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Challenges of High-Grade Renal Trauma Management in a Resource-Limited Setting: A Case Report and Review of the Literature

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ABSTRACT

Ureteral injuries from blunt trauma are rare (<1% of urologic trauma) and even less common in children. In resource-limited settings such as rural Chad, limited diagnostics, absence of fluoroscopy, and delayed presentation complicate management. We present the case of a 13-year-old male who presented with fever, tachycardia and severe right-sided abdominal and flank pain four days after falling from a mango tree and striking his right flank. Bedside ultrasound showed severe right hydronephrosis and Foley catheterization yielded gross hematuria. A percutaneous nephrostomy was inserted under real-time ultrasound guidance. Additionally, a battery-powered flexible scope was utilized to place a double-J ureteral stent, as fluoroscopy is not available in this setting. The intervention proved to be lifesaving acutely and the patient was discharged with plans for delayed ureteral reconstruction. This case is unique considering that pediatric blunt ureteral injury is exceptionally rare and underrepresented in the literature. Falls from mango trees are a recognized cause of pediatric trauma in under-resourced agrarian regions. In the absence of Computed Tomography (CT) and fluoroscopy, portable ultrasound and endoscopic tools can facilitate safe urinary diversion. Redundancy in diversion methods may be beneficial when advanced imaging is unavailable and portable, battery-powered devices can enable life-saving interventions in austere environments and serve as a bridge to definitive surgical repair.

Key Words: Blunt abdominal injury, mango tree fall, pediatric ureteral trauma, percutaneous nephrostomy, resource-limited setting

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Introduction

Chad (Fr. Tchad) is a landlocked, Francophone country located at the heart of sub-Saharan Africa. As of 2023, this developing nation had a population of 19.3 million. [1] The life expectancy at birth is 59.1 years—lower than both the global average of 71.4 years and the African average of 63.6 years-with 66.4% of deaths attributable to causes that are readily preventable in more developed nations. These include communicable diseases, maternal and perinatal complications, and

poor nutritional conditions. [1] Traumatic injuries rank among the most devastating contributors to early mortality. [2] A major contributor to this health profile is the lack of funding and infrastructure. For example, the 2025 financial act allocated only 22.5% of the national budget to health, education, and social affairs combined. [3]

In this pervasively low-resource setting, access to radiologic imaging is particularly limited. Recent statistics from the World Health Organization indicate a density of only 0.18 Computed Tomography (CT) units per million population. [4] In our experience, these units are geographically concentrated in the capital city of N'Djamena, located on the country's western border. Reaching the capital from our hospital requires an approximately eight-hour bus ride, making diagnostic CT a practical impossibility in the management of acute renal trauma, for which contrast-enhanced CT is considered first-line. [5]

We present a case of acute urotrauma complicated by urosepsis and describe the unique, resourceful management approach undertaken in this austere environment.

Case presentation

A 13-year-old male presented to a rural district hospital four days after falling from a mango tree. The patient had been referred from a larger regional hospital in Chad to a smaller district hospital. This seemingly paradoxical referral is due to a dearth of trained surgeons in the country as a whole and none are present in the larger hospital. He had reportedly sustained blunt abdominal trauma from striking his right flank on a branch as he fell.

On arrival, the patient was toxic-appearing, febrile to 40.6°C, tachycardic, and complained of severe right-sided abdominal and flank pain. Physical examination revealed marked tenderness over the right abdomen, flank, and costovertebral angle. Due to limitations in advanced imaging and lack of access to CT, bedside ultrasound (US) was the primary diagnostic tool. Initial US demonstrated significant right-sided hydronephrosis, with no significant intra-abdominal free fluid. A Foley catheter was placed, which yielded gross hematuria. The patient was started on empiric intravenous ceftriaxone.

Despite antibiotic therapy, there was no clinical improvement over the subsequent 24 hours. Repeat US again showed severe right hydronephrosis, raising concern for ongoing urinary obstruction or high-grade renal injury. Given the lack of CT and fluoroscopy, the decision was made to proceed to the operating room for further evaluation and drainage.

