The North African Journal of Scientific Publishing (NAJSP)
مجلة شمال إفريقيا للنشر العلمي (NAJSP)
E-ISSN: 2959-4820
Volume 4, Issue 2, 2026
Page No: 80-91
Website: https://najsp.com/index.php/home/index
SJIFactor 2024: 5.49 معامل التأثير العربي (AIF) 2025: 0.69 ISI 2024: 0.696

Urogenital Emergencies in Post-Disaster Libya: A 12-Month Prospective Study at a Tertiary Referral Centre

Abdulsalam Ahmeedah Abdulsalam[1*], Jalal Abdullah Bu Diraah[2]
[1]Department of Urology, Faculty of Medicine, University of Derna, Derna, Libya
[2]Department of Urology, Al-Wahda Hospital, Derna, Libya

حالات الطوارئ البولية والتناسلية في ليبيا ما بعد الكوارث: دراسة مستقبلية لمدة 12 شهرًا في مركز إحالة ثالثي

عبدالسلام أحميده عبدالسلام[1*]، جلال عبدالله بودراعه[2]
[1]قسم جراحة المسالك البولية، كلية الطب، جامعة درنة، درنة، ليبيا
[2]قسم جراحة المسالك البولية، مستشفى الوحدة، درنة، ليبيا

*Corresponding author: a.ehmida@gmail.com

Received: February 12, 2026	Accepted: March 27, 2026	Published: April 08, 2026

Abstract:

Background: Al-Wahda Hospital stands as the sole tertiary referral centre for Derna and northeastern Libya's surrounding district—a region battered by a decade of armed conflict and, in September 2023, the catastrophic Cyclone Daniel. Urogenital emergency patterns in this setting have never been systematically documented. We therefore conducted a 12-month prospective study to characterise the epidemiology, management, and clinical outcomes of acute urological conditions at this institution. **Methods:** We consecutively enrolled all patients presenting with urogenital emergencies to Al-Wahda Hospital between January and December 2024. Urological emergency was defined as any condition requiring investigation or intervention within 24 hours of presentation to prevent mortality or permanent morbidity. Using a standardised proforma, we collected data on demographics, presentation timing, diagnosis, interventions, complications, length of stay, and transfers. The principal investigator verified all entries weekly. Major complications were defined as Clavien-Dindo grade ≥IIIb (return to theatre, organ loss, vasopressor-dependent sepsis, or ICU admission). We computed descriptive statistics with SPSS v22 and compared outcomes between transferred and non-transferred patients using Fisher's exact test. **Results:** Of 106 patients (mean age 47.2 years; 77.4% male), the commonest emergencies were iatrogenic bladder injury during caesarean section (17.9%, n=19), acute urinary retention (17.0%, n=18), obstructed ureteral stones (16.0%, n=17), and Fournier's gangrene (15.1%, n=16). Ninety-four patients (88.7%) underwent surgical intervention. No in-hospital deaths occurred; however, 24 patients (22.6%) developed major complications (Clavien-Dindo ≥IIIb) and 8 (7.5%) suffered organ loss, six potentially preventable with earlier presentation. Thirty-six patients (34.0%) required inter-hospital transfer due to three distinct system gaps: consumable supply (n=3), absent endourological equipment (n=17), and lack of reconstructive surgical expertise (n=16). Transferred patients had significantly higher complication rates (44.4% vs. 11.4%; p<0.001). **Conclusion:** Al-Wahda Hospital saves lives reliably but cannot yet deliver definitive or reconstructive urological care. Three distinct system gaps, consumable supply, capital equipment, and surgical expertise—drive a 34.0% transfer rate. Addressing

these through targeted investment and community awareness campaigns would tackle the principal drivers of preventable morbidity identified in this cohort.

Keywords: Urogenital emergencies; Fournier's gangrene; testicular torsion; iatrogenic bladder injury; resource-limited settings; post-disaster healthcare; Libya.

الملخص:

