



AN PROSPECTIVE OBSERVATIONAL RESEARCH TO INVESTIGATE THE PREVENTION AND TREATMENT OF POLYTRAUMA

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ABSTRACT:

OBJECTIVE:A subclass of severely injured individuals who have sustained damage to many bodily parts or organs, any of which could be deadly, are referred to as having "polytrauma." Definitions vary depending on the specialty and the country. Early Appropriate Care (EAC) is an orthopedic trauma management approach for rapid resuscitative care that aims to spotlight any significant trauma and handle the most time-sensitive bodily damage without increasing their physiological strain. To lower the risk of problems, early appropriate treatment aims to correct and stabilize the core skeletal system as well as the peripheral long bones of the skeletal system.

METHODS:The participants in this prospective observational study, which was conducted from November 2021 to December 2022, totaled 29 patients, with a mean age of 35. Early Appropriate Care managed all of the patients. The patients were revived on average for 8 hours. Patients were monitored for a month after surgery to look for any complications.

RESULTS:Three individuals in our study had pulmonary embolisms. Complications in patients were successfully managed, and no patients passed away. As a result, both in our series and in the body of existing research, the EAC protocol appears to be associated with a low incidence of mortality.

CONCLUSIONS: Polytrauma patients who have good resuscitation and acidosis correction may be eligible for early definitive repair of their bone injuries. This prevents the need for a second operation, shortens hospital stays, lowers postoperative complications, and allows for the creation of early rehabilitation programs.

KEYWORDS: polytrauma, EAC, injury

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719



INTRODUCTION: The two main demographic groups impacted by polytrauma, a prominent cause of death and disability worldwide, are young people and the elderly. [1]Definitions of polytrauma vary depending on the specialty and the country. Multiple injuries that are more severe than what is considered to be normal (ISS ≥ 17) are referred to as polytrauma. The breakdown or dysfunction of distant organs and vital systems that have not been directly impacted may be caused by sequential systemic reactions. [2]

Through alterations to the metabolic route and the activation of the innate immune system, polytrauma causes significant physiological changes. Hypermetabolism, which involves increased energy consumption, protein catabolism, hyperglycemia linked to insulin sensitivity, and lactic acidosis, which is linked to hyperlactatemia, are a few examples of post-traumatic metabolic alterations. [3]Orthopedics account for 50% of operations performed, and the best time to do surgery on these patients is still debatable. Polytrauma patients will have bone damage in 90% of cases. [4]

Early total care, the first and most effective orthopedic treatment for all bone fractures, is difficult because the additional bleeding brought on by orthopedic surgery is occasionally connected to a negative SIRS and its consequences in critically ill patients, resulting in a "second strike" on top of the systemic effects of the injury itself (first hit).

A few years ago, the phrase "Damage Control Orthopedics" (DCO) was initially used to refer to medical practices that focus more on preventing fatalities and exsanguinations than fixing shattered bones. When there has been multiple trauma, stabilizing the patient becomes more crucial than fixing the broken bone. The goal of orthopedics is to delay major orthopedic surgical procedures until the patient is medically able to do so without running any significant risks, to avoid the "second hit" of an orthopedic surgical treatment that might aggravate the patient's condition. Initially,

minimally invasive surgical methods like external fixation are employed. Then, in subsequent days, decisive procedures will be performed. The goal of Early Appropriate Care (EAC), an early resuscitative treatment method in orthopedic trauma care, is to treat the most immediate life-threatening physical injuries without placing an undue physiological strain on the patient.

To lower the risk of problems, early appropriate treatment aims to correct and stabilize the core skeletal system as well as the peripheral long bones of the skeletal system. Only with proper resuscitation, hemodynamic stabilization, and prompt skeletal damage fixation can these patients improve.

If the patient's vital signs, such as base excess (BE) ≥ -5.5 mmol/L, PH ≥ 7.25 , and lactate < 4.0 mmol/L, are within normal range, first stabilization should take place within 36 hours after the injury in patients with polytrauma and unstable fractures of the central skeleton bones. In the treatment of trauma, this is regarded as the standard of care. It's crucial to keep in mind that this timeline might change based on the particulars of the case and other elements, such as the patient's general state of health. Before surgery, polytrauma patients must be revived and their lab values must be normal to reduce post-operative complications. [5]

METHODS: 29 polytraumatized patients were enrolled in this prospective observational research, and they all got Early Appropriate Care. All patients who had polytrauma had been involved in auto accidents. The research was conducted from November 2021 to December 2022. There were 29 patients, 25 of them males, and 4 of them women. The patient was 35 years old on average (range: 19yrs-52yrs). The following list includes the inclusion criteria for including polytrauma patients in the research.