Under handheld ultrasound guidance with a Butterfly iQ handheld US (Butterfly Network, Guilford, CT, USA) connected to a smart device, a percutaneous nephrostomy tube was successfully placed (Figure 1). This yielded approximately 400 mL of thin hematic fluid. To further assess and relieve the obstruction, a portable, battery-powered flexible cystoscope (Richard Wolf GmbH, Knittlingen, Germany; Model 7305.001) was advanced into the bladder. Due to the presence of significant intravesical clot burden, the patient was repositioned to the left lateral decubitus position to allow better visualization of the right ureteral orifice. A 6 French, 30 cm double-J ureteral stent was advanced over a guidewire into the right ureter without fluoroscopic guidance. A 16 French Foley catheter was then reinserted, returning a large volume of clear urine mixed with blood clots.

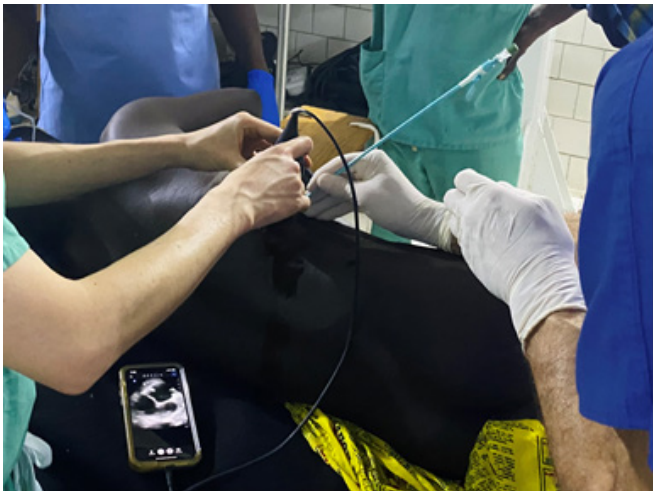

Fig. 1. Handheld ultrasound-guided percutaneous nephrostomy placement with a portable, battery-powered probe connected to a smart device. The nephrostomy tube was advanced into the collecting system under real-time imaging guidance.

Postoperatively, the patient remained on ceftriaxone and was also prescribed oral ciprofloxacin and amoxicillin–clavulanate. This choice of antibiotic coverage was to maximize the spectrum of coverage with the available medications within the country while also minimizing the risk of nephrotoxicity. His fevers did not respond to 24 hours of IV ceftriaxone. Laboratory capacity to obtain culture and sensitivity data remains unavailable in most of the country, including in our region. Ciprofloxacin was added to cover pseudomonas. Amoxicillin–clavulanate was added as a beta-lactamase inhibitor to cover potential resistant organisms. gentamicin was avoided due to possible nephrotoxic damage to his remaining normal kidney. Antibiotics were tapered off as he improved with cessation of ceftriaxone after 7 days and completion of ciprofloxacin the following week. He remained febrile for three days following the procedure, with mild tachycardia (heart rate 104-114 bpm), but ultimately defervesced. His flank pain improved dramatically, gross hematuria resolved, and output from the nephrostomy drain became clear.

The nephrostomy was studied by injecting it with iohexol followed by plain radiographs (Figure 2). There was an absence of contrast flow through the double-J stent or native ureter into the bladder. This finding was consistent with malposition of the double-J stent, as it did not traverse the ureteral disruption and reach the renal calyx. Drainage of the right renal collecting system was solely through the nephrostomy tube. Repeat ultrasound demonstrated resolution of the right-sided hydronephrosis. A future open exploration for ureteral reconstruction is planned, and the stent will remain in place to help identify the distal ureter during that operation.

The patient's flank pain resolved completely within a week after the interventions. He remained hospitalized for follow up studies and education. He was monitored for a week after the antibiotics completed to verify he did not have any further signs of infection. The patient's family was instructed regarding the care and emptying of his nephrostomy tube. Return precautions were provided should he develop fevers or increasing pain. The patient was discharged home with the nephrostomy in place and scheduled follow-up.

Fig. 2. Contrast injection (iohexol) through the nephrostomy. There was an absence of contrast flow through the double-J stent or native ureter into the bladder. This finding was consistent with malposition of the double-J stent, as it did not traverse the ureteral disruption and reach the renal calyx. Drainage of the right renal collecting system was solely through the nephrostomy tube.

Discussion

This case highlights a diagnostically challenging scenario of acute ureteral injury in a pediatric patient following blunt abdominal trauma within the context of a resource-limited setting. Ureteral injuries from blunt trauma are exceedingly uncommon, accounting for as little as 1% of all urologic trauma and are even more rare in children with very few cases reported in the literature. [6] Most available evidence comes from adult or mixed-aged cohorts, often within high-resource environments. [6] This paucity of pediatric-specific data poses challenges for clinicians, as mechanisms of injury, associated trauma patterns, and physiological responses may differ significantly from those in adults. In low-resource settings, these challenges are compounded by the absence of advanced imaging and specialized pediatric urologic care.

