

# Kidney-preserving surgery for AAST grade IV penetrating renal trauma with ureteropelvic disruption: a military case report at Role 3

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High-grade renal trauma (AAST IV and V) represents a significant challenge for surgeon in both civilian and military settings. Renal pelvic disruption with complete ureteral transection is uncommon and technically challenging for kidney repair, although an organ-preserving approach is possible in such cases to preserve renal function.

**Aim.** The aim of this report is to present a case of successful kidney-preserving surgical treatment of severe penetrating renal trauma (AAST IV) with ureteropelvic junction disruption in a combat environment. We highlight the feasibility of reconstructive surgery at Role 3 facilities and emphasize its value in organ preservation and long-term rehabilitation of military personnel.

**Materials and methods.** We report the case of a military service member who was admitted with stable hemodynamic parameters but developed, within three hours, a decline in hemoglobin concentration from 13.0 g/dL to 8.9 g/dL accompanied by hemodynamic instability. An exploratory laparotomy was performed to achieve hemostasis, surgical revision, and an organ-preserving intervention.

**Results.** The patient underwent resection of the lower pole of the right kidney with ligation of the inferior segmental vessels. Ureteral continuity was restored by end-to-end anastomosis with stenting. Postoperatively, the patient was stabilized, and renal function was preserved.

**Conclusions.** This case illustrates the feasibility of an organ-preserving strategy in severe renal trauma (AAST IV) with ureteropelvic junction injury under combat conditions. Reconstructive procedures performed at Role 3 facilities enable kidney preservation and maintenance of urinary tract function, which is of particular importance for the long-term rehabilitation of military personnel.

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## Нирковозберігальна хірургія при проникній травмі нирки IV ступеня за класифікацією AAST з розривом сечоводу та миски: військовий клінічний випадок у Role 3

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Травма нирки високого ступеня (AAST IV та V) є значним викликом для хірурга й у цивільних, і в військових умовах. Розрив ниркової миски з повним пересіченням сечоводу є рідкістю та технічно складною ситуацією для відновлення нирки, хоча в таких випадках можливий органозберігальний підхід для збереження функції нирок.

**Мета роботи** – описати випадок органозберігального хірургічного лікування тяжкої проникної травми нирки (AAST IV ступеня) з порушенням сечоводно-мискового з'єднання в бойових умовах, показати можливість виконання реконструктивних процедур у закладах Role 3 і їхню важливість для довгострокових функціональних результатів.

**Матеріали і методи.** Проаналізовано випадок лікування військовослужбовця, який звернувся зі стабільними гемодинамічними параметрами, але протягом трьох годин у нього спостерігали зниження концентрації гемоглобіну з 13,0 г/дл до 8,9 г/дл, що супроводжувалося гемодинамічною нестабільністю. Виконали лапаротомію для досягнення гемостазу, хірургічної ревізії та органозберігального втручання.

**Результати.** Пацієнту виконано резекцію нижнього полюса правої нирки з перев'язуванням нижніх сегментарних судин. Безперервність сечоводу відновлено за допомогою анастомозу «кінець у кінець» зі стентуванням. Після операції стан пацієнта стабілізовано, а функцію нирок збережено.

**Висновки.** Описаний випадок підтверджує доцільність органозберігальної стратегії при тяжкій травматі нирки (AAST IV) з пошкодженням сечоводу та мискового переходу в бойових умовах. Реконструктивні процедури,

які здійснюють в установах Role 3, дають змогу зберегти нирку та підтримувати функцію сечовивідних шляхів, що має особливе значення для довгострокової реабілітації військовослужбовців.

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Renal trauma remains a major clinical concern in both civilian and military settings. These injuries account for approximately 5 % of all traumatic cases and up to 24 % of parenchymal abdominal organ injuries [1]. The kidney is the most frequently affected organ of the genitourinary system, representing 65–90 % of all urogenital traumas [2].

The severity of renal trauma is graded according to the American Association for the Surgery of Trauma (AAST) scale, ranging from I to V. Grade IV injuries, which involve deep parenchymal lacerations with collecting system or segmental vascular involvement, are considered particularly hazardous due to the high risk of complications and the frequent need for surgical management [3].

