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A PROSPECTIVE COMPARATIVE STUDY OF EARLY TOTAL CARE VS DAMAGE CONTROL ORTHOPEDICS IN POLY-TRAUMATIZED PATIENTS

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ABSTRACT **Aim:** To compare the efficacy and treatment outcomes of early total care (ETC) and Damage control orthopedics in management of poly traumatic patients **Materials and methods:** A total of 64 admitted poly-traumatized patients were studied in between February 2022 to June 2023. The patients presented with femoral and /or tibial shaft fractures and associated multiple injuries. The treatment was done in a tertiary care medical hospital. The patients were divided into two groups based on the treatment strategies. Group A patients were treated by early total care (ETC) and intramedullary nailing (IMN) within 24 hours of injury. Group B patients were treated with temporary external fixation as a bridge to IMN. There were 34 patients in group A and 30 patients in group B. The outcomes of the treatments were analyzed retrospectively. Institutional ethical committee approval was obtained and written informed consent was taken from all the patients. A p value <0.005 was considered to have a statistical significance **Results:** The groups were comparable with respect to age, gender, mechanism of injury and ISS. The patients in the DCO group required more fluids when compared to the ETC group (6.2 vs 2.2 PRBC). The estimated blood loss was more in ETC group when compared to the DCO group (400 cc vs 90 cc) Mean operative time was 45 minutes for external fixation and 100 minutes for IMN. There was a significantly increased incidence of MOF (20.5% vs 6.6%) and ARDS (17.6% vs 6.6%) in DCO group when compared to ETC group. ETC group was associated with increased incidence of wound infection, osteomyelitis **Conclusion:** External fixation is a safe procedure for achieving rapid, temporary rigid stabilization in unstable patients with multiple injuries. This procedure is associated with less blood loss and minimum systemic complications like ARDS and MOF, when compared to Early treatment group (ETC)

KEYWORDS : Damage control orthopedics, External fixation, Femur, Fracture.

INTRODUCTION

For a patient with multiple orthopedic injuries, the best course of treatment is immediate and comprehensive final operative care for all fractures. The benefits of early total care approach have been demonstrated in numerous studies within the past two decades[1-4]. Research conducted in the 1980s recommended early total care (ETC) for femur fractures, including the earliest possible surgical fixation[5,6]. ETC was linked to less pulmonary complications, less pain, better mobility, and better postoperative care in several studies[7-9]. During the 1990s, the majority of trauma centers in North America adopted ETC as their standard protocol for treating femur fractures.

The utility of ETC in patients with multiple injuries has come under scrutiny recently. Limited research indicates that the "second hit" insult of surgical fracture stabilization may enhance morbidity in certain patient subgroups receiving intramedullary nailing for acute femoral shaft fracture stabilization[9]. Furthermore, hemodynamic or metabolic instability may prevent certain patients from receiving early, definitive stabilization. Recently, the idea of initial temporary fixation followed by a subsequent conversion to a final technique has been promoted for these patients, and the phrase "damage control orthopedic surgery" has been coined[10]. It was developed from trauma patients with pelvic and abdominal injuries, where it has been demonstrated that improving postoperative course by planned revision for definitive treatment and initial bleeding management are beneficial[11-13].

Damage control orthopedics involves using an external fixator for immediate stabilization, followed by an intramedullary nail or open reduction and internal fixation for definitive care after the patient is stabilized (up to two weeks later) [14]. Acute resuscitation, hemodynamic stabilization, and damage control external fixation (DCO) work together to stabilize fractures with the least amount of blood loss and anesthetic duration possible. With the idea of DCO, the known advantages of early fracture stabilization are maintained while reducing the possibility of increased morbidity and mortality from increased operative exposure. This study compared the acute patient outcomes of individuals with multiple injuries who received treatment for stabilizing femur fractures using DCO versus ETC.