الخلفية: يُعد مستشفى الوحدة مركز الإحالة الثالثي الوحيد لمدينة درنة والمناطق المحيطة في شرق ليبيا، وهي منطقة عانت من عقدٍ من النزاع المسلح، وتعرضت في سبتمبر 2023 لإعصار دانيال الكارثي. لم يتم توثيق أنماط الطوارئ البولية والتناسلية في هذا السياق بشكل منهجي من قبل. لذلك أجرينا دراسة مستقبلية لمدة 12 شهرًا لوصف الوبائيات، وأساليب التدبير، والنتائج السريرية للحالات البولية الحادة في هذه المؤسسة. **الطرق:** تم إدراج جميع المرضى الذين حضروا بحالات طوارئ بولية وتناسلية إلى مستشفى الوحدة بشكل متتابع خلال الفترة من يناير إلى ديسمبر 2024. عُرِّفت حالة الطوارئ البولية بأنها أي حالة تتطلب فحصًا أو تدخلاً خلال 24 ساعة من الوصول لتجنب الوفاة أو حدوث عجز دائم. باستخدام نموذج موحد، جُمعت بيانات حول الخصائص الديموغرافية، توقيت الحضور، التشخيص، التدخلات، المضاعفات، مدة الإقامة، والتحويلات. قام الباحث الرئيسي بمراجعة جميع البيانات أسبوعيًا. عُرِّفت المضاعفات الكبرى وفق تصنيف كلافين-ديندو بدرجة ≥IIIb (العودة إلى غرفة العمليات، فقدان عضو، إنتان يتطلب أدوية رافعة للضغط، أو دخول العناية المركزة). تم تحليل البيانات إحصائيًا باستخدام برنامج SPSS الإصدار 22، ومقارنة النتائج بين المرضى المحولين وغير المحولين باستخدام اختبار فيشر الدقيق. **النتائج:** شملت الدراسة 106 مرضى (متوسط العمر 47.2 سنة؛ 77.4% ذكور). وكانت أكثر الحالات شيوعًا: إصابة المثانة الناتجة عن تدخل طبي أثناء العملية القيصرية (17.9%، عدد=19)، احتباس البول الحاد (17.0%، عدد=18)، حصوات الحالب المصحوبة بانسداد (16.0%، عدد=17)، غرغرينا فورنييه (15.1%، عدد=16)، خضع 94 مريضًا (88.7%) لتدخل جراحي. لم تُسجل أي وفيات داخل المستشفى، إلا أن 24 مريضًا (22.6%) تعرضوا لمضاعفات كبرى (≥IIIb)، و8 مرضى (7.5%) فقدوا عضوًا—وكان بالإمكان تجنب ست حالات منها مع الحضور المبكر. احتاج 36 مريضًا (34.0%) إلى التحويل بين المستشفيات بسبب ثلاث فجوات رئيسية في النظام الصحي: نقص المستهلكات الطبية (عدد=3)، غياب معدات جراحة المسالك البولية بالمنظار (عدد=17)، نقص الخبرة في الجراحات الترميمية (عدد=16) وكانت معدلات المضاعفات أعلى بشكل ملحوظ لدى المرضى المحولين (44.4% مقابل 11.4%؛ p<0.001). **الاستنتاج:** ينجح مستشفى الوحدة في إنقاذ الأرواح بشكل موثوق، لكنه لا يزال غير قادر على تقديم الرعاية البولية النهائية أو الترميمية بشكل كامل. تؤدي ثلاث فجوات رئيسية—نقص المستهلكات، المعدات، والخبرة الجراحية—إلى معدل تحويل يبلغ 34.0%. إن معالجة هذه التحديات من خلال استثمارات موجهة وحملات توعية مجتمعية يمكن أن تقلل من العبء الرئيسي للمضاعفات التي يمكن الوقاية منها في هذه الفئة من المرضى.

الكلمات المفتاحية: الطوارئ البولية والتناسلية، غرغرينا فورنييه، التواء الخصية، إصابة المثانة الناتجة عن تدخل طبي، البيئات محدودة الموارد، الرعاية الصحية بعد الكوارث، ليبيا.

Introduction:

Al-Wahda Hospital occupies a unique position in Libyan healthcare. It functions simultaneously as Derna City's primary emergency facility and the only tertiary referral centre for over 177,000 people across northeastern Libya [1]. For a man with testicular torsion at 2 a.m., a patient in acute retention with no catheter available, or a woman with a post-caesarean urine leak, this hospital is not a choice, it is the only option within reasonable distance.

This singular status renders the institution's vulnerabilities unusually consequential. A decade of armed conflict gradually eroded subspecialty surgical capacity, destabilised supply chains, and shifted institutional focus toward trauma [2,3]. When Cyclone Daniel struck in September 2023, destroying a quarter of the city's infrastructure and killing over 4,000 people [4], it did not create a healthcare crisis from nothing. It compounded one already quietly unfolding. Floodwater contamination and collapsed sanitation amplified infection risk [5], the obstetric caseload strained an already stretched surgical service, and documented shortages of diagnostic imaging [6] and essential consumables [7] exposed structural gaps that paper-based records and fragmented coordination had long hidden [8].

Despite these challenges, Al-Wahda's clinicians continue managing the full spectrum of urological emergencies with whatever tools and supplies become available. What has never been done, until now, is to systematically document what those emergencies look like, how they are managed, where the system succeeds, and where it fails. This study aimed to identify specific, modifiable barriers to care through systematic prospective data collection that could guide targeted interventions.

Study Objectives:

Our primary objective was to characterise the epidemiology, management pathways, and clinical outcomes of urogenital emergencies at Al-Wahda Hospital over one calendar year. Secondary objectives included quantifying the spectrum and incidence of acute urological conditions presenting to this centre, identifying modifiable barriers to care, whether rooted in patient behaviour, diagnostic

capacity, consumable supply, or absence of definitive treatment technology, and comparing outcomes between transferred and non-transferred patients.

Methods:

Study Design and Setting:

We conducted a prospective observational study at Al-Wahda Hospital, Derna, Libya, from 1 January to 31 December 2024. Data collection spanned the emergency department and urology ward. Al-Wahda Hospital is a public 300-bed facility and the sole tertiary surgical referral centre for northeastern Libya. CT availability fluctuated throughout the study period due to maintenance requirements and power disruptions. Based on hospital engineering records and daily operational logs, the machine operated fully for approximately 70% of the calendar year, a factor influencing both overall utilisation rates and individual diagnostic delays.

Participants:

We enrolled all consecutive patients presenting with urological conditions requiring urgent investigation or operative management. We defined urological emergency as any condition requiring investigation or intervention within 24 hours of presentation to prevent mortality or permanent morbidity (e.g., acute scrotal pain, acute urinary retention, obstructive uropathy, urogenital trauma, necrotizing infections). We excluded patients with stable, non-urgent conditions managed on an outpatient basis. No age restrictions applied; we included both adult and paediatric cases meeting urgency criteria. All consecutive patients presenting during the 12-month period were enrolled; no a priori sample size calculation was performed as this was a descriptive epidemiological study.

