections without suggesting its universal use as a first-line treatment.

This two-case series was prepared in accordance with the CARE (CAse REport) reporting guideline, adapted for case series, and with consideration of the PROCESS 2023 recommendations for surgical case series. A completed CARE compliance checklist is provided in Supplementary Table S1 (Mathew et al., 2023).

METHODS

This descriptive two-case series reviewed de-identified clinical records and imaging from two urological services in Indonesia. Clinical, laboratory, imaging, procedural, microbiological, treatment, and one-month follow-up data were collected. Incompletely documented procedural details were confirmed by the treating author. Written informed consent for publication of clinical information and images was obtained from both patients.

Renal subcapsular collection was defined as a crescentic or circumferential fluid collection within the subcapsular or perirenal space identified on ultrasonography or computed tomography, with associated separation, indentation, or compression of the renal parenchyma. Differential diagnoses included urinoma, abscess, hematoma, lymphocele, ascites, and nonspecific perinephric fluid. The etiology of the collection was determined based on the clinical context, imaging characteristics, urinary tract findings, and available fluid analysis or microbiological data. The extent of perirenal or subcapsular fluid accumulation was descriptively assessed according to its size, distribution, and degree of renal parenchymal compression on ultrasonography and cross-sectional imaging (Yildirim & Guz, 2021).

A focused literature search was performed in PubMed/MEDLINE from database inception through August 2026. The search concept was: ("floating kidney" OR "kidney sweat" OR "renal subcapsular fluid collection" OR "perirenal subcapsular fluid") AND ("nephrotic syndrome" OR "obstructive uropathy" OR "Page kidney"). Reference lists of relevant publications were manually screened. Human case reports or series describing spontaneous or disease-associated renal subcapsular or perirenal collections were included for contextual comparison. Traumatic and post-biopsy hematomas were excluded from Table 1, whereas recent Page kidney reports were retained for mechanistic context. This search was performed for contextual purposes and was not intended to be systematic.

Fluid was assessed by gross appearance, available culture, and fluid-to-serum urea and creatinine comparison. Case 2 reportedly grew ciprofloxacin-susceptible Escherichia coli, although the original report was unavailable. Standardized biochemical, cytological, and Gram-

stain analyses were not performed. Both patients underwent bilateral ultrasound-guided drainage using 8-Fr pigtail catheters and the Seldinger technique under local anesthesia (160 mg of 2% lidocaine per side). Puncture was performed caudal to the costal arch under real-time ultrasound guidance. Case 1 used a BK Medical 2101 Falcon system and Case 2 a GE Venue system, both with abdominal probes. Catheter position was confirmed sonographically. Drains were removed after cessation of drainage and clinical assessment (days 3 and 7 in Case 1; day 7 in Case 2).

Both patients received oral antimicrobials; Case 2 received ciprofloxacin based on reported susceptibility. Prednisone 1 mg/kg/day was restarted in Case 1. Clinical status and blood pressure were monitored, with one-month ultrasonography assessing residual/recurrent collections and hydronephrosis. Serial blood pressure, renal function, cortical thickness, and intrarenal Doppler data were unavailable; therefore, physiological or renal functional responses to decompression could not be quantitatively assessed. Renal recovery was not expected in Case 2 because both kidneys were non-functioning before drainage.

Written informed consent for publication of clinical information and accompanying images was obtained from both patients. All identifying information was removed, and clinical data were handled in de-identified form.

RESULTS

Case 1

A 26-year-old man presented with progressive abdominal distension for one year. He had steroid-sensitive nephrotic syndrome diagnosed during adolescence and had remained in remission for approximately three years without maintenance corticosteroids. He denied urinary symptoms, fever, or weight loss. Examination revealed marked, non-tender abdominal distension, bilateral lower-extremity edema, and blood pressure of 145/92 mmHg. Serum creatinine was 1.2 mg/dL (eGFR 75 mL/min/1.73 m²) and albumin 2.2 g/dL. Urinalysis showed 4+ proteinuria and microscopic hematuria, consistent with nephrotic syndrome relapse. Contrast-enhanced CT demonstrated bilateral renal subcapsular collections measuring approximately 8 cm on the right and 5 cm on the left, with substantial renal parenchymal displacement and compression but no hydronephrosis or urinary tract obstruction (Figure 1).

