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Original Research Article

Frontline Surgery at a Forward Surgical Centre During Active Conflict: A Retrospective Case Series of Representative Combat Casualties

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Conflict of interest: Nil

Abstract:

Background: Armed conflict poses unique challenges to surgical management due to resource limitations, logistical constraints, and high casualty loads. Forward Surgical Centres (FSCs) play a critical role in managing combat trauma under austere conditions, particularly during modern kinetic warfare.

Aim: To describe injury patterns, damage control strategies, and early outcomes of combat casualties managed at a Forward Surgical Centre during active conflict.

Method: This retrospective case series describes eight representative combat casualties selected from a total of 18 patients managed at a Forward Surgical Centre over 96 hours. Patients underwent rapid triage, ATLS-based resuscitation, and damage control resuscitation and surgery. Outcomes included survival, evacuation status, and limb salvage.

Results: The mean age was 34.4 ± 6.4 years. Injuries involved extremities, abdomen, head and neck, and genital regions. Of the eight patients, five survived initial management at the FSC and were evacuated. Two patients died at the FSC. One patient survived initial stabilization but later succumbed at a higher centre due to sepsis. Limb-threatening trauma occurred in four cases, with one eventual amputation.

Conclusion: FSCs are vital in reducing mortality and morbidity in combat trauma through timely haemorrhage control, damage control resuscitation and surgery, and rapid evacuation.

Keywords: Forward Surgical Centre, Damage Control Surgery, Combat Casualty, ATLS.

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Introduction

Armed conflict, especially air warfare presents one of the most challenging environments for delivery of surgical care. The complex interplay of resource constraints, logistical barriers, and battle casualties demands rapid decision-making and multidisciplinary coordination [1]. We received a total 18 casualties over a period of 96 hours of conflict and this case series of 8 representative combat casualties illustrates the spectrum of trauma management in a conflict zone. These casualties sustained injuries involving the head and neck, extremities, torso, and genital region. They were transferred directly to our Forward Surgical Centre (FSC)[2] in varying states of injury and morbidity. After being stabilised primarily with damage control surgery (DCS)[3] & damage control resuscitation (DCR)[4] by an emergency trauma surgical team, they were evacuated under fire to next medical echelon for further treatment. This case series highlights clinical strategies, operative approaches, adaptive resilience, and challenges encountered while delivering surgical care on the front lines of war. There is limited published literature describing real-time surgical decision-making at FSCs during active kinetic warfare, particularly from resource-constrained environments.

Methods

This retrospective case series describes eight representative combat casualties managed at an FSC over 96 hours of active conflict. The cases were monitored until they were discharged from FSC, evacuated to another facility, or passed away. Of the 18 combat casualties managed during the study period, 8 representative cases were selected based on injury severity, anatomical diversity, and completeness of clinical documentation. This study

therefore represents a purposive case series rather than a consecutive cohort.

Inclusion Exclusion Criteria

Inclusion: Patients with injuries in head and neck, extremities, torso, and genital regions were included. All patients underwent rapid triage, resuscitation following Advanced Trauma Life Support (ATLS) principles.

Exclusion: Patients with minor injuries not requiring ATLS-based resuscitation or surgical intervention were excluded.

Ethical Statement: This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and its amendments. The authors have obtained all appropriate patient consents. The patient(s) have given their written consents for their images and other clinical information to be reported in the journal. The patient(s) understand(s) that their name(s) and initials will not be published, and due efforts will be made to conceal his/her/their identity, but anonymity cannot be guaranteed. Institutional ethical review board approval was waived due to the retrospective nature of the study and operational constraints in a conflict zone; however, administrative permission was obtained from the competent military medical authority.

Outcome Measures: Primary outcomes included survival status at FSC, need for evacuation to higher medical echelon, limb salvage versus amputation, and immediate postoperative complications.

Bias and Limitations: As a retrospective case series conducted in a combat setting, this study is subject to selection bias, lack of long-term follow-up, and absence of a control group.

Type of conflict: Sudden onset kinetic warfare with shelling of high velocity artillery firearms.