Data Collection and Verification:

At each presentation, the principal investigator or a trained research assistant completed a standardised paper-based proforma recording: patient demographics and geographic origin, hours between symptom onset and hospital arrival, primary diagnosis and diagnostic tools used, type and timing of intervention, in-hospital complications, length of stay, and reasons for any inter-hospital transfer. When delays occurred, we recorded the specific barrier and classified it against established time-critical thresholds: surgical exploration within six hours for testicular torsion [9], and operative debridement within 12 hours for Fournier's gangrene. We categorised delays as patient-related (symptom onset to presentation) or system-related (presentation to diagnosis/treatment). Preventability was assessed by the principal investigator based on these established time-critical thresholds: testicular torsion >6 hours from symptom onset and Fournier's gangrene >12 hours from symptom onset were classified as 'High' preventability; other delays were classified based on whether they could have been avoided with optimal system function.

Within 24 hours, we entered completed proformas into a password-protected electronic database. The principal investigator reviewed all entries weekly, cross-checking for consistency and completeness, resolving discrepancies through direct case record review.

We defined major complications as any event classified Clavien-Dindo grade IIIb or higher: return to theatre (including planned re-debridement of Fournier's gangrene wounds), organ loss (orchidectomy or nephrectomy), vasopressor-dependent sepsis requiring ICU care, or ICU admission. All 16 Fournier's gangrene patients with significant tissue loss required at least one planned return to theatre under general anaesthesia for wound assessment and further debridement (Clavien-Dindo IIIb); bedside debridement was never employed.

Statistical Analysis:

We computed descriptive statistics using SPSS Statistics v22 (IBM Corp., Armonk, NY, USA). For comparative analysis between transferred and non-transferred patients, we used Fisher's exact test for categorical variables and independent t-tests for continuous variables, setting statistical significance at $p<0.05$. The higher complication rate in transferred patients was driven primarily by Fournier's gangrene severity; adjusted analysis was not performed due to sample size constraints.

Definitions:

- **Surgical intervention:** Any invasive procedure performed in an operating theatre or procedure room under local or general anaesthesia, including major surgery (debridement, repair, nephrectomy, orchidectomy) and minor invasive procedures (DJ stent insertion, percutaneous nephrostomy, suprapubic catheter insertion, percutaneous drainage).
- **Organ loss:** Surgical removal of a testis (orchidectomy) or kidney (nephrectomy) due to irreversible damage.
- **Major complication:** Clavien-Dindo grade ≥IIIb as defined above.
- **Inter-hospital transfer:** Transfer to another healthcare facility for any reason during the index admission.

Ethics:

The Research Ethics Committee of the Faculty of Medicine, University of Derna, approved the study, and Al-Wahda Hospital administration granted institutional operational permission. All participants or their legal guardians provided written informed consent before enrolment. For patients unable to consent on arrival (e.g., sepsis, altered mental status), delayed consent was obtained from next of kin or upon patient recovery. We anonymised all data at entry by replacing patient identifiers with unique study codes; no personally identifiable information remained in the study database. We conducted the study in full accordance with the Declaration of Helsinki.

RESULTS:

Demographic and Geographic Profile:

Over 12 months, we enrolled 106 patients. The cohort was predominantly male (77.4%) and working-age (mean 47.2 ± 14.8 years)—a distribution shaped by case mix as much as demographics, since urological emergencies naturally favour men, and most female patients presented with obstetric-related conditions. The 19 caesarean section patients were of reproductive age, while 5 older women (aged 52–68 years) presented with stones or infections, giving a female mean age of 41.2 ± 12.8 years. Approximately two-fifths of patients travelled from outside Derna City; Aqaba, approximately 50 km east of Derna, accounted for 19.8% of presentations, confirming Al-Wahda's role as a regional hub rather than merely a local facility. Table 1 presents the complete demographic profile.

Table (1): Patient demographics and geographic distribution (N=106).

Parameter	Category	n	%	Mean Age (years ± SD)
Total cohort		106	100.0	47.2 ± 14.8
Sex	Male	82	77.4	49.0 ± 13.5
	Female	24	22.6	41.2 ± 12.8
Age group	18–35 years	39	36.8	27.4 ± 4.9
	36–55 years	47	44.3	45.8 ± 5.5
	>55 years	20	18.9	68.3 ± 7.1
Geographic origin	Derna City	64	60.4	46.1 ± 15.0
	Aqaba	21	19.8	48.9 ± 14.2
	Umm al Rizam	7	6.6	49.3 ± 13.8
	El Ezzeiat	6	5.7	44.7 ± 16.1
	Timimi	4	3.8	51.5 ± 12.4
	Elbeida	4	3.8	53.0 ± 11.2

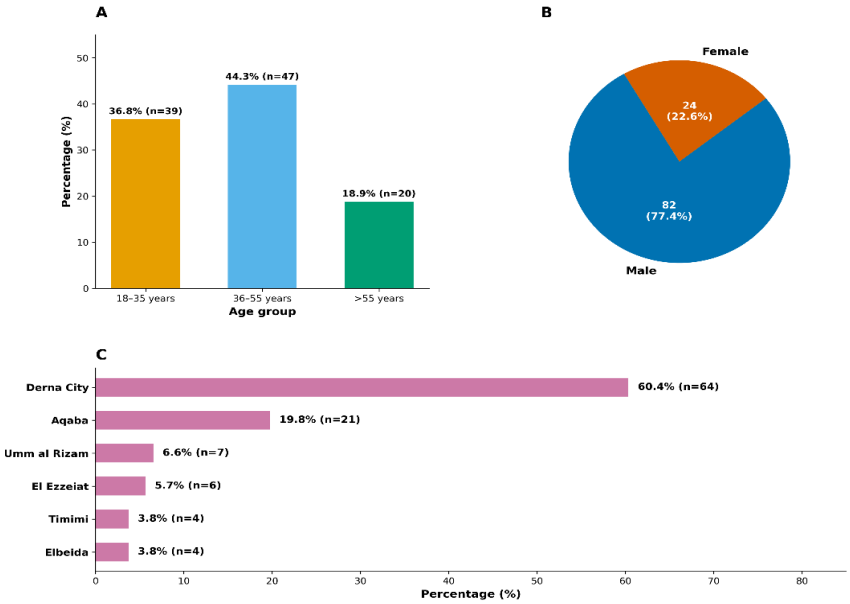

Figure (1): Demographic and geographic distribution of 106 patients with urogenital emergencies. Panel A: Age distribution. Panel B: Sex distribution. Panel C: Geographic distribution.