Recent professional guidelines emphasize the importance of maximal organ preservation in emergency interventions. For example, the Eastern Association for the Surgery of Trauma (EAST) advocates nephron-sparing techniques (partial nephrectomy, parenchymal repair) over nephrectomy, as they reduce both mortality and the risk of chronic renal insufficiency [4]. A similar position is endorsed by the joint WSES–AAST guidelines, which highlight a multidisciplinary approach involving urologists, trauma surgeons, interventional radiologists, and intensivists [2].

In combat settings, particularly at Role 3 facilities, decision-making is complicated by limited resources and the imperative of rapid return of injured personnel to duty. Although some reports describe the feasibility of laparoscopic nephrectomy even at Role 2 hospitals, organ-preserving procedures require experienced surgeons and hemodynamic stability of the patient [5].

Ureteral injuries, especially complete transection or avulsion at the ureteropelvic junction, are rare because of the retroperitoneal location and relative protection of the ureter [6]. Such injuries necessitate reconstructive surgery, ranging from direct anastomosis to various urinary diversion techniques. Among these, end-to-end ureteral anastomosis with stenting remains the preferred method of restoring continuity, provided sufficient length and adequate vascularization of the ureter are preserved [6].

However, the literature contains almost no reports of combined grade IV renal trauma with complete ureteral transection managed by organ-preserving open surgery in combat conditions. The present case is therefore noteworthy, as it demonstrates the feasibility of partial nephrectomy with ureteral reconstruction even in the resource-limited environment of a Role 3 military hospital.

## Aim

The aim of this report is to present a case of successful kidney-preserving surgery for severe penetrating renal trauma (AAST IV) with ureteropelvic junction disruption in a combat environment. We highlight the feasibility of reconstructive surgery at Role 3 facilities and emphasize its value in organ preservation and long-term rehabilitation of military personnel.

## Case description

Patient D., a 45-year-old male, sustained an explosive injury on February 26, 2025, at approximately 18:45 as a result of a drone-delivered munition. He was evacuated from a Role 2 medical facility to a Role 3 military hospital.

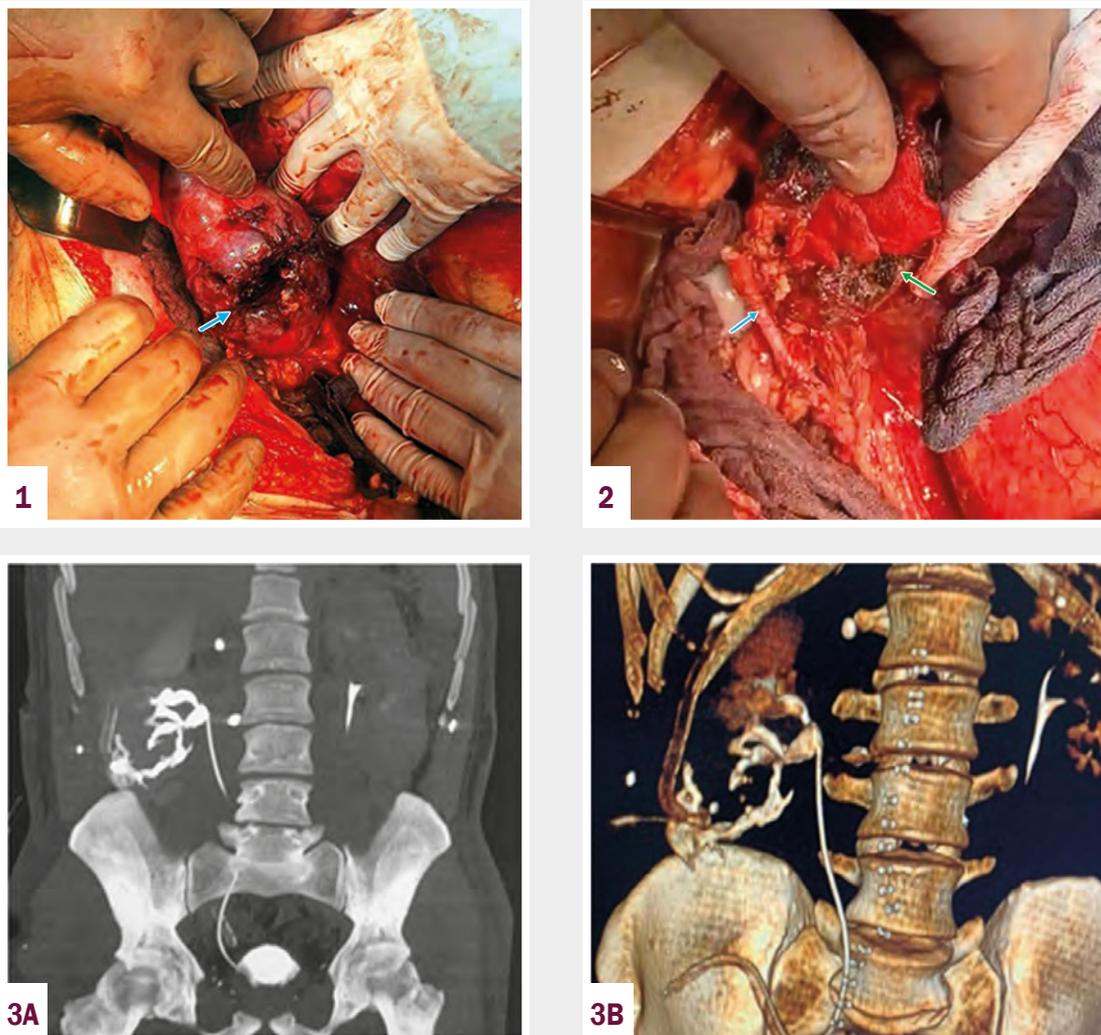
On admission, his condition was assessed as severe, but stable. The patient was conscious (Glasgow Coma Scale score: 15). Vital signs: blood pressure 90/60 mmHg, heart rate 85 bpm, body temperature 36.6 °C, oxygen saturation 98 %, and respiratory rate 16/min. Physical examination revealed multiple gunshot and shrapnel wounds to the abdomen, left thigh, and lower leg.