Results

Table 1: Summary of representative combat casualties managed at the Forward Surgical Centre (FSC)

Case	Age (years)	Mechanism / Injury	Triage Priority	Key Intervention at FSC	Transfusion (Warm Whole Blood)	Evacuation Status	Outcome
1	21	Splinter injury with open comminuted fracture of left tibia and fibula	P2	Hemostasis and limb immobilization with splintage	No	Yes	Survived at FSC and evacuated
2	30	Grenade blast injury with degloving scrotal injury, shattered right testis, open comminuted fracture of right humerus, penetrating right thigh injury	P2	Debridement, right orchidectomy, hemostasis, limb immobilization	Yes (1 unit)	Yes	Survived at FSC and evacuated
3	32	Splinter injuries to neck and abdomen with cardiopulmonary arrest and hypovolaemic shock	P1	Damage control resuscitation (DCR)	No	No	Died at FSC
4	31	Splinter injury to right thigh	P3	Splinter removal and hemostasis	No	Yes	Survived at FSC and evacuated
5	38	Penetrating splinter injury abdomen with burst abdomen	P1	Damage control laparotomy, contamination control, abdominal drainage	Yes (2 units)	Yes	Survived at FSC; died after referral (sepsis)

6	43	Severe traumatic open head injury	P4	No resuscitative intervention possible	No	No	Died at FSC
7	35	Splinter injury to face and right shoulder with blunt head trauma	P3	Elective splinter removal	No	Yes	Survived at FSC and evacuated
8	35	Splinter injury to right elbow with open comminuted fracture and brachial artery injury	P1	Hemostasis, debridement, limb immobilization	Yes (1 unit)	Yes	Survived at FSC; later amputation at higher centre

Abbreviations: FSC – Forward Surgical Centre; DCR – Damage Control Resuscitation; P1–P4 – Triage priority levels.

Table 2: Descriptive Statistics

Parameter	N	Mean	Standard Deviation
Age (Years)	8	34.375	6.44

As per table 2, the mean age of patient was 34.375 (SD = 6.44) years, showing that majority of the patients were young adults.

Of the eight patients, five survived initial management at the FSC and were evacuated. Two patients died at the FSC. One patient survived initial stabilization but later succumbed at a higher centre due to sepsis. Limb-threatening injuries were present in four cases (50%), of which one required definitive amputation at a higher centre. Blood transfusion in the form of freshly donated warm whole blood was required in three patients (37.5%).

Case1: 21 years old individual, sustained splinter injury with an open comminute fracture of left tibia and fibula. (Figure 1)

Management: He was managed with hemostasis and immobilization of limb with splintage and evacuated to next medical echelon for definitive surgery.

Case 2: 30 years old individual, sustained grenade blast injury:

1. Degloving scrotal injury with shattered right testis
2. Open comminuted fracture lower end of right humerus
3. Penetrating injury right thigh (Figure 2)

Management: He was received at the FSC in state of shock and resuscitated as per ATLS [5] protocol. Freshly bled 1 unit of warm whole blood, bled from fellow combatant was transfused. He underwent right orchidectomy (Figure 3), debridement and hemostasis of injured right thigh, debridement of wound at right arm and immobilization of elbow. Immediately he was evacuated to next medical echelon after stabilization.

Case 3: 32 years old individual sustained splinter injuries neck & abdomen with cardiopulmonary arrest and hypovolaemic shock.

Management: DCR as per ATLS protocol and was declared dead despite exhaustive resuscitative efforts.

Case 4: 31 years old individual sustained splinter injury right thigh.

Management: He underwent splinter removal (Figure 4) and evacuated to next medical echelon.

Case 5: 38 years old individual sustained penetrating splinter injury abdomen and had burst abdomen. [6] (Figure 5)

Management: He was brought to the FSC in state of severe shock, burst abdomen with bowel loops hanging out of the abdomen. He was resuscitated as per ATLS protocol. Immediate central line inserted in internal jugular vein and freshly bled 2 units of warm whole blood, bled from fellow combatant were transfused. He underwent damage control laparotomy, [7] prevention of contamination and abdominal drain insertion. Bowel loops perforated at multiple sites were marked with stay sutures that enabled surgeon at next echelon for faster identification of perforation sites for definitive surgery. He further underwent definitive surgery with resection of perforated bowel loops, anastomosis and diversion colostomy [8]. After resuscitation and mechanical ventilation for around a month, the patient succumbed at tertiary care center due to secondary infection and sepsis [9].