METHODOLOGY

A retrospective study was carried out in between 2022 February to 2023 June. There were 64 poly-traumatized patients with various body injuries associated with femoral/ and or tibial fractures treated in our hospital. Patients were grouped according to the treatment strategies for stabilization of the fractures. Group A consists of 34 patients treated with early total care (ETC) and intramedullary nailing (IMN) within 24 hours of injury. Group B consists of 30 patients treated with temporary external fixation as a bridge to IMN All injuries were classified and ISS was calculated. Outcome events, and major complications, were also recorded on an ongoing basis. The patients were treated according to similar protocols regarding early intubation and ventilation, and aggressive resuscitation[15].

A long bone fracture is considered an emergency that requires internal surgery or external fixation to stabilize it acutely (at least within 8 hours). Therefore, a patient who is in critical condition as a result of other associated injuries may first have a craniotomy or laparotomy before undergoing long bone fracture stabilization[16]. In the event that a patient becomes extremely unstable during the procedure, they may be moved to the intensive care unit (ICU) and have external fixation concurrently with the abdominal or cranial operation, after which an external fixateur is implanted[17]. Prior carrying the operative procedure for improving the general condition of the patient, we do not put him directly on the intensive care unit (ICU).However, stabilization may be undertaken later. Eight hours after arrival, primary surgery was started, including external fixation for significant fractures.

The ISS was used to categorize the severity of injury prior to surgery[18]. The Glasgow Coma Scale score was used to assess the initial neurologic condition[19]. Primary surgery was defined as an operative intervention within 24 hours post-trauma. Moore et al.'s criteria were used to define multiple organ failure[20].

A parenchymal pulmonary lesion identified as a lung contusion on the first chest computed tomography scan or by radiologic abnormalities on the 24-hour chest radiograph was considered a lung contusion. Whether or whether there were rib fractures, the diagnosis was made[21], When the systolic blood pressure dropped below 90 mm Hg in spite of volume therapy and catecholamine infusions, shock was diagnosed. Green's criteria were used to diagnose wound infections and pin-track infections[22]

INCLUSION CRITERIA

Age 19 to 65 years
Multiple trauma
ISS of 18 or more

Presence of a femoral shaft fracture eligible for intramedullary stabilization Demographic findings were documented. Furthermore, clinical markers (incidence of acute respiratory distress syndrome [ARDS], ICU complications) representing the posttraumatic course of therapy and organ function were documented.

TWO GROUPS WERE CREATED

Group A**:** This group consists of 34 patients, treated by Early total care (ETC). The treatment plan for the fracture of the femur shaft involved early (less than 24 hours) definitive stabilization.

Group B: This group consists of 30 patients treated by Damage control orthopedic surgery (DCO). Typically, individuals with multiple injuries who are at risk of posttraumatic sequelae would receive early (< 24 hours) temporary stabilization for their femur shaft fracture, followed by a secondary conversion to intramedullary nailing.

Primary outcomes included respiratory complications (adult respiratory distress syndrome [ARDS] and multiple organ failure (MOF). The two groups were also compared based on resuscitation requirements (blood products and volume), operative time, blood loss and complications.

Fisher exact tests were used to identify associations between group memberships. All data were analyzed using SPSS software (SPSS 11.5, Chicago, IL). Significance level for all analyses was set at alpha = 0.05

RESULTS

A total of 64 patients with femoral shaft fractures were retrospectively analyzed during the study period. The patients were divided into two groups based on the treatment they received. There were 34 patients in group A and 30 in group B. Group A patients were treated with ETC and group B patients were treated with DCO**.** The patient groups were comparable regarding age, gender, and mechanism of injury. Mean ISS was higher in DCO group, when compared to ETC group, however it was still statistically non-significant.