Locally, there was a wound in the right flank along the mid-axillary line (3 × 4 cm), two wounds in the left hypogastrium (3 × 4 cm and 1 × 2 cm), and a gunshot wound to the left thigh (3 × 4 cm) accompanied by abnormal mobility and crepitus in the distal third of the femoral shaft. A superficial wound measuring 1 × 1 cm was also noted on the left lower leg.

Comprehensive assessment, including abdominal computed tomography (CT), radiography, and laboratory tests, confirmed right renal injury. Whole-body CT demonstrated multiple blast-fragment injuries, including a non-penetrating shrapnel wound with a metallic fragment lodged in the left temporal region, as well as numerous fragments within the abdominal wall bilaterally and in the region of the right inguinal fold. Of particular concern was a penetrating shrapnel wound to the right lumbar region with injury to the right kidney, consistent with grade IV trauma according to the AAST classification. Imaging showed a large subcapsular hematoma, signs of parenchymal contusion with a cortical laceration deeper than 1 cm, a right retroperitoneal hematoma, and intraperitoneal free gas consistent with pneumoperitoneum. Additionally, there was a gunshot injury with hematoma in the projection of the right iliopsoas muscle and a comminuted fracture of the right 11th rib.

Serial laboratory monitoring revealed progressive decline in hemoglobin concentration: from 130 g/L (13.0 g/dL) at 02:40 to 89 g/L (8.9 g/dL) at 05:40, consistent with ongoing internal bleeding. On February 27, 2025, the patient underwent emergency laparotomy. Intraoperative findings included grade IV right renal trauma (AAST) with renal pelvic injury and complete ureteral transection, along with involvement of the segmental vessels of the lower renal pole (Fig. 1). Associated injuries included a marginal laceration of hepatic segments V–VII, fractures of the right IX–X ribs, serosal injury of the descending duodenum, and retroperitoneal hematoma.

During surgery, a lower pole resection of the right kidney was performed with ligation of the segmental artery and vein. Continuity of the ureteropelvic junction was restored by an end-to-end anastomosis over a 6F ureteral stent. Hemostasis of the liver and primary repair of the injured segment of the duodenum were achieved (Fig. 2). In addition, resection of the right IX–X ribs, abdominal and retroperitoneal lavage with drainage were performed. The gunshot wound of the thigh was debrided, and external fixation of the femoral fracture was performed using an external fixation device.



**Fig. 1.** AAST grade IV injury to the right kidney with damage to the renal pelvis (blue arrow) and complete transection of the ureter.