Case 6: 43 years old individual sustained penetrating splinter injury with severe traumatic open head injury.

Management: He was brought to the FSC in an unconscious, non-responsive state with no signs of life.

Case 7: 35 years old individual sustained splinter injury face & right shoulder with blunt trauma head.

Management: He presented to FSC after the conflict was over, underwent elective splinter removal and transferred to next medical echelon for further imaging.

Case 8: 35 years old individual sustained penetrating splinter injury to right elbow and had open comminuted fracture of lower end of humerus with brachial artery injury. [10]

Management: Initially managed by compression dressing and tourniquet application at the forward post. He was received at the FSC in state of shock after 7 hours of injury with hypotension, cold and cyanosed right hand. He was resuscitated as per ATLS protocol. Freshly bled 1 unit of warm whole blood, bled from fellow combatant was transfused [11]. He underwent debridement with hemostasis and immobilization of right elbow and immediately evacuated to next medical echelon after stabilization. He further underwent right above elbow amputation in view of non-salvageable limb [12]. (Figure 6)

Appendix

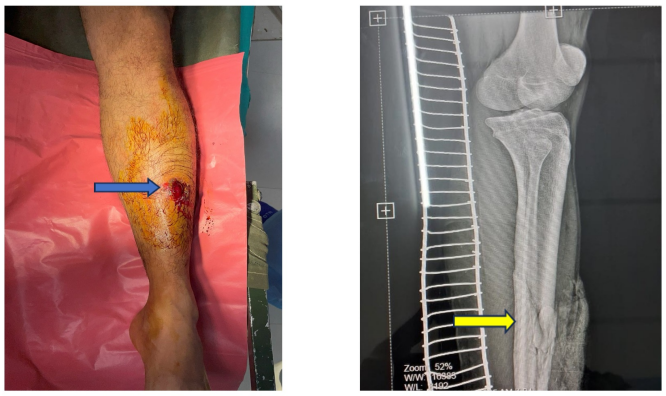

Figure 1: Splinter injury (left), and Comminuted fracture of left tibia & fibula (right)

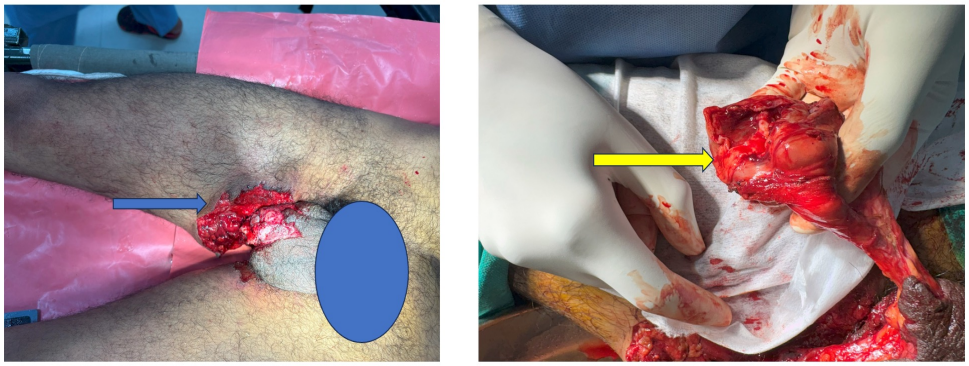

Figure 2: Splinter injury right thigh with degloving injury to scrotum (left side), Shattered right testis (right side)