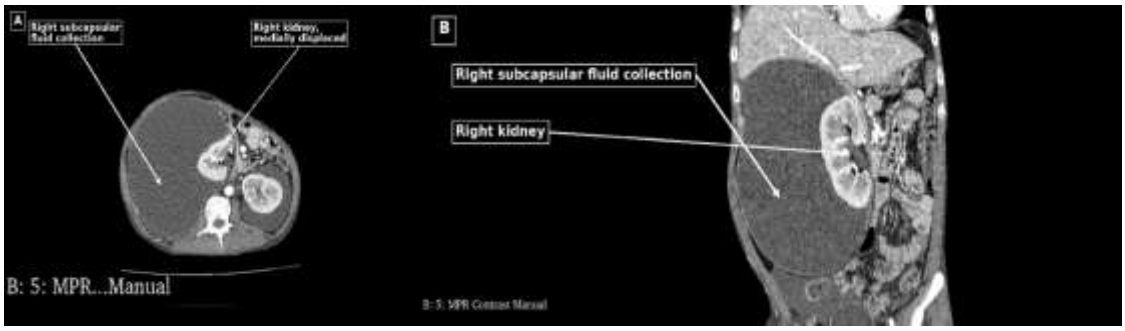

Figure 1. Contrast-enhanced abdominal computed tomography demonstrating a massive right renal subcapsular fluid collection. (A) Axial image showing the right subcapsular fluid collection and medial displacement of the right kidney. (B) Coronal multiplanar reconstruction showing the craniocaudal extent of the collection and its relationship to the right kidney

Bilateral ultrasound-guided percutaneous drainage was performed using 8-Fr pigtail catheters and the Seldinger technique under local anesthesia (160 mg of 2% lidocaine per side) with a BK Medical 2101 Falcon ultrasound system and abdominal probe. Puncture was performed caudal to the costal arch. The right and left collections yielded 5,000 and 2,500 mL of whitish, purulent-appearing and clear fluid, respectively. Microbiological and standardized fluid analyses were unavailable; thus, infection could not be confirmed based on gross appearance alone. Oral cefixime 200 mg twice daily for 7 days was administered. Prednisone 1 mg/kg/day was restarted for nephrotic syndrome after approximately 3 years without corticosteroid therapy. Catheters were removed on days 3 and 7 without documented complications. One-month ultrasonography showed complete resolution without re-accumulation, with post-drainage blood pressure of 125/85 mmHg. However, serial blood pressure, creatinine, eGFR, and albumin measurements were unavailable, precluding objective assessment of physiological or renal functional response.

Case 2

A 63-year-old woman with chronic kidney disease secondary to obstructive uropathy presented with progressive bilateral flank pain for two months. She had stage IIIB cervical squamous cell carcinoma with complete distal bilateral ureteric stenosis and a right nephrostomy tube placed four months earlier. She had undergone intermittent, non-regular hemodialysis and denied fever, urinary symptoms, or recent trauma. Examination showed moderate, non-tender abdominal distension and blood pressure of 160/100 mmHg. The nephrostomy tube was appropriately positioned. Blood urea nitrogen was 85 mg/dL and serum creatinine 6.8 mg/dL; previous renal scintigraphy showed bilateral non-functioning kidneys. Non-contrast CT demonstrated bilateral approximately 6 cm renal subcapsular collections with grade II hydronephrosis (Figure 2).

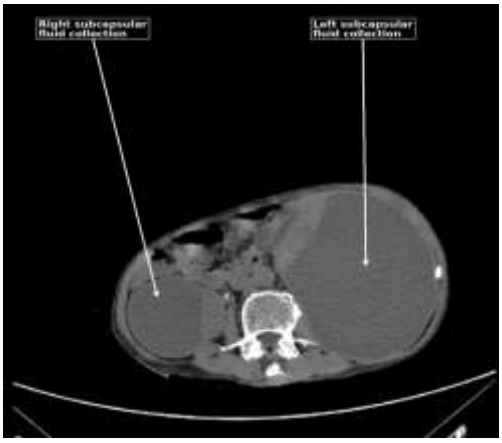

Figure 2. Pre-procedural non-contrast axial CT from Case 2. Arrows identify the right and left renal subcapsular fluid collections. Grade II hydronephrosis was reported on the complete CT examination but is not optimally demonstrated on this selected axial slice.

Bilateral ultrasound-guided percutaneous drainage was performed using 8-Fr pigtail catheters and the Seldinger technique under local anesthesia (160 mg of 2% lidocaine per side) with a GE Venue ultrasound system and abdominal probe. Puncture was performed caudal to the costal arch. Approximately 2,000 mL of whitish, purulent-appearing fluid was drained from each side. Escherichia coli susceptible to ciprofloxacin was reported, although the original report was unavailable for verification. Fluid-to-serum urea and creatinine levels suggested a non-urinoma origin. Standardized fluid analyses were unavailable. Oral ciprofloxacin 500 mg twice daily for 7 days was administered. Both catheters were removed on day 7 without documented complications. One-month ultrasonography showed complete resolution without re-accumulation. Post-drainage blood pressure was 142/92 mmHg; serial blood pressure and renal chemistry measurements were unavailable. As both kidneys were non-functioning before intervention, renal recovery was not expected. The primary outcomes were anatomical decompression and resolution of the collections.