Table 1: Demographic and ISS Data for ETC and DCO Groups

	ETC (n=34)	DCO (n=30)	P value
Males	26	24	0.253
Females	8	6	0.156
Mean age (yrs)	32.3	30.4	0.311
Mean ISS	28	31.4	0.267
Mechanism of injury:			
Motor vehicle crash	24 (70.5)	23 (76.6%)	0.234
Pedestrian	4 (11.7%)	3 (10%)	0.113
Motorcyclist	5 (14.7%)	3 (10%)	0.121
Other	1 (3%)	1 (3.3%)	0.321

ISS- Injury severity score

The results of the Mann-Whitney test indicate that there were statistically significant differences between the DCO group and the ETC group for ARDS (p = <0.005) and MOF (p<0.005). ARDS was significantly seen in less patients in DCO group, when compared to ETC group (6.6% vs 17.6%). Similarly MOF was seen significantly less in DCO group, when compared to ETC group (6.6% vs 20.5%). The DCO group required significantly more fluids than ETC group (2.2 vs. 6.2 p <0.005). The DCO group saw a significantly reduced estimated blood loss (90 cc vs. 400 cc, p < 0.005) and a significantly shorter operative time (45 minutes vs. 100 minutes, p < 0.005). The outcome measures and significances are outlined in table 2

Table 2: ETC vs. DCO Outcome Measurements and Statistical Significance per Group

	ETC (n=34)	DCO (n= 30)	P value
Mean operative time (min)	100	45	<0.005*
Total estimated blood loss (cc)	400	90	<0.005*
Transfusion requirements (PRBC units)	2.2	6.2	<0.005*
MOF	7 (20.5%)	2 (6.6%)	<0.005*
ARDS	6 (17.6%)	2 (6.6%)	<0.005*

*p value <0.005 indicates statistically significant difference between ETC and DCO groups

As documented in table 3, there were significantly lower complications in DCO group, when compared to ETC group for wound infection (1 vs. 6, p<0.005) and osteomyelitis (1 vs. 5, p<0.005).

Table 3: Post-operative local complications

	ETC	DCO	P value
Pin track infection	2	3	0.432
Wound infection	6	1	<0.005*
Osteomyelitis	5	1	<0.005*
Delayed union	1	1	0.245
No union	1	0	0.134

*p value <0.005 indicates statistically significant difference between ETC and DCO groups

DISCUSSION

In the early stages of resuscitation, DCO appears to offer the advantages of fracture stabilization with less added operational load (i.e., less time spent on surgery and less blood loss). Multiple-injured patients have been shown to benefit from early, definitive stabilization of long bone fractures; nevertheless, this necessitates putting the patient through the physiologic stress of prolonged anesthesia, surgery, and greater blood loss. Both the groups presented with a similar demographic data.

In comparison to ETC, external fixation was proven to be a safer and more successful method of stabilizing femur fractures, requiring a much shorter amount of operating time and resulting in less blood loss. Another interesting finding we noted was that the DCO procedure was associated with less systemic complications like MOF and ARDS, when compared to ETC procedure, despite patients in DCO group had higher ISS. Similar findings were reported in a study by Mark S tuttle et al[23], where they found DCO to be presenting with less systemic complications (ARDS, MOF), however unlike our results, those authors could not find a statistically significant difference in this regard. When we look into the local complications associated with both the procedures, we found a statistically significant difference between both the treatment procedures with regard to occurrence of wound infection and osteomyelitis. The ETC group showed higher incidence of osteomyelitis and wound infection. In view of the characteristics of intramedullary nail fixation, bacteria will spread to the entire medullary cavity along the intramedullary nail once infection occurs, it could progress to chronic osteomyelitis, which would have a major impact on fracture healing and result in limb impairment[24]. Similar findings were observed in a study by Hua H et al[25]. While the DCO group had none of these local complications. Thus, DCO can be considered a safe and efficacious management practice that does not increase morbidity or mortality