Inclusion Requirements

- (1). Adults suffering from polytrauma
- (2). People who have two broken femurs.

(3). Having ISS score more than 16

The following patients were excluded from the study

- (1). Patients were disqualified because they had poor energy mechanism injuries
- (2). Patients with undeveloped skeletons
- (3). Having an ISS score of under 16.
- (4). Patients receiving ongoing non-operative treatment
- (5). Patients that arrive at the casualty department after 24 hours
- (6). Referral from a different hospital after the first resuscitation
- (7). Patients who need urgent surgery

All patients with polytrauma admitted from the casualty were first assessed, a thorough history of the injury was obtained, and an immediate rapid systematic assessment was carried out to identify any potential life-threatening situations. Documentation was made on the characteristics of the fracture, accompanying injuries, complications, as well as the date and mode of provisional treatment. Laboratory parameters and vital signs were recorded. As soon as a patient arrived at the trauma center, blood tests for the total count, lactic acid, hematocrit, ph, blood grouping, base excess, and arterial blood gas values, were conducted. This thorough acute diagnostic examination has been completed after the patient's vital signs have stabilized. The degree of polytrauma was graded using the ISS scoring method after several organ systems implicated in trauma were evaluated. Study participants had an Injury Severity Score (ISS) greater than 16.

Patients were sent to the ICU for further treatment after an initial examination, stabilisation, and trauma scoring. In order to uncover any further underlying medical illnesses, such as hypertension, diabetes, and past cardiac or respiratory problems, the patient received an additional assessment in the ICU. Patients were actively handled by administering crystalloids, sodium bicarbonates, colloids, and blood in case of emergency,

depending on the severity of the injury and acidosis. To measure hematocrit levels, ph, Hb, base excess, lactic acid, and arterial blood gas values, a second sample was sent eight hours after preoperative admission and after the correction of acidosis and blood loss.

Once the acidosis was corrected, which is measured by the base excess, lactic acid, and ph readings, patients were brought in for final operations. The kind of anesthetic was chosen based on the fracture pattern. Within 8–12 hours, we were able to bring the acidity levels of all patients who participated in the study to a neutral state. Patients were taken from the operating room to the ICU for post-operative care. An ICU intensivist provided the necessary post-operative care, and a third sample was taken 12 hours later to check for lactic acid, ph, and excess bases. Patients are moved out of the ICU after their levels have returned to normal.

It was established how long the patient would need to be in the hospital overall, how long they would need to stay in the ICU with or without ventilator support, and how many transfusions they would need during the course of their treatment. To evaluate the aforementioned problems, patients were monitored for a month. One patient out of 29 required ventilator assistance due to respiratory problems after surgery.

RESULTS: 29 patients in all, ranging in age from 19 to 52, were involved in this research. Three of the patients were in their 20s. Six patients ranged in age from 21 to 30. There were 12 patients in the 31–40 age group, and 8 of them were beyond 40. (Table 1). Table 2 displays the injury's level of severity. Table 3 provides information on post-operative complications. Table 3 shows that just 3 patients (10.3%) experienced complications, whereas the other 26 patients had none at all.

A treatment plan for patients who responded well to first CPR, such as those with lactate levels under 4.0 mmol/L, pH levels over 7.26, or base excesses above -5.5 mmol/L. Within 36

hours, these patients received care by an established orthopedic treatment strategy for long bone, pelvi-acetabular complex, and dorso-lumbar spine fractures.

Table 1: Patients' distribution according to their ages.

Age (Years)	N (%)
Above 40	8 (27.6%)
31 – 40	12 (41.4%)
21 – 30	6 (20.7%)
Up to 20	3 (10.3%)
Total	29 (100%)
Range	19 – 52
Mean	35.0
S.D.	9.5

Table 2: Presentation of an injury severity score.