Table 1 Selected published reports of disease-associated or spontaneous renal subcapsular/perirenal fluid collections compared with the present cases

Study	Etiology / patient	Collection / fluid	Management	Outcome
Hacibey et al., 2022	33-year-old man; idiopathic	Bilateral massive effusions	US-guided drainage	Complete resolution at 6 weeks
Yildirim & Guz, 2021	21-year-old man; C3 glomerulopathy/FSGS	Bilateral; right 5 cm; 15 L transudate	Drainage + DJ stent + albumin/diuretic/immunosuppression	Complete resolution
Izekor, Odigwe, Goraya, & Duran, 2021	Adult; post-nephrectomy ureteric obstruction	Subcapsular urinoma; urine-compatible biochemistry	Drainage + nephrostomy	Renal recovery; dialysis discontinued
Alp, 2023	Nephrotic syndrome; 2 adults	Bilateral massive collections	US-guided drainage + immunosuppression	Symptomatic improvement; no recurrence

Study	Etiology / patient	Collection / fluid	Management	Outcome
Alshanafey, Alkhani, & Alkibsi, 2022	Pediatric renal lymphangiectasia	Perirenal/parapelvic/intrarenal lymphatic collections	Supportive therapy + recurrent sclerotherapy	Managed without nephrectomy
I. H. Lee, Shin, & Ahn, 2022	56-year-old woman; obstructive uropathy, retained DJ stent	Perinephric abscess; ESBL-*E. coli*	Antibiotics + drainage + stent removal	Infection resolved
Taniguchi, Yamamoto, Tomita, & Iehara, 2023	48-year-old woman; hydronephrosis, HTN, renal dysfunction	Bilateral perirenal/subcapsular collections	Ureteral stenting + drainage	HTN and renal dysfunction improved
Mehedra et al., 2024	26-year-old woman; spontaneous bilateral collection	Right 102 × 163 mm; non-urinary biochemistry	Bilateral DJ stents + drainage	6.9-mm residual layer at 2 months
Hu et al., 2025	59-year-old woman; ureteric stone, severe hydronephrosis	Subcapsular fluid with hemorrhagic features	Conservative treatment + DJ stent	Complete radiologic resolution
Tacyildiz & Yergin Tacyildiz, 2025	51-year-old woman; bilateral renal lymphangiectasia	Bilateral perirenal/intrarenal cystic lesions	Conservative management	Pain and laboratory abnormalities resolved
Present Case 1	26-year-old man; nephrotic relapse	Right 5.0 L purulent-appearing; left 2.5 L clear	Bilateral US-guided 8-Fr drainage + cefixime + prednisone	Complete US resolution at 1 month
Present Case 2	63-year-old woman; ESRD with bilateral ureteric obstruction	2.0 L/side; purulent; *E. coli* reported	Bilateral US-guided 8-Fr drainage + ciprofloxacin	Complete US resolution at 1 month

Table 2 Clinical, laboratory, drainage, and outcome characteristics of the two patients

Characteristic	Case 1	Case 2
Age / sex	26-year-old man	63-year-old woman
Underlying condition	Steroid-sensitive nephrotic syndrome relapse	ESRD due to cervical-cancer-related bilateral ureteric obstruction; bilateral non-functioning kidneys
Presentation	1-year progressive abdominal distension; no fever/urinary symptoms	2-month progressive bilateral flank pain; no fever/urinary symptoms
Baseline BP	145/92 mmHg	160/100 mmHg
Renal function	Creatinine 1.2 mg/dL; eGFR 75 mL/min/1.73 m²	BUN 85 mg/dL; creatinine 6.8 mg/dL
Albumin	2.2 g/dL	Not documented
Imaging	Right ~8 cm, left ~5 cm collections; no hydronephrosis	Bilateral ~6 cm collections; grade II hydronephrosis
Drainage / fluid	Right 5,000 mL purulent-appearing; left 2,500 mL clear	2,000 mL/side; whitish/purulent
Microbiology	Not documented; infection unconfirmed	*E. coli* reported, ciprofloxacin-sensitive; report unavailable
Antibiotics	Cefixime 200 mg BID × 7 days PO	Ciprofloxacin 500 mg BID × 7 days PO
Drain removal	Left day 3; right day 7	Bilateral day 7