**Fig. 2.** Resection of the lower pole of the right kidney with ligation of the segmental artery and vein, renorrhaphy (green arrow), restoration of the integrity of the ureteral segment by applying an end-to-end ureteral anastomosis (blue arrow).

**Fig. 3.** Fluid formation in the perirenal space on the right with confirmed signs of urine extravasation into its cavity, consistent with urinoma. **A:** Coronal view CT; **B:** 3D CT reconstruction.

In the early postoperative period, follow-up abdominal CT performed on March 5, 2025 (several days after surgery) demonstrated expected postoperative changes with a partially encapsulated fluid collection in the right perirenal space, consistent with urinary extravasation from a renal calyx. Additional findings included a small, drained pneumoperitoneum and hydroperitoneum, bilateral hypostatic pneumonia, and a minor left-sided hydrothorax. A marginal comminuted fracture of the right 11th rib was also identified, along with multiple metallic fragments within the retroperitoneum and soft tissues of the lateral abdominal walls (Fig. 3).

Subsequent evaluation on March 19, 2025, demonstrated progression of the local process, with the formation of a well-demarcated fluid collection in the right perirenal space. Imaging confirmed ongoing urinary extravasation into this cavity, consistent with a urinoma. Metallic fragments persisted in the retroperitoneum and

adjacent soft tissues. No evidence of generalized complications or progression of intra-abdominal pathology was observed.

The postoperative course thus evolved from initial limited urinary extravasation with fluid collection to the development of a clearly encapsulated urinoma by postoperative day 14, necessitating continued monitoring and potential interventional management.

Clinically, the course was relatively favorable. On postoperative day 3, urine output through the drain reached up to 400 mL/day, consistent with a renal fistula, which subsequently closed spontaneously by day 14. Serum nitrogen levels remained within normal limits. The ureteral stent was replaced after 4 weeks and completely removed after another 4 weeks. At discharge, renal function was preserved, the urinoma had regressed, and the overall condition of the patient was stable with a tendency toward complete recovery.

## Discussion

Over the past decades, the paradigm of managing high-grade renal trauma (HGRT) has undergone substantial transformation. Whereas penetrating grade IV–V injuries were historically considered absolute indications for nephrectomy, current evidence emphasizes the importance of renal preservation whenever feasible, particularly in hemodynamically stable patients [7,8].

Contemporary studies demonstrate that conservative or minimally invasive strategies are achievable in the majority of HGRT cases, reducing nephrectomy rates and improving long-term outcomes [9].

Nevertheless, the literature highlights critical differences between stab wounds and gunshot injuries. The latter, particularly in combat settings, are associated with higher nephrectomy rates (up to 80 %), extensive parenchymal contusion, and a greater burden of associated injuries [10]. Our patient presented with a constellation of high-risk features: a gunshot wound, subcapsular and retroperitoneal hematomas, a cortical laceration >1 cm, and complete transection of the ureter at the renal pelvis. Such a combination typically carries a poor prognosis for renal salvage and is usually managed with nephrectomy.

Despite these challenges, relative hemodynamic stability at the time of intervention and the availability of a surgical team at Role 3 level facilitated an organ-preserving open approach. In contrast to most modern protocols – where conservative management with adjunctive angioembolization or ureteral stenting is prioritized [4,11] – these options were not available in this battlefield scenario. This underscores the realities of military medicine, where limited access to interventional radiology often necessitates open surgery as the only viable strategy.

The evidence base strongly supports nephron-sparing approaches in hemodynamically stable patients. For instance, a meta-analysis by J. C. Prihadi et al. [7] encompassing 36 studies (2015–2023) showed that conservative management reduced nephrectomy risk by 52 % (95 % CI 0.38–0.66) and mortality by 9 % (95 % CI 0.05–0.13) compared to operative strategies. Similarly, I. Glykas et al. [12] reported that among 57 stable patients with AAST grade IV–V trauma, nephrectomy was avoided in all, with only 27.8 % requiring embolization and 22 % requiring stenting or drainage to manage urinary leakage. Analysis of the National Trauma Databank (2017–2019) revealed that 38 % of grade V patients were managed non-operatively, with significantly lower mortality (10.9 % vs. 22.6 % in operative cases). Although penetrating trauma and transfusion requirements markedly reduced the likelihood of renal salvage (OR 0.13 and 0.22, respectively), nephron-sparing management remained feasible in stable patients [13].