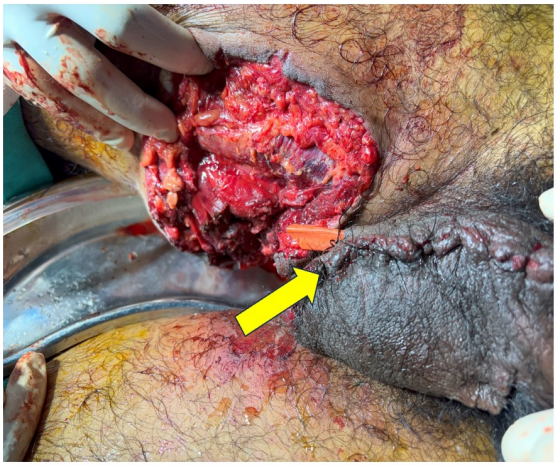

Figure 3: Right orchidectomy with corrugated drain insertion

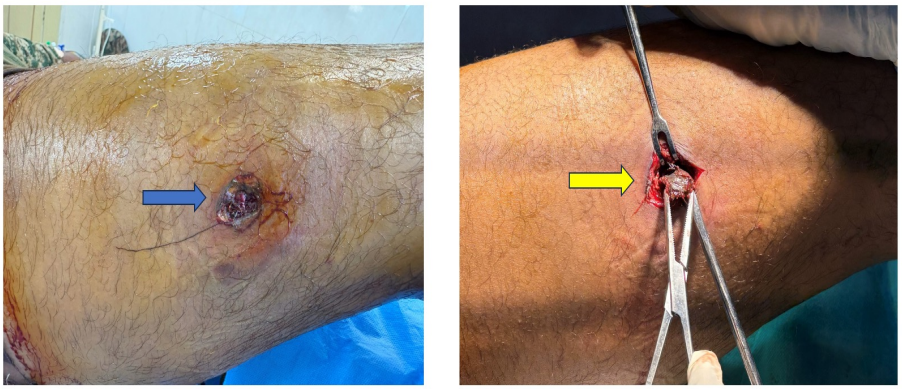

Figure 4: Splinter injury to right thigh (left side); Splinter removed from right thigh (right side)

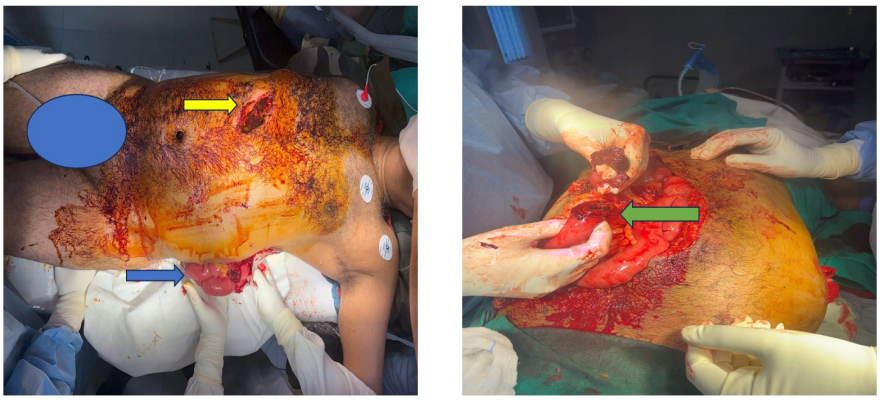

Figure 5: Burst Abdomen-Wound of entry in RHC region (left side-yellow arrow)
Wound of exit in left lumbar with hanging out bowel loops (left side-blue arrow)
Perforated bowel loops (right side)

Figure 6: Splinter injury to right elbow with vascular injury (left side); Tourniquet application (left side); Amputated limb (right side)

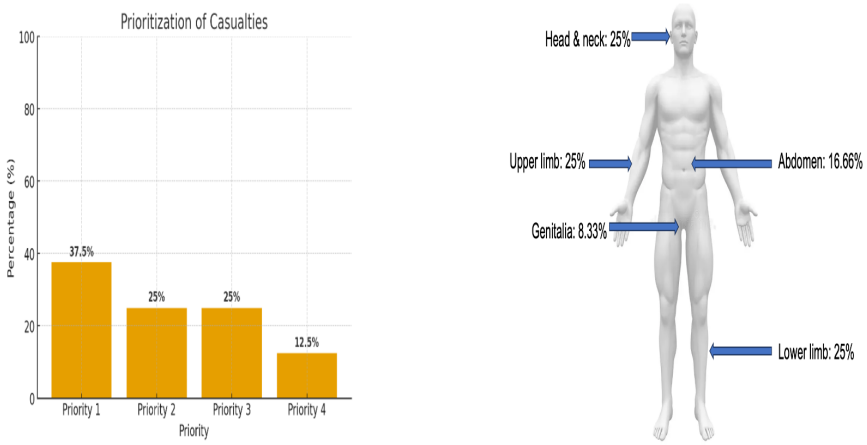

Figure 7: Prioritization of Casualties (left side);Anatomical distribution of trauma (right side)