Characteristic	Case 1	Case 2
Post-drainage BP	125/85 mmHg	142/92 mmHg
1-month outcome	Complete US resolution; no documented recurrence	Complete US resolution; no re-accumulation

Table 3 CARE-oriented clinical timeline

Timepoint	Case 1	Case 2
Pre-presentation	Steroid-sensitive nephrotic syndrome; ~3-year remission without routine steroids	Stage IIIB cervical cancer; complete distal bilateral ureteric stenosis; right nephrostomy 4 months earlier; intermittent hemodialysis
Presentation	1-year abdominal distension; BP 145/92; albumin 2.2 g/dL; creatinine 1.2 mg/dL	2-month bilateral flank pain; BP 160/100; BUN 85 mg/dL; creatinine 6.8 mg/dL
Imaging	CECT: right ~8 cm and left ~5 cm collections; no obstruction	NCCT: bilateral ~6 cm collections; grade II hydronephrosis
Intervention	Bilateral US-guided 8-Fr pigtail drainage; Seldinger technique; local anesthesia; prednisone restarted; cefixime × 7 days	Bilateral US-guided 8-Fr pigtail drainage; Seldinger technique; local anesthesia; ciprofloxacin × 7 days
Days 1–3	Right 5 L purulent-appearing; left 2.5 L clear; left drain removed day 3	2 L/side; purulent fluid; *E. coli* reported
Day 7	Right drain removed	Both drains removed
1 month	US: complete resolution; no documented recurrence	US: complete resolution; no re-accumulation

DISCUSSION

The two cases shared a similar radiologic phenotype but occurred in distinct clinical contexts. Case 1 developed during relapse of steroid-sensitive nephrotic syndrome and was characterized by hypoalbuminemia with relatively preserved renal function. Reduced oncotic pressure, sodium and water retention, and impaired lymphatic clearance may promote subcapsular fluid accumulation. Experimental evidence has linked nephrotic sodium retention to increased epithelial sodium channel activity, supporting enhanced renal sodium reabsorption as a contributor to fluid retention (Essigke et al., 2022). Perirenal fluid collections are an uncommon manifestation of nephrotic syndrome and may cause substantial renal displacement or compression (Alp, 2023; Claudio & Gabriella, 2023; Hacibey et al., 2022; Yildirim & Guz, 2021).

In Case 2, end-stage renal disease (ESRD), advanced cervical cancer, bilateral distal ureteric stenosis, and grade II hydronephrosis provided a different clinical context. Although hypoalbuminemia could not be confirmed because serum albumin levels were unavailable, chronic urinary tract obstruction and malignant retroperitoneal disease may impair venous or lymphatic drainage, thereby increasing interstitial pressure and promoting fluid accumulation. Urinary leakage resulting in urinoma formation also remained a possible explanation. Thus,

the “floating kidney” should be regarded as describing a radiologic phenotype rather than a single disease entity.

The etiologic spectrum extends beyond nephrotic syndrome. Obstructive urinary tract may result in perirenal fluid collections through urinary extravasation or pressure-related injury (Alp, 2023; Guitynavard et al., 2021; Hacibey et al., 2022; Shyam et al., 2021; Yildirim & Guz, 2021). Page kidney has also been reported with ureteropelvic junction obstruction in a child with a partially duplex kidney, with hypertension resolving after treatment of the obstructed moiety, supporting an association between severe obstruction, renal compression, and Page kidney physiology (Nishio et al., 2024). More recently, spontaneous renal subcapsular fluid accumulation with hemorrhage has been described in ureteral stone disease with severe hydronephrosis (Hu et al., 2025). These observations support obstruction as a relevant context for Case 2, although they do not establish urinoma formation.

Renal lymphatic disorders should also be considered in the differential diagnosis of extensive perirenal fluid collections. Renal lymphangiectasia is characterized by dilatation of perirenal, parapelvic, and/or intrarenal lymphatic channels and may produce extensive cystic-appearing perirenal collections. Three pediatric cases of renal lymphangiectasia were managed with recurrent sclerotherapy and supportive treatment, highlighting the heterogeneous presentation and management of this rare disorder (Alshanafey et al., 2022). Bilateral renal lymphangiomatosis has similarly been reported as a rare cause of extensive bilateral perirenal lymphatic abnormalities (Tanzeel Abbasi et al., 2022). More recently, adult cases of bilateral renal lymphangiectasia were reported, and conservative management was common, whereas percutaneous drainage, marsupialization, or nephrectomy were used in selected symptomatic or complicated cases (Tacyildiz & Yergin Tacyildiz, 2025). These reports are relevant because lymphatic disorders may produce perirenal collections that mimic cystic, obstructive, or other fluid-containing processes. However, the present cases lacked the characteristic imaging and clinical findings required to establish renal lymphangiectasia or lymphangiomatosis; therefore, these conditions should be regarded as differential diagnoses rather than presumed etiologies.