In this case, delayed presentation and absence of CT necessitated a high degree of clinical suspicion and innovative medical management. The patient's persistent flank pain, high fever, gross hematuria, and

worsening hydronephrosis following blunt abdominal trauma raised concern for a high-grade renal or collecting system injury. Bedside US, although less sensitive than CT, was critical in guiding the initial diagnostic workup and subsequent interventions.

Percutaneous nephrostomy placement with a handheld US connected to a smart device and ureteral stent insertion via cystoscopy without fluoroscopic assistance represent noteworthy adaptations of standard urologic techniques in a medically bare setting. These interventions allowed for urgent urinary diversion, infection control, and clinical stabilization for eventual definitive management. While this patient will ultimately require delayed open ureteral reconstruction, the initial drainage and infection control were lifesaving and set the stage for a favorable long-term outcome.

Although the ureteral stent was malpositioned, failing to traverse the ureteral disruption, its placement did not compromise the patient's recovery. The patient's presentation and clinical course suggest that this was a complete ureteral disruption. In retrospect, effective ureteral stenting would have likely remained unsuccessful even with fluoroscopic guidance had it been available.

The functioning nephrostomy provided effective drainage, highlighting the importance of redundancy in urinary diversion when full imaging is not available. Additionally, the retained stent will serve a secondary purpose by identifying the distal ureter during surgical exploration and reconstruction.

This case also underscores the critical role of portable, battery-powered technology in global health. In higher-resource settings, ureteral stent placement under fluoroscopic guidance is the standard approach. When a stent attempt is unsuccessful, image-guided percutaneous nephrostomy is routinely performed. However, in rural Chad, where most hospitals lack stable electricity and interventional radiology is virtually nonexistent, providers must rely on careful patient selection, evaluation and assessment as well as innovative techniques and proper training. In similar contexts, minimally invasive procedures with similar equipment can provide life-saving management when more advanced tools are unavailable. [7,8]

Additionally, this case demonstrates a unique urotrauma etiology. In many parts of sub-Saharan Africa and the Pacific, these injuries occur during seasonal fruit harvesting, when children are frequently tasked with climbing trees for produce collection. In a recent study from Ziguinchor, Senegal, mango trees accounted for 60.2% of all tree fall-related traumatic brain injuries, with most incidents occurring during the April-June harvest season; most affected individuals were children, often sustaining additional orthopedic or abdominal injuries. [9] Similar findings have been reported in the Solomon Islands, where falls from coconut and mango trees represent a major cause of both morbidity and mortality, [10] and in Burkina Faso, where 106 cases of tree fall trauma were managed in a single year, with mango trees being a common source. [11] In Fiji, 82% of mango tree falls occur during the fruiting season (June–November), and over three-quarters of patients were aged 5-13 years. Forearm fractures are the most common injuries (56%), but spinal cord injuries, head trauma, and intra-abdominal injuries are also observed. [12] Additionally, a recent systematic review of fall-related mortality in sub-Saharan Africa underscored the significant public health burden of such injuries, particularly in rural regions lacking organized trauma systems. [13] While largely preventable, mango tree falls place a substantial burden on under-resourced health systems in terms of acute care as well as long-term disability.

While this case highlights an innovative approach to managing blunt renal trauma in a low-resource setting, we recognize that resource availability between comparable rural areas can be highly variable. Even within resource-limited environments, differences in staffing, equipment, and training may significantly impact care. Therefore, our approach may have limited practical applicability to other clinical settings where the degree of resource scarcity dictates the standard of care.

Conclusion

This case demonstrates that, even in the absence of advanced imaging, fluoroscopy, and stable electricity, timely diagnosis and intervention for high-grade pediatric ureteral trauma are possible through the creative use of portable, battery-powered devices and adapted surgical techniques. The combination of percutaneous nephrostomy and attempted ureteral stenting provided effective urinary diversion, infection control, and stabilization for delayed definitive repair. While pediatric ureteral injuries from blunt trauma are exceptionally rare and underrepresented in the literature, they must remain on the differential for children presenting with flank trauma and hematuria, particularly in resource-limited settings. By sharing our experience, we aim to expand the evidence base for managing these injuries in austere environments and to highlight the importance of maintaining redundancy in urinary diversion strategies when conventional tools are unavailable.

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