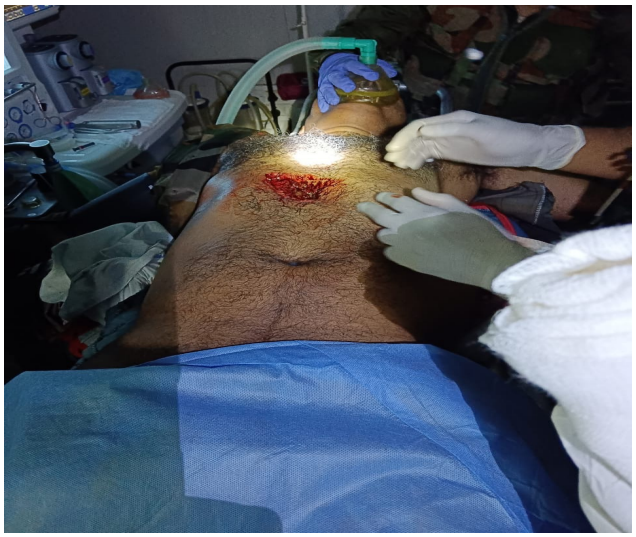

Figure 8: Resuscitation and intubation of case of splinter injury abdomen in torch light due to complete blackout

Discussion

This case series adds real-world operational insight into trauma care delivered under continuous threat, power failure, and manpower constraints. It highlights how adherence to damage control principles can be maintained even in severely austere environments. This study presents a representative sample of cases and does not reflect all casualties managed during the study period. Our 45 bedded FSC was expanded to 83 beds during the conflict. Out of total 18 battle casualties we received, 8 representative cases and their management are included in this case series (Table 1). Our first response was triage [13] of casualties which is the dynamic process of sorting casualties by priority of their severity of injury and need for emergent care.[14] Triage is done in four priorities.

- P1: Patients requiring immediate resuscitation and urgent surgery; preferably within 1 hour.
- P2: Surgical intervention can be delayed up to 6 hours.
- P3: Walking wounded patients with minor injuries.
- P4: Moribund patients.

Prioritisation of casualties is as shown in (Figure 7) and it demonstrates anatomical distribution of trauma. Our findings are consistent with previous studies reporting predominance of extremity injuries (65–70%) in modern combat settings.[15] The observed survival rate at the FSC underscores the effectiveness of early haemorrhage control and forward surgical deployment.

The injury patterns observed in this series are consistent with contemporary combat trauma literature, where extremity and blast injuries predominate. Early haemorrhage control, warm whole blood transfusion, and damage control surgery have been shown to significantly improve survival in austere environments. Our experience reinforces the importance of forward deployment of surgical assets, rapid triage, and timely evacuation in reducing preventable battlefield deaths. This case series adds real-world operational insight into surgical decision-making under conditions of active shelling, infrastructure disruption, and resource limitations.

Challenges

As all casualties were managed under active artillery shelling, there is always a requirement of hardened, shell proof roof for OT. We initially started operating case of burst abdomen in torch light due to complete blackout (Figure 8). Backup electricity supply is required for continuous electricity supply. Mental and physical fatigue of treating team at FSC plays significant role in emergent and rapid management of casualties, preventing wound contamination, rapid evacuation to next medical echelon and getting geared up for next casualty to operate. The small sample size limits generalisability; however, such detailed frontline data are inherently difficult to capture and remain valuable for military and disaster surgery planning.

Conclusion

This case series highlights pattern of injuries in modern air warfare and significant role of FSCs in managing combat casualties in conflict zones. This study demonstrates that forward surgical centres play a critical role in early survival of combat casualties through rapid triage, haemorrhage control, and damage control surgery. While definitive outcomes depend on higher-level care, timely intervention at the FSC significantly improves survivability and limb salvage in resource-constrained conflict settings.

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Data Availability Statement: The data that support the findings of this study are available from the corresponding author, [Dr OG], upon reasonable request.

IRB approval statement: The study was conducted in accordance with the Declaration of Helsinki and was approved by the Unit Head of the FSC. The informed patient consent is waived by obtaining approval from the Unit Head of the FSC due to the retrospective nature and to protect their identities. As all patients were combatants at the conflict zone, received at the FSC, severely injured in active air warfare, verbal consent was gained from all patients for publication of this case series and any accompanying images

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