Differentiating subcapsular collections from urinoma or other perirenal collections is clinically important because management depends on etiology. Low fluid urea and creatinine may support a non-urinary origin, whereas urinoma may occur with malignant ureteric involvement (Luu et al., 2021; Mehedra et al., 2024). Paired fluid-to-serum measurements may aid differentiation, while delayed or excretory-phase CT can demonstrate urinary communication (Guitynavard et al., 2021). In Case 2, the absence of standardized biochemical analysis precluded definitive exclusion of urinoma.

Unlike predominantly noninfectious collections, Case 1 contained purulent-appearing fluid without microbiological testing, whereas Case 2 reportedly yielded ciprofloxacin-susceptible Escherichia coli, although the original report was unavailable. Infection therefore could not be definitively established. Potential risk factors included nephrotic syndrome-related loss of immunoglobulins and complement and immunosuppressive exposure in Case 1, and kidney failure, malignancy, obstruction, and nephrostomy in Case 2 (Claudio & Gabriella, 2023; Shyam et al., 2021). The absence of fever does not exclude localized infection, and available data cannot establish whether infection was primary or secondary.

The rationale for decompression is related to external renal compression. A large subcapsular collection may increase pressure within a relatively non-compliant compartment, compressing the renal parenchyma and intrarenal microvasculature. Severe compression may reduce renal perfusion and activate the renin–angiotensin–aldosterone system, producing secondary hypertension and renal dysfunction, a mechanism classically termed Page kidney (T. W. Lee et al., 2022; Rahman et al., 2022). Recent clinical evidence further illustrates that Page kidney can arise from spontaneous bilateral renal subcapsular accumulation and can present with secondary hypertension and systemic fluid manifestations, reinforcing the importance of recognizing renal compression as a potentially hemodynamically relevant process (Wang et al., 2024). Although most Page kidney reports involve subcapsular hematoma, similar compression-related physiology may occur with other collections, including urinoma and obstruction-associated fluid collections (Izekor et al., 2021; Nishio et al., 2024; Taniguchi et al., 2023). Hydronephrosis-associated renal tamponade was accompanied by hyperreninemic hypertension and renal dysfunction, with improvement after relief of obstruction and perirenal drainage (Taniguchi et al., 2023).

Renal compression may affect renal perfusion and neurohumoral regulation through the kidney's integrated neurovascular and juxtaglomerular architecture. Recent three-dimensional mapping demonstrates close interactions among nephron segments, renal vessels, and nerves involved in blood-flow, fluid, and blood-pressure regulation, including renin–angiotensin–aldosterone signaling (McLaughlin et al., 2025). However, these findings provide biological context rather than direct evidence linking subcapsular fluid collections to Page kidney physiology.

Doppler ultrasonography may provide supportive evidence of hemodynamic compromise. Increased intrarenal resistive indices and, in severe cases, absent or reversed end-diastolic flow have been described in Page kidney, particularly after transplantation or renal biopsy (Dadan et al., 2026; Fonseca de Jesus Silva et al., 2025; T. W. Lee et al., 2022). However, most

available evidence concerns acute subcapsular hematoma rather than chronic collections associated with nephrotic syndrome or malignant obstruction. Moreover, resistive index is influenced by systemic hemodynamic and vascular factors and should therefore complement, rather than replace, clinical and structural assessment.

The present cases also emphasize the distinction between anatomical decompression and physiological recovery. Both patients achieved complete sonographic resolution at 1 month. Post-drainage blood pressure was 125/85 mmHg in Case 1 and 142/92 mmHg in Case 2; however, standardized serial blood-pressure measurements, renal biochemical parameters, and intrarenal Doppler indices were unavailable. Therefore, these cases demonstrate anatomical decompression and short-term radiologic resolution but do not establish reversal of Page kidney physiology, improved cortical perfusion, or renal functional recovery. This distinction is particularly important in Case 2, in which bilateral non-functioning kidneys were documented before drainage. Case 1 had relatively preserved renal function, but the absence of standardized post-procedural measurements prevents assessment of a measurable physiological benefit.