The positive effect of fracture fixation in multiple injured patients became apparent after the implementation of standard techniques for open reduction internal fixation[26]. Research conducted in the 1970s revealed that surgical stabilization during the first 24 hours following trauma reduced pulmonary problems and enhanced postoperative care[27]. These advances lead to the concept of early definitive stabilization

ETC (24 hours) versus delayed fixing (after 48 hours) was the comparison of two cohorts of patients with femoral fractures conducted by Bone et al[28]. 3. Pneumonia, ARDS, prolonged ICU stays, and higher hospital expenses were more common among patients in the delayed fixation group. Other studies confirmed the benefit of early fixation and discredited the theory that ETC increases fat embolism syndrome[29].13 However, when high ISS patients' survival rates increased, the debate over ETC in multiple injured patients changed.

Pape et al.'s[30] analysis of the ETC experience in Hannover (2014) revealed that certain patient subgroups fared better when a DCO approach was used. Multisystem organ failure (MOF) and acute respiratory distress syndrome (ARDS) rates were seen to be considerably higher (p < 0.05) in the ETC group. Over the course of 11 years, Reynolds et al. retrospectively assessed 105 patients who had femur diaphysis fractures and were treated with reamed femoral IM nailing. The following criteria were used to create groups: immediate IM nailing (24 hours), early therapy (24–48 hours), or delayed treatment (IM nailing 48 hours). In the ETC group, patients with low ISS (18) tended to have less respiratory complications. There was no correlation between the time of operation and the occurrence of respiratory problems in patients with multiple injuries (ISS 18)[31].

In many facilities, especially in North America, intramedullary nailing combined with ETC has become standard treatment, even though there is no specific evidence in high ISS patients[6,7,26]

The debate about DCO vs ETC is especially controversial when femur shaft fractures are connected to traumatic brain injury. When an individual has several injuries, IM nailing may result in severe hypotension or the activation of the inflammatory system, which can cause systemic harm[32].

According to research by Townsend et al. (2017), patients with a GCS score of 9 are more likely to experience secondary brain injury with ETC. This suggests delaying surgery to avoid hypoxia, hypotension, and a drop in cerebral perfusion pressure[33].

But even in patients with concurrent head or chest injuries, Brundage et al shown that early internal fixation with appropriate resuscitation (~24 hours) was associated with a better outcome[34].

Giannoudis et al recently reviewed studies involving multiple injured patients with closed head injuries and femur fractures, and they came to the conclusion that the available literature does not permit determination of the optimal course of treatment due to variations in experimental design and patient selection[35].

While the best course of treatment for a patient with concurrent orthopedic and brain injuries is still unclear from a physiologic perspective, DCO is a productive and useful strategy in the acute situation.

For DCO, external fixators offer a great surgical option. They offer sufficient transient stability and are simple and quick to apply. The possibility of infection following conversion to an implanted nail is a significant perceived disadvantage. Nonetheless, a number of investigations have demonstrated that the risk of infection is not raised by initial external fixation followed by revision to an IM nail[36-38]

Certain patient subgroups may benefit from DCO's facilitation of multidisciplinary therapy during the resuscitation phase and reduction of the first surgical and anesthetic exposure (surgical time, hypothermia, and blood loss).

Although there were just a few comparable patients in each therapy group, we discovered notable variations in the duration of the operative time and the amount of blood lost during the procedure.
Both the blood loss and operative time were significantly lower in the DCO group. Between the ETC and DCO groups, there were more local and systemic complications associated with the ETC group. Comparing the DCO group to the ETC group, we saw no negative effects even though the DCO group's ultimate surgery was delayed.

CONCLUSIONS

The findings of this study validates the safety of DCO procedure. There were significantly reduced incidence of general systemic complications (ARDS, MOF) and reduced blood loss in DCO group, when compared to ETC group. Modification of treatment protocol from ETC to DCO group was not associated with additional complication. External fixation appears to be a safe procedure for achieving rapid, temporary rigid stabilization in unstable patients with multiple injuries.

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