Clinical Case Spectrum and Management:

The caseload's defining feature is its surgical weight: 88.7% of patients required some form of surgical intervention. Only 12 patients (11.3%) underwent no procedure—3 transferred before SPC insertion and 9 managed conservatively for minor renal trauma (AAST I–III). Obstructive conditions—retention and stones together—comprised just under a third of presentations (33.0%), while urogenital trauma of various types accounted for 38.7% (including iatrogenic and non-iatrogenic injuries). Notably, 19 patients (17.9% of all urological emergencies) presented with iatrogenic bladder injury sustained during caesarean section—making this the most common single emergency diagnosis in the cohort.

We did not capture the total C/S denominator, therefore cannot calculate injury rate per procedure. Nevertheless, presenting as a urological emergency following obstetric surgery at this volume and frequency signals a systemic issue warranting structured quality review of obstetric surgical practice [10]. Reported bladder injury rates during C/S range from 0.1–0.5% in high-income settings [11]; the frequency we observed demands structured review. Table 2 details the complete case spectrum.

Table (2): Clinical case spectrum, interventions, and outcomes (N=106).

Category	Specific Diagnosis	n	%	Primary Intervention(s)	Major Complications† (n)	Mean LOS (Days)
Necrotizing Infections	Fournier's Gangrene	16	15.1	Surgical Debridement (16)	16 patients (all required return to theatre [IIIb]; 4 developed sepsis [IVa])	8.5
Urogenital Trauma	Bladder Injury (C/S)	19	17.9	Surgical Repair (19)	None	5.5
	Renal Trauma (AAST I–III)	9	8.5	Conservative Management (9)	None	5.0
	Renal Trauma (AAST IV–V)	5	4.7	Renorrhaphy (3), Nephrectomy (2)	2 patients (nephrectomy – organ loss)	9.5
	Bladder Injury (RTA)	1	0.9	Surgical Repair (1)	None	7.0
	Scrotal/Penile Trauma	7	6.6	Exploration & Repair (7)	None	3.5
Ischemic/Infective	Testicular Torsion	6	5.7	Orchidectomy (4), Orchidopexy (2)	4 patients (orchidectomy – organ loss)	2.0
	Testicular Abscess	2	1.9	Orchidectomy (2)	2 patients (orchidectomy – organ loss)	3.0
Obstructive	Obstructed Ureteral Stone	17	16.0	DJ Stent (10), PCN (7)	None	2.5
	Acute Urinary Retention	18	17.0	SPC (15) *	None	2.5
Other	Infected Cyst/Abscess	3	2.8	Percutaneous Drainage (3)	None	4.0
TOTALS		106	100.0	106 procedures	24 Major Complications†	5.0

*Three patients transferred before SPC insertion.

† *Major complication: Clavien-Dindo grade ≥IIIb. Total major complications = 16 (Fournier's) + 2 (nephrectomy) + 4 (torsion) + 2 (abscess) = 24. Organ loss occurred in 8 patients (4 torsion, 2 abscesses, 2 nephrectomy). *

Abbreviations: C/S, caesarean section; RTA, road traffic accident; DJ, double-J stent; PCN, percutaneous nephrostomy; SPC, suprapubic catheter; LOS, length of stay.

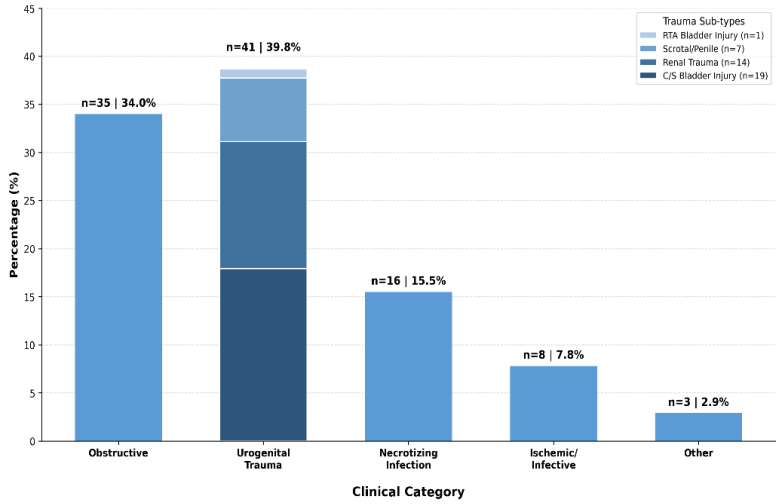

Figure (2): Distribution of urogenital emergency presentations by clinical category. Another category includes infected cyst/abscess (n=3).

Diagnostic Modality Utilisation:

Ultrasound served as the workhorse, used in 63.2% of cases—most often for scrotal and flank pain, acute retention, and trauma assessment. It frequently provided sufficient information for definitive diagnosis or procedural guidance and was performed in all 18 acute retention patients to confirm diagnosis, even in the three later transferred due to supply shortages.