The relationship between obstruction and Page kidney physiology further supports the need to address the underlying cause. Resolution of hypertension after treatment of severe ureteropelvic junction obstruction in a child with a poorly functioning renal moiety (Nishio et al., 2024). While another paper reported improvement after treatment of hydronephrosis and associated perirenal compression (Taniguchi et al., 2023). In Case 2, persistent bilateral distal ureteric stenosis represented an ongoing obstructive process; therefore, drainage should not be regarded as definitive treatment of the underlying disease.

In nephrotic syndrome, treating the underlying glomerular disease remains essential. Renin–angiotensin system inhibitors were associated with higher remission rates in membranous nephropathy, although this was not consistent across pathologies (Shimizu et al., 2023). This evidence is not directly applicable to steroid-sensitive nephrotic syndrome or mechanical decompression but supports addressing the underlying disease alongside its complications.

Drainage volume should not be considered a surrogate for disease severity or treatment success. Case 1 yielded 5,000 and 2,500 mL, compared with 2,000 mL per side in Case 2. Although lower than the 15-L volume reported by Yildirim & Guz (2021), clinical significance depends on collection location, pressure, duration, and tissue compliance. Treatment should therefore consider symptoms, parenchymal compression, hemodynamic effects, renal function, infection, etiology, and procedural feasibility. These cases support ultrasound-guided

percutaneous drainage as a feasible option in selected patients, rather than a universally established first-line treatment. It may benefit large symptomatic or infected collections, particularly where advanced surgery is unavailable. Etiologic management remains essential: urinomas require correction of urinary leakage or obstruction, whereas infected collections require drainage and appropriate antimicrobials.

Early tertiary referral should be considered for hemodynamic instability, active bleeding, complex or recurrent collections, suspected urinoma requiring definitive correction, malignancy, inadequate source control, progressive renal dysfunction, severe hypertension suggestive of Page kidney, or uncertain etiology. Complex cases may require multidisciplinary evaluation by urology, nephrology, radiology, and interventional radiology. Potential health-system benefits of percutaneous drainage should be interpreted cautiously. Ultrasound-guided drainage under local anesthesia may reduce general anesthesia and operating-room requirements, but this series did not assess cost, hospitalization, resource utilization, patient-reported outcomes, or surgical comparators. Thus, reduced cost and hospitalization remain unproven. CEUS may additionally assess renal microvascular perfusion without iodinated contrast exposure, although its role in chronic subcapsular collections remains uncertain (Srivastava et al., 2024). Future studies should evaluate whether quantitative CEUS or Doppler parameters correlate with collection size, renal compression, blood pressure, and renal function.

Several limitations should be considered. The two-case design limits generalizability and is susceptible to selection and publication bias. Fluid characterization was incomplete, with unavailable microbiology in Case 1 and unverified reported E. coli culture in Case 2; standardized biochemical, cytological, and Gram-stain analyses were not performed. Some procedural parameters, including probe frequency, needle trajectory, and catheter-removal criteria, could not be retrospectively verified. No histopathological examination was performed. Follow-up was limited to 1 month without standardized serial blood pressure, renal function, albumin, or Doppler measurements; therefore, post-drainage blood pressures do not establish quantitative hemodynamic improvement or reversal of Page kidney physiology. Image exports also lacked DICOM pixel-spacing metadata and post-procedural catheter-position imaging, limiting calibrated assessment.

Future multicenter prospective studies should standardize etiologic, imaging, fluid, Doppler/CEUS, procedural, clinical, renal-function, recurrence, complication, resource-utilization, and patient-reported outcomes. Comparative studies should evaluate catheter size, access strategies, removal criteria, and percutaneous versus surgical approaches to establish

criteria for observation, antimicrobial therapy, drainage, or early surgical referral and identify patients most likely to benefit physiologically from decompression.

CONCLUSIONS

Ultrasound-guided percutaneous drainage was technically feasible and achieved complete sonographic resolution of large renal subcapsular fluid collections at one-month follow-up. However, these findings do not support universal first-line use; rather, drainage may be considered a reasonable initial decompressive option in selected symptomatic or compressive collections, particularly where minimally invasive surgery is unavailable.

Management should be guided by the underlying etiology, including altered oncotic pressure, fluid retention, urinary leakage, hemorrhage, lymphatic or venous obstruction, and infection. Purulent or suspicious fluid should undergo microbiological and, when feasible, standardized biochemical analysis to distinguish infected collections from urinoma and other noninfectious causes. Clinical follow-up should include blood pressure monitoring, interval ultrasonography, and assessment of renal perfusion by Doppler when available.