Injury Severity Score	N (%)
Above 50	3 (10.3%)
41 to 50	7 (24.1%)
31 to 40	9 (31%)
21 to 30	9 (31%)
Up to 20	1 (3.5%)
Total	29 (100%)
Range	19 – 66
Mean	36.97
SD	10.86

Table 3: Complications after surgery.

Postoperative Complications	N (%)
No	26 (89.7%)
Yes (Pulmonary Embolism)	3 (10.3%)
Total	29 (100%)

Table 4: Variations in lactic acid values

Lactic Acid Value	Lactic Acid Value	
	Mean (S.D)	Range
Initial	5.61 (0.98)	4 – 8
8 h after stabilization (Before operation)	2.24 (1.01)	0.7 – 4.4
12 hours (Postoperative)	0.69 (0.52)	0 – 1.9
Change in 8 hours	-3.37(0.57)	-5.0 – (-2.6)
Change in 12 hours (Postoperative)	-4.92(0.77)	-6.7 – (-3.6)



Table 5: Variations in ph levels

PH levelsat	PH levels	
	Mean (S.D)	Range
Initial	7.3 (0.06)	7.18 – 7.4
8 h after stabilization (Before operation)	7.37 (0.06)	7.24 – 7.46
12 hours (Postoperative)	7.4 (0.05)	7.28 – 7.46
Change in 8 hours	0.07 (0.05)	0.01 – 0.2
Change in 12 hours (Postoperative)	0.1 (0.05)	0.02 – 0.2

Table 6: Variations in base excess values

Base Excess values at	Base Excess values	
	Mean (S.D)	Range
Initial	-3.45 (2.71)	-10.1 – (+1.0)
8 h after stabilization (Before operation)	-1.75 (1.12)	-4 – (+1.0)
12 hours (Postoperative)	-0.27 (1.38)	-4 – (+1.0)
Change in 8 hours	1.7 (2.11)	-1.8 – (+6.1)
Change in 12 hours(Postoperative)	3.18 (2.05)	-0.3 – (+8.7)

DISCUSSIONS: Mechanically and clinically unstable long bone fractures, including those of the pelvis, thoracic-lumbar spine, and acetabulum, typically need complete immobilization and bed rest before surgery. Damage control orthopedics provides short-term stabilization to reduce complications while giving the body time to fully recover. This calls for more surgical procedures, which lengthens the time a patient must stay in the hospital and necessitates the use of mechanical stabilizers such as orthopedic implants and splints. Damage Prevention If the acetabulum-pelvis complex and central spine complex (thoracic spine, lumbar spine, cervical spine) are fractured, orthopedic treatment may not be an option, and even if temporary stabilization is feasible, the patient may not be able to move about immediately away. When early total care is sufficient and suitable, there are probably favorable circumstances and options throughout the therapeutic spectrum from Damage Control Orthopedics to Early Total Care that may be pursued.

Major polytrauma patients often need and demand extensive resuscitative procedures to

address abnormal blood indicators, volume losses due to shock, and the ensuing abnormal metabolic acidosis, as seen by pH shifts and excess base. To maintain hemostasis, these conditions necessitate swift transfusions of crystalloid, platelets (Plt), colloid, FFP, and PRBC. When present, metabolic acidosis is a predictive sign for the emergence of pulmonary problems, organ failure, and death. [6,7] According to the EAC procedure, acidosis is continuously evaluated as a result of resuscitation. When strict laboratory requirements are satisfied and final fixation occurs within 36 hours of the damage, surgery is allowed. In addition to shortening hospital stays, the strategy will lessen pulmonary and other problems. [8,9,10] Therefore, it is assumed that following the early appropriate care-EAC protocol would benefit the patient in all respects, particularly by shortening hospital stays as a result of effective treatment of early difficulties, which will then help the patients financially.