CT scanning, employed in 33 patients (31.1%), was used for renal trauma staging (13 stable patients), obstructed stone characterisation (17 patients), and infected cyst/abscess drainage planning (3 patients). CT was not performed in one unstable renal trauma patient (AAST V) taken directly to theatre, nor in the bladder injury (RTA) patient undergoing immediate laparotomy, nor in any patient where ultrasound or clinical diagnosis sufficed (Fournier's, torsion, retention, scrotal trauma, iatrogenic injuries). Fournier's gangrene was diagnosed clinically based on physical examination findings (crepitus, necrotic skin changes, systemic toxicity) in all 16 cases; imaging was not required for diagnosis and would have delayed life-saving debridement.

Intraoperative diagnosis accounted for all 19 C/S bladder injuries, 1 renal trauma (AAST V) case, and 1 bladder injury (RTA) case-21 patients total, 19.8%. Table 3 presents the full diagnostic breakdown.

Table (3): Diagnostic modality utilisation by clinical case spectrum (N=106).

Diagnostic Tool	Performed (n)	Not Performed (n)	Rate (%)	Primary Indications (n)	Reasons Not Performed
Ultrasound	67	39	63.2%	Acute scrotum (8); flank pain/stones (17); renal trauma-stable (13); scrotal trauma (7); acute retention (18); infected cyst/abscess (3); bladder injury RTA-FAST (1)	• Clinical diagnosis sufficient (Fournier's, n=16) • Intraoperative diagnosis (C/S injuries, n=19) • Immediate OR required (severe scrotal trauma, n=3; unstable renal trauma, n=1)
CT Scan	33	73	31.1%	Renal trauma staging AAST I–IV (13); obstructed stones (17); infected cyst/abscess (3)	• Not clinically indicated (Fournier's, torsion, retention, scrotal trauma, iatrogenic injuries) • Unstable – direct to OR (renal trauma AAST V; bladder injury RTA) • Transferred before imaging could be performed (retention, n=3)
Intraoperative Diagnosis	21	85	19.8%	Bladder injury C/S (19); renal trauma AAST V (1); bladder injury RTA (1)	Diagnosis made intraoperatively; not applicable to other cases

Analysis of Delays and Clinical Impact:

Twenty-two patients (20.8% of the cohort) experienced identifiable delays in their care pathway (Table 4). Patient-related delays carried consequences difficult to convey in percentages. All four patients whose testicular torsion went unexplored beyond six hours lost their testis; average time from symptom onset to arrival was 28.5 hours. Among the 12 Fournier's gangrene patients presenting late (>12 hours), all required more extensive debridement than earlier intervention would have necessitated, and four developed sepsis. Three patients with high-grade renal trauma were initially misdiagnosed as musculoskeletal back pain and discharged from the emergency department, representing diagnostic error with mean delay of 72 hours. All three represented days later with complications requiring intervention. Combined, late presentation directly caused 75% of all organ losses, a proportion no surgical skill can reverse once the patient finally arrives.

System-related delays, though fewer, expose two fixable institutional vulnerabilities: persistent gaps in recognising renal trauma on initial assessment (3 cases), and an intermittent supply chain failure forcing three patients to transfer without receiving any treatment. Figure 3 illustrates these findings.

Table (4): Delay analysis by category and clinical consequence (N=106).

Delay Category & Cause	Cases (n)	% Cohort	Mean Delay (hrs)	Direct Clinical Consequence
Patient-Related				
Torsion presentation >6 h	4	3.8	28.5	Orchidectomy in all 4 cases
Fournier's presentation >12 h	12	11.3	42.0	Wider debridement required (12); sepsis developed (4)
System – Diagnostic				
Renal trauma misdiagnosis	3	2.8	72.0	Delayed definitive intervention; all 3 discharged and represented with complications
System – Logistic				
SPC kit unavailability	3	2.8	6.0	Forced transfer before any treatment
Operating room backlog	5	4.7	4.0	Prolonged pain; delayed surgery
UNIQUE PATIENTS WITH ≥1 DELAY	22*	20.8	—	—

**Five patients experienced more than one delay type (e.g., patient-related delay plus OR backlog); therefore, the sum of individual delay categories (27) exceeds the number of unique patients with delays (22). *

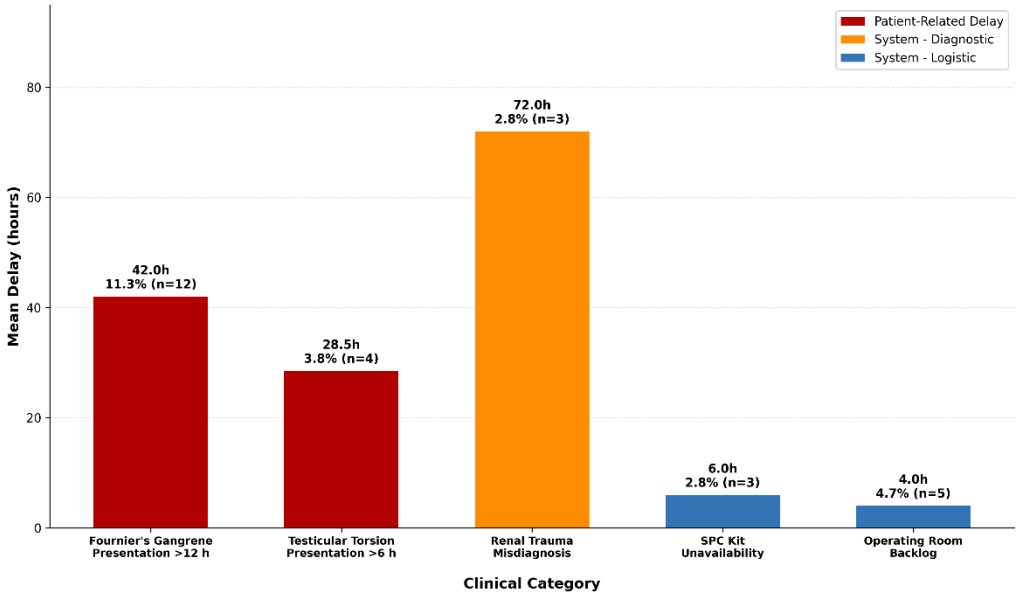

Figure (3): Delay analysis by category and clinical impact.