Early tertiary urological referral is warranted for hemodynamic instability, active bleeding, complex or recurrent collections, suspected malignancy or urinoma requiring definitive correction, inadequate source control, or anticipated surgical intervention. These cases highlight the potential value of ultrasound-guided intervention, microbiological diagnostics, and coordinated nephrology–urology care in resource-constrained settings. Nevertheless, this two-case series remains descriptive and hypothesis-generating; larger prospective or multicenter studies are needed to establish patient-selection criteria, drainage techniques, recurrence rates, and comparative outcomes before standardized management algorithms can be recommended.

REFERENCES

Alp, A. , H. B. , & G. D. G. (2023). Sieged Kidneys. *Saudi Journal of Kidney Diseases and Transplantation*, *33*(2), 343–344. https://doi.org/10.4103/1319-2442.379035

Alshanafey, S., Alkhani, A., & Alkibsi, A. (2022). Renal lymphangiectasia in pediatric population: case series and review of literature. In *Annals of Saudi Medicine* (Vol. 42, Number 2, pp. 139–144). King Faisal Specialist Hospital and Research Centre. https://doi.org/10.5144/0256-4947.2022.139

Claudio, P., & Gabriella, M. (2023). Nephrotic syndrome: pathophysiology and consequences. In *Journal of Nephrology* (Vol. 36, Number 8, pp. 2179–2190). Springer Science and Business Media Deutschland GmbH. https://doi.org/10.1007/s40620-023-01697-7

Dadan, S., Mirza, W., & Khan, M. A. (2026). Page kidney secondary to subcapsular hematoma in renal transplant recipients: a systematic review of reported cases. In *International Urology and Nephrology* (Vol. 58, Number 6, pp. 2153–2162). Springer Science and Business Media B.V. https://doi.org/10.1007/s11255-025-04879-3

Essigke, D., Bohnert, B. N., Janessa, A., Wörn, M., Omage, K., Kalbacher, H., Birkenfeld, A. L., Bugge, T. H., Szabo, R., & Artunc, F. (2022). Sodium retention in nephrotic syndrome is independent of the activation of the membrane-anchored serine protease prostasin (CAP1/PRSS8) and its enzymatic activity. *Pflugers Archiv European Journal of Physiology*, *474*(6), 613–624. https://doi.org/10.1007/s00424-022-02682-y

Fonseca de Jesus Silva, C., Sosa Barrios, R. H., Burguera Vion, V., Fernández Lucas, M., & Rivera Gorrín, M. E. (2025). Reversed diastolic intrarenal flow in page kidney following renal biopsy. *Journal of Ultrasound*, *28*(4), 1049–1053. https://doi.org/10.1007/s40477-023-00857-6

Guitynavard, F., Tamehri Zadeh, S. S., Tehranipour, E., Rakebi, M. M., & Kazem Aghamir, S. M. (2021). Urinoma as the result of a 3mm stone in ipsilateral ureter: A rare case report. *Urology Case Reports*, *36*. https://doi.org/10.1016/j.eucr.2021.101571

Hacibey, I., Sahin, Y., Serifoglu, I., & Muslumanoglu, A. Y. (2022). Idiopathic bilateral massive perirenal subcapsular effusion: The first case in the literature. *Urologia Journal*, *89*(3), 481–483. https://doi.org/10.1177/03915603211001252

Hu, Y., Wang, X., Chen, Y., Li, J., Zhu, F., Yuan, Y., Ye, J., Yang, F., & Zhong, Y. (2025). Spontaneous renal subcapsular fluid accumulation with hemorrhage due to ureteral stone: a case report and literature review. *Frontiers in Surgery*, *12*. https://doi.org/10.3389/fsurg.2025.1580745

Izekor, B. E., Odigwe, C., Goraya, N., & Duran, P. A. (2021). Page Kidney From a Subcapsular Urinoma Following Contralateral Radical Nephrectomy. *Cureus*. https://doi.org/10.7759/cureus.15639

Lee, I. H., Shin, H. S., & Ahn, D. J. (2022). A forgotten double-J ureteral stent resulting in an emphysematous perinephric abscess: A case report. *Medicine (United States)*, *101*(25), E29418. https://doi.org/10.1097/MD.0000000000029418

Lee, T. W., Bae, W., Choi, J., Bae, E., Jang, H. N., Chang, S. H., & Park, D. J. (2022). Page kidney following spontaneous subcapsular hematoma immediately after kidney transplantation: a case report. *BMC Nephrology*, *23*(1). https://doi.org/10.1186/s12882-022-02855-y

Luu, D. T., Duc, N. M., Tra My, T. T., Duc, N. H., Bang, L. V., & Van Lenh, B. (2021). Subcapsular urinoma following metastasis of testicular embryonal carcinoma. *Urology Case Reports*, *37*. https://doi.org/10.1016/j.eucr.2021.101615