A total of 29 patients in our study were treated by the EAC protocol. When patients arrived at the casualty department, their serum lactate



levels, pH levels, and base excess levels were evaluated. The patients were then revived to improve the hemodynamic parameters. After 8 hours of resuscitation, the metabolic markers (base excess, ph, lactate) were reevaluated. If these factors had stabilized, the patients were sent to the operating room for final stabilization of the bone damage. Resuscitation was carried out for an additional eight hours if the parameters did not return to normal levels. Resuscitation was maintained in the previous literature until 12 to 15 hours had passed to equalize the values. [11,12,13]

Only two of the 29 individuals in our research needed resuscitation for a maximum of 12 hours. Therefore, the resuscitation procedure does not unnecessarily postpone final surgeries. Three individuals had serious problems in our group of 29 patients treated according to the EAC procedure. After surgical intervention, fat embolism occurred in two out of three cases because long bones were involved, and one patient suffered deep vein thrombosis (DVT), which ultimately led to pulmonary embolism (PE). The ICU provided treatment and management for each of these patients for an average of around one week. Mechanical breathing was necessary for one patient with DVT and PE, although oxygenation with a mask, intravenous fluids, and supportive treatment was adequate for the other two patients with fat embolisms. Low molecular weight heparin (LMWH) injections were used to treat the deep vein thrombosis patient. The rates of complications in our series, which are 12% and 16.3%, respectively, are similar to those reported in other investigations. [14,15] Even individuals that had problems underwent effective treatment without suffering any fatalities. By lowering complication rates and shortening ICU and hospital stays, the EAC procedure seems to be linked to a low incidence of death in both our series and the body of previous research. [16,17,18]

All of the patients in our case series stayed in the hospital for an average of 12.7 days. This is

equivalent to the 10.8, 9.52, and 11.2-day median length of hospital stays reported in the literature currently in use. [19] Both the financial strain on the patients and the danger of nosocomial infections are decreased as a result. The EAC regimen has extremely little need for recurrent secondary surgical operations. In our study, there were no patients who required further surgeries before being released from the hospital. Other writers who have embraced the EAC procedure have likewise had this experience. [20] The absence of multiple surgical procedures lowers morbidity and enables quick recovery for these individuals.

According to our study, individuals with polytrauma were more likely to be between the ages of 31 and 40, with a 35-year-old average. Road traffic incidents were the cause of injuries in all cases. The greater mobility of urban working people may be to blame for this. The second peak was among those over 40. Three patients in our research had pulmonary embolisms; two of them belonged to the younger age group (30 years), and the third was an elderly patient (>45 years), which is statistically insignificant. Our data is analogous to a prior study that concluded that EAC is related to similar rates of complications in both young and old individuals. Our series showed an 86.2% male to 13.8% female ratio, which is similar to all previous research. The greater outdoor activity of men may be a good explanation for the preponderance of men.

Two of the four female patients in our study who had pulmonary embolisms were female. There hasn't yet been any written research on the relationship between postoperative problems and gender distribution. These issues may be related to the two female patients in our group having higher ISS scores and higher ASA grades. If there are gender disparities in how patients respond to the EAC procedure, more research involving larger patient cohorts is needed.

We included individuals with ISS scores greater than 16 in our research. An anatomical scoring system called the Injury Severity Score (ISS) assigns patients with numerous injuries a final score. It was acknowledged that postoperative complications and ISS had a statistically significant relationship. Three problems were seen in cases with a mean ISS score of 55.0, whereas none were seen in instances with a mean ISS score of up to 34.88. Comparable studies have shown that postoperative complications, mortality, and morbidity can all be accurately predicted by using the ISS grading, and our investigation supports this finding. [21,22] It is connected to hospital stay duration; patients with longer stays and more complications scored higher on the ISS.

CONCLUSIONS: Early definitive fixation of bony injuries in polytrauma patients is possible after adequate resuscitation and acidosis correction, which eliminates the need for a second surgery, shortens hospital stays, lowers postoperative complications, and enables the development of early rehabilitation protocols. Correction of BE less than 5.5 mmol/L, pH > 7.25, or lactate < 4.0 mmol/L over the first 8 hours is associated with a decreased risk of pulmonary issues. A prediction model for complications must also take into account the presence and severity of head injuries, chest injuries, the number of fractures that need treatment, the time it takes to fixate the fractures, and the total number of fractures. Therefore, we draw the conclusion that by providing polytrauma patients with effective resuscitation, they may be admitted for speedy final fixation, may anticipate few postoperative complications, and may also shorten their stay in the hospital. This ought to result in decreased healthcare expenses.

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