Inter-Hospital Transfer Analysis:

Thirty-six patients-34.0% of the cohort-transferred to another facility (Table 5). Examining reasons proves more instructive than the raw number. Three patients with acute urinary retention left without receiving any treatment because SPC kits were out of stock. Seventeen patients with obstructed stones stayed long enough to stabilise (via DJ stent or PCN), then transferred because the hospital lacks a lithotripter or ureteroscope, precluding definitive stone management on site. Sixteen patients who underwent emergency debridement for Fournier's gangrene transferred for the reconstructive phase, as no reconstructive surgeon is locally available. These are not overlapping problems, they represent three distinct institutional gaps with three different investment horizons.

Comparative analysis revealed that transferred patients had significantly higher complication rates than those managed entirely in-house (16/36, 44.4% vs. 8/70, 11.4%; difference 33.0% [95% CI 14.2–51.8%]; p<0.001, Fisher's exact test), driven primarily by Fournier's gangrene severity. We observed no significant difference in mortality (0% in both groups) or mean length of stay (4.9 vs. 5.1 days, p=0.67). Figure 4 illustrates these findings.

Table (5): Inter-hospital transfer analysis by category, reason, and impact (N=36).

Transfer Category	Diagnosis	n	% Transfers	% Cohort	Reason for Transfer	System Gap
Transfer without intervention	Acute Urinary Retention	3	8.3	2.8	No SPC kits available	Consumable supply chain
Transfer after stabilisation	Obstructed Stone	17	47.2	16.0	No lithotripter/ureteroscope	Capital equipment
Transfer for reconstruction	Fournier's Gangrene	16	44.4	15.1	No reconstructive surgeon	Sub-specialist expertise
TOTAL		**36**	**100.0**	**34.0**		

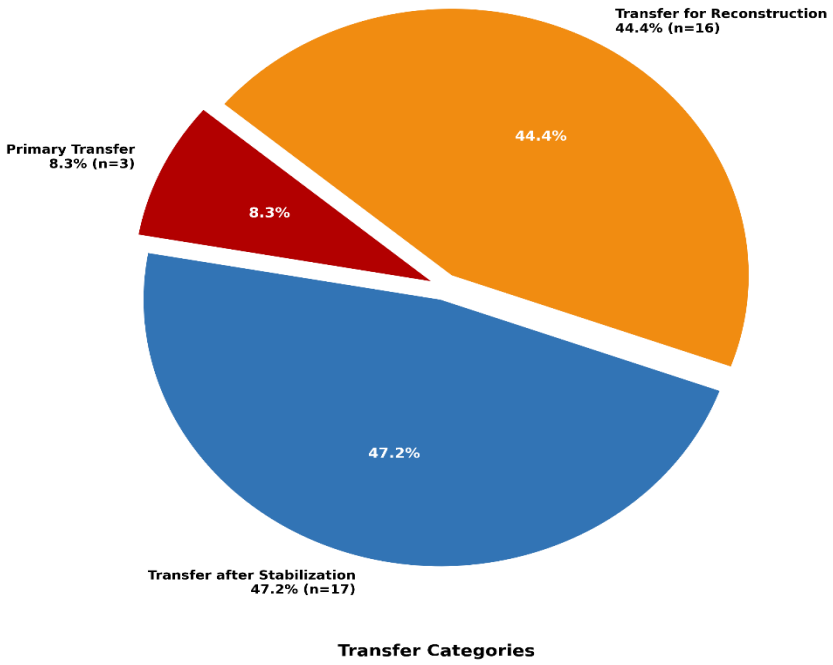

Figure 4. Transfer categories among the 36 transferred patients, illustrating three distinct system gaps.

Clinical Outcomes:

No patient died during index admission at Al-Wahda Hospital. This figure represents in-hospital mortality only; post-transfer outcomes for the 36 transferred patients were not tracked and remain unknown (see Limitations). For patients completing care at this institution, including 16 Fournier's gangrene cases, complex renal trauma requiring nephrectomy, and presentations from across a geographically dispersed post-disaster region, zero in-hospital mortality is no small achievement.

Major complications (Clavien-Dindo ≥IIIb) affected 24 patients (22.6%): 16 Fournier's gangrene patients required return to theatre (IIIb) with 4 developing sepsis (IVa); 6 patients underwent orchidectomy for torsion or abscess (organ loss); and 2 patients underwent nephrectomy for high-grade renal trauma (organ loss). Orchidectomy patients were discharged promptly once stable due to bed pressure; follow-up and further management were arranged on an outpatient basis. Notably, no major complications occurred in iatrogenic bladder injuries, renal trauma repairs (except the 2 nephrectomies counted as organ loss), obstructed stone interventions, scrotal/penile trauma, acute retention procedures, or infected cyst drainages, reflecting technical proficiency when patients present in time and resources permit.

Organ loss occurred in 8 patients (7.5%): 6 orchidectomies (4 testicular torsion, 2 testicular abscess) and 2 nephrectomies (high-grade renal trauma). Six of these eight losses (75%) were potentially preventable with earlier patient presentation. Surgical intervention was performed in 94 patients (88.7%), confirming the high-acuity, predominantly operative caseload. Mean length of stay was 5.0 days overall, though Fournier's cases averaged 8.5 days and high-grade renal trauma with nephrectomy averaged 9.5 days.