Mathew, G., Sohrabi, C., Franchi, T., Nicola, M., Kerwan, A., Agha, R., Ekser, B., McCaul, J., Mei, Z., Pagano, D., Raja, S., Kasivisvanathan, V., Manning, T., Surani, S., Giordano, S., Miguel, D., Nixon, I., Bradley, P., Raison, N., … Coppola, A. (2023). Preferred Reporting Of Case Series in Surgery (PROCESS) 2023 guidelines. *International Journal of Surgery*, *109*(12), 3760–3769. https://doi.org/10.1097/JS9.0000000000000940

McLaughlin, L., Zhang, B., Sharma, S., Knoten, A. L., Kaushal, M., Purkerson, J. M., Huyck, H. L., Pryhuber, G. S., Gaut, J. P., & Jain, S. (2025). Three dimensional multiscalar neurovascular nephron connectivity map of the human kidney across the lifespan. *Nature Communications* , *16*(1). https://doi.org/10.1038/s41467-025-60435-8

Mehedra, A., Babty, M., Maachi, Y., Slaoui, A., Karmouni, T., Elkhader, K., Koutani, A., & Ibenattya, A. (2024). Subcapsular renal collection of idiopathic origin: An exceptional entity. *Urology Case Reports*, *55*. https://doi.org/10.1016/j.eucr.2024.102753

Nishio, H., Mizuno, K., Sakata, T., Matsumoto, D., Kamisawa, H., Kurokawa, S., Nakane, A., Maruyama, T., Yasui, T., & Hayashi, Y. (2024). Page kidney in a child with ureteropelvic junction obstruction of lower moiety in a partial duplex system. *Urology Case Reports*, *57*. https://doi.org/10.1016/j.eucr.2024.102880

Rahman, S., Imanzadeh, A., Martin, T., & Ayyagari, R. (2022). Page kidney: an unusual complication of image-guided native renal parenchymal biopsy - case report and

literature review. *Radiology Case Reports*, *17*(6), 2006–2010. https://doi.org/10.1016/j.radcr.2022.03.062

Shimizu, S., Niihata, K., Nishiwaki, H., Shibagaki, Y., Yamamoto, R., Nitta, K., Tsukamoto, T., Uchida, S., Takeda, A., Okada, H., Narita, I., Isaka, Y., & Kurita, N. (2023). Initiation of renin–angiotensin system inhibitors and first complete remission in patients with primary nephrotic syndrome: a nationwide cohort study. *Clinical and Experimental Nephrology*, *27*(5), 480–489. https://doi.org/10.1007/s10157-023-02331-3

Shyam, K., Andrew, D., & Johny, J. (2021). Adult with infected spontaneous perinephric urinoma secondary to uro-obstruction by VUJ calculus: pop-off mechanism. In *BMJ Case Reports* (Vol. 14, Number 1). BMJ Publishing Group. https://doi.org/10.1136/bcr-2020-240390

Srivastava, S., Dhyani, M., & Dighe, M. (2024). Contrast-enhanced ultrasound (CEUS): applications from the kidneys to the bladder. *Abdominal Radiology*, *49*(11), 4092–4112. https://doi.org/10.1007/s00261-024-04388-4

Tacyildiz, C., & Yergin Tacyildiz, S. (2025). Bilateral renal lymphangiectasia mimicking renal cystic disease and literature review. *BJR|Case Reports*, *11*(6). https://doi.org/10.1093/bjrcr/uaaf051

Taniguchi, T., Yamamoto, K., Tomita, M., & Iehara, N. (2023). Renal tamponade in a patient with hydronephrosis-related Page kidney. *CEN Case Reports*, *12*(4), 378–383. https://doi.org/10.1007/s13730-023-00779-6

Tanzeel Abbasi, M., Arif, M., Nauman Hashmi, M., Asghar, R., Bashir, K., & Ali, W. (2022). Bilateral Renal Lymphangiomatosis. In *Saudi J Kidney Dis Transpl* (Vol. 33, Number 1).

Wang, L., Qiu, Z., Zhan, S., Shi, G., He, W., Cen, Z., Xu, F., Tian, W., & Li, D. (2024). Case report: Page kidney with multiple serosal effusions caused by bilateral spontaneous renal subcapsular hemorrhage. *Frontiers in Medicine*, *11*. https://doi.org/10.3389/fmed.2024.1290470

Yildirim, S., & Guz, G. (2021). The floating kidney: an unusual complication of nephrotic syndrome. *Journal of Nephrology*, *34*(6), 2109–2110. https://doi.org/10.1007/s40620-021-01026-w