Angioembolization now constitutes a cornerstone of HGRT management. In stable patients with contrast extravasation, embolization enables renal preservation in over 90 % of cases [11]. Even among grade V injuries in the multicenter MiGUTS analysis, more than 60 % were successfully treated without nephrectomy using embolization or stenting [14]. Guidelines, including those from the Eastern Association for the Surgery of Trauma, recommend angioembolization as first-line therapy for stable patients with active bleeding, given its impact on reducing nephrectomy, delayed hemorrhage, and renal dysfunction [4].

The uniqueness of our case lies in the combined reconstructive approach: lower pole resection with segmental vessel ligation together with ureteral continuity restoration via end-to-end anastomosis over a stent. While such techniques are aligned with contemporary recommendations for ensuring watertight closure of the collecting system and urinary diversion, they are rarely reported in the context of combat trauma [15,16]. When open surgery is mandated by instability or lack of interventional radiology, nephron-sparing strategies – including partial nephrectomy or renorrhaphy with drainage – remain essential for preserving renal function. European Association of Urology guidelines advocate for meticulous techniques including temporary arterial occlusion, excision of devitalized tissue, watertight repair of the collecting system and parenchyma, use of capsular or omental flaps, topical hemostatics, and retroperitoneal drainage [15].

Military data further highlight the feasibility of nephron-sparing surgery (NSS) under austere conditions. Reports from Afghanistan (2017–2023) indicate renal salvage in 61 % of severe injuries managed with NSS, even in early evacuation settings, although nephrectomy remained necessary in 41 % [16]. Despite the complexity of high-energy injuries, combined firearm and fragment trauma, organ-preserving procedures were associated with favorable survival (~91 %) and acceptable complication rates. Our case aligns with these observations: despite an AAST grade IV firearm injury with associated damage, open reconstructive surgery avoided nephrectomy and preserved renal function. This outcome carries particular significance for military patients, where long-term quality of life and rehabilitation potential depend on organ preservation.

In summary, this case illustrates the critical role of individualized treatment strategies in HGRT. It demonstrates that even in the absence of interventional radiology, open organ-preserving procedures with ureteral reconstruction can achieve successful outcomes in stable patients with severe penetrating trauma. While advances in conservative and interventional management have transformed HGRT care, nephrectomy remains unavoidable in unstable patients with life-threatening hemorrhage or vascular pedicle avulsion.

## Conclusions

1. This case highlights the feasibility of successful organ-preserving surgery in a patient with AAST grade IV combat-related renal trauma complicated by disruption of the pelvicalyceal system and complete ureteral transection. Despite the high risk of nephrectomy in such scenarios, the applied strategy – partial nephrectomy with segmental vessel ligation combined with ureteral end-to-end anastomosis over a stent – enabled renal preservation.

2. Importantly, this report underscores that in combat surgery at the Role 3 level, even with resource limitations, organ-sparing interventions may serve as effective alternatives to nephrectomy when hemodynamic stability and surgical expertise permit. Such approaches hold substantial clinical and social value for military patients, directly contributing to long-term quality of life and functional recovery after injury.

**Prospects for further research.** Organ-preserving surgical interventions in penetrating renal trauma remain a relatively

underexplored area despite their significant clinical and social relevance. Future research should focus on systematically evaluating the outcomes of reconstructive procedures in diverse clinical settings, including both military hospitals and civilian practice. It is particularly important to collect and analyze multidisciplinary data on survival, complication rates, renal function preservation, and patient quality of life following partial nephrectomy or combined reconstructive techniques. At present, the evidence base remains fragmented and largely limited to retrospective case series and isolated case reports. Therefore, well-designed prospective multicenter studies are urgently needed to establish standardized management protocols for patients with penetrating renal injuries and to develop evidence-based clinical guidelines.

### Ethical approval

This study has been exempted from ethical approval by our institution (conclusion of the Ethics Committee of the Zaporizhzhia Military Hospital dated October 7, 2025). The presented clinical case does not require separate ethical approval, as it is based on an analysis of standard clinical treatment and adheres to the principles of anonymity and confidentiality.

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