Table (6): Summary of clinical outcomes (N=106).

Outcome Metric	n	%	Details
Mortality	0	0.0	No deaths during index admission
Major Complications*	24	22.6	16 Fournier's patients (all required return to theatre [IIIb]; 4 developed sepsis [IVa]); 6 orchidectomies (organ loss); 2 nephrectomies (organ loss)
Organ Loss	8	7.5	Orchidectomy (6) and nephrectomy (2); 6 of 8 cases (75%) potentially preventable with earlier presentation (all 6 orchidectomies)
Surgical Intervention	94	88.7	Includes all patients except 3 transferred acute retention cases and 9 conservatively managed renal trauma (AAST I–III) patients
Inter-Hospital Transfer	36	34.0	Reflects institutional inability to provide definitive stone management (17), reconstructive surgery (16), and basic consumables (3)
Mean Hospital Stay	—	—	5.0 days overall (range 1–12 days). Longest stays: Fournier's gangrene (8.5 days) and high-grade renal trauma (9.5 days)

* Clavien-Dindo grade ≥IIIb: organ loss, return to theatre, vasopressor-dependent sepsis, or ICU admission.

DISCUSSION:

This study documents a paradox. A hospital achieving zero in-hospital mortality across a 12-month cohort of complex urological emergencies, including Fournier's gangrene, high-grade renal trauma, and septic presentations, pment or expertise to complete their care. Both statements are true, and neither cancels the other. Understanding what drove both success and system failure is this paper's practical purpose.

Zero Mortality: Clinical Competence Under Duress:

The zero-mortality finding deserves genuine recognition before we contextualise it away. Historical Libyan hospital data recorded renal disease mortality at 7.2% [12]; published series from comparable resource-limited settings report Fournier's gangrene mortality rates of 20–40% [13,14]. Achieving no deaths in a year that included 16 FG cases and five AAST grade IV–V renal injuries reflects real clinical competence in resuscitation and emergency surgery. Our aggressive debridement protocol, early broad-spectrum antibiotics, early ICU support, and dedicated surgical team likely contributed to these outcomes. This serves as the baseline from which everything else should be measured.

Iatrogenic Bladder Injury: Obstetric Safety Gap:

Nineteen iatrogenic bladder injuries during caesarean section constituted 17.9% of the entire urological emergency cohort, a finding warranting editorial scrutiny. We did not capture the total C/S denominator, therefore cannot calculate injury rate per procedure. What it tells us is that obstetric bladder trauma generated nearly one in five urological emergency admissions over the year, a frequency pointing to systemic rather than individual surgical failure. Reported bladder injury rates during C/S range from 0.1–0.5% in high-income settings [11]; our observed frequency demands structured review. Al-Wahda Hospital carries a documented history of above-benchmark C/S rates [10], and the post-cyclone period likely further stressed obstetric throughput with reduced supervision. The appropriate response is structural: a mandatory pre-operative safety checklist for high-risk cases (prior uterine surgery, known pelvic adhesions) is a low-cost intervention with strong evidence in resource-constrained obstetric settings. Future studies should capture C/S denominator to calculate true injury rate.

Fournier's Gangrene: A Public Health Signal:

The proportion of Fournier's gangrene among urological emergencies (15.1%) substantially exceeds that typically reported in stable settings, where FG constitutes less than 2% of urological admissions [13,14]. This requires a different explanation. Fournier's gangrene does not arise from surgical error; it arises from the environment patients inhabit and the immunological state they arrive in. In Derna during 2024, that environment included floodwater-contaminated soil, disrupted refuse collection, and a primary healthcare system still recovering from the cyclone's impact. Viewing the FG burden as merely clinical underestimates its meaning as a public health signal about infrastructure recovery. That all 16 FG patients survived their acute episode at Al-Wahda (0% mortality, compared to 20–40% in other resource-limited series [13,14]) speaks to surgical debridement and sepsis management quality, but their transfer for reconstruction highlights the lack of comprehensive care.

Three Gaps, Three Solutions:

The transfer data contain the most actionable findings. Three transfer categories reveal three gap categories, each requiring distinct intervention.

The first category, patients transferred without any intervention because SPC kits were unavailable, can be solved within weeks by any hospital administrator with a procurement budget and the will to use it. A three-month consumable buffer stock is standard practice and simply has not been applied here. These three transfers represent a fundamental supply chain failure undermining confidence in the entire system.

The second category, patients stabilised then moved for lithotripsy or ureteroscopy, accounts for nearly half of all transfers (47.2%) and represents the single largest efficiency loss. Procuring an endourological tower and lithotripter would, based on this year's data, keep 17 patients in-house who currently leave. This capital investment decision offers clear return: reduced transfer burden, retained revenue, and complete patient care. Preliminary costing obtained from suppliers estimates US$150,000–200,000 for basic endourological tower, excluding recurrent consumable costs.

The third category, post-FG patients requiring reconstructive surgery, is the most complex, requiring human capital investment rather than equipment. These 16 patients received life-saving debridement locally but had to travel for wound closure. This gap is appropriately targeted for tele-mentoring partnerships and structured fellowship programmes [15], building local capacity over time.

Comparative analysis confirmed that transferred patients had significantly higher complication rates (44.4% vs. 11.4%; difference 33.0% [95% CI 14.2–51.8%]; $p<0.001$), driven by FG severity. This reinforces that transfers are not a benign solution but a marker of disease severity and system limitation.

Organ Loss: Community Health Literacy and Access Barriers:

The organ loss data reframe discussion unexpectedly. Six of eight organ losses, 75%, resulted from patients arriving after the surgical salvage window closed. The torsion patients who lost their testes had not been delayed by long ultrasound waits or unavailable theatres. They had waited at home for 28 hours before coming to hospital. While health literacy is a factor, the concept that a painful scrotum can cost a man his fertility if not assessed within hours remains unfamiliar, transportation difficulties, security checkpoints, and cost barriers likely also contribute. Qualitative research is needed to fully understand pre-hospital delays in this setting. A targeted public awareness campaign is, by this study's own data, the intervention with highest potential impact per unit cost. It is also the one least likely to attract funding, because it involves neither equipment nor buildings.

Diagnostic Practice: Appropriate and Resource-Conscious:

Diagnostic utilisation patterns in this study reflect rational, guideline-based practice. Ultrasound was used appropriately for time-sensitive conditions; CT was reserved for complex cases where it would change management (renal trauma, stone characterisation, complex infection); no unnecessary imaging was performed. The 100% CT utilisation in stable renal trauma and obstructed stone patients enabled precise staging and treatment planning, while CT absence in clinically obvious conditions (Fournier's, torsion) avoided delays in life-saving intervention. However, intermittent CT availability (approximately 70% operational) contributed to diagnostic delays, and the three renal trauma misdiagnoses indicate need for better trauma evaluation training among emergency physicians—gaps addressable through focused educational interventions and improved equipment reliability as outlined in our recommendations.

Implications Beyond Libya:

Looking beyond Libya, this study offers a transferable methodology for other post-disaster or conflict-affected settings. The three-tier transfer analysis, consumables, technology, expertise, provides a rapid framework for classifying institutional gaps that can be applied prospectively during healthcare system recovery planning [16]. The finding that patient-related delays outweigh system-related delays as an organ loss driver may not hold universally, but it is a hypothesis worth testing in comparable environments. What this study demonstrates is that prospective, systematically collected data, even

from a single centre, even from a paper-based proforma, can generate findings specific enough to inform concrete investment decisions. That is precisely what surveillance-level research in fragile health systems should do.

Conclusion:

This prospective study demonstrates that Al-Wahda Hospital provides effective acute and life-saving urological care in a resource-constrained, post-disaster setting, evidenced by zero in-hospital mortality across 106 complex emergency presentations. However, a 34.0% inter-hospital transfer rate, 22.6% major complication rate, and 7.5% organ loss rate reveal that definitive and reconstructive care capacity has not kept pace with acute surgical capability. Three sequenced investments, consumable supply chain reform, endourological technology procurement, and reconstructive surgical expertise development, alongside a community awareness campaign for time-critical urological emergencies, represent the highest-yield priorities for closing this gap.

Recommendations:

Immediate (0–6 Months):

Implement a mandatory pre-caesarean surgical safety checklist for high-risk cases (prior uterine surgery, known pelvic adhesions), adapted from the WHO Surgical Safety Checklist for high-risk obstetric cases, to reduce iatrogenic bladder injuries.

Establish a three-month consumable buffer stock-SPC kits and double-J stents at minimum-to eliminate supply-driven emergency transfers.

Short-Term (6–18 Months):

Launch a community health campaign on time-critical urological emergencies, focusing on testicular torsion and Fournier's gangrene with the clear message that hours matter, while also addressing transportation and access barriers through community engagement.

Introduce a written clinical pathway for flank trauma evaluation to reduce diagnostic delays seen in this cohort. Provide focused trauma evaluation training for emergency physicians to prevent renal trauma misdiagnosis.

Long-Term (18+ Months):

Procure endourological equipment (lithotripter and ureteroscopic tower) to enable in-house stone management; preliminary costing estimates US$150,000–200,000 for basic endourological tower, excluding recurrent consumable costs. This alone would eliminate the largest inter-hospital transfer category. Develop reconstructive surgical capacity through tele-mentoring and fellowship placements to allow post-FG reconstruction locally.

Study Limitations:

Five limitations require acknowledgment:

- First, the **single-centre design** limits generalisability to other Libyan hospitals without further study, though the structural barriers we identified, specialist scarcity, consumable instability, absent technology, are unlikely unique to Al-Wahda.
- Second, **loss to follow-up for transferred patients** constitutes a major limitation. We attempted no follow-up for the 36 patients transferred to other institutions after index Al-Wahda admission. We made no contact with receiving hospitals and conducted no telephone follow-up. The final morbidity and mortality for 34.0% of the cohort following transfer therefore remains uncaptured. This means our zero in-hospital mortality finding cannot extend to a 30-day or overall mortality claim, and the true complication burden is likely underestimated.
- Third, the **post-cyclone case mix**, particularly elevated FG and external trauma rates, limits direct comparison with figures from stable healthcare settings; this is a study of emergency urology after natural disaster and should be read as such.
- Fourth, **resource availability fluctuated** across the calendar year. CT availability (estimated 70% operational) and consumable stock varied, introducing variability that aggregate annual figures cannot fully express. Intermittent CT availability may have resulted in under-identification of some conditions (e.g., low-grade renal trauma, subtle stones), though this is unlikely to have affected major outcome capture.
- Fifth, **potential observer bias** exists as data verification was performed by a single investigator without inter-rater reliability assessment. Complication grading was performed by the surgical team without independent adjudication, introducing potential classification bias.

Declarations:

- **Conflict of Interest:** The authors declare no conflicts of interest.
- **Funding:** This research received no external funding.
- **Acknowledgements:** The authors thank the staff of the emergency and urology departments of Al-Wahda Hospital for their cooperation, and all patients who consented to participate. Colleagues in the surgical team provided invaluable support with data collection during a demanding period.

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