

# Levels of serum lactate in patients with single long bone femur shaft fractures

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## Abstract

In the past decades, major improvements are made to manage the polytraumatized patients caused a significant reduction in mortality from 40% in 1970s to around 10% in 2000. Before 30 years, the modality of treatment for multiple injured patient with fractures was to maintain the fractured limb in a splint, until the patient is stabilized enough to undergo surgery for fracture fixation. Data collection was started after obtaining clearance from the Institution Ethical Committee. Informed consent was taken from study participants. After explaining the purpose of the survey, data was collected from all patients regarding personal information like age and gender. Vital signs (Pulse Rate, Blood pressure, Respiratory Rate and Temperature) and Parameters like Urine output and Saturation at room air were measured. Serum lactate levels were measured at the time of admission and after 1-6 days of the surgery. At the time of admission, majority (67.6%) had high serum lactate levels. None had less than 4.5mg/dl. Only 2% had higher Serum lactate levels after 1-6 days of admission.

**Keywords:** Serum lactate, single long bone femur shaft fractures, vital signs

## Introduction

Polytrauma is a term describing injured patients who have sustained injuries to more than one body region or organ system of which at least one is life threatening. Trauma is a major cause of death and disability worldwide that mainly affects young adults <sup>[1]</sup> (aged 15-29 years) and affects all economic levels <sup>[2]</sup>. The definition of multiple trauma varies among surgeons from different specialties and between different centres and countries. Polytrauma-injured patients who have sustained injuries to more than one body region or organ system of which at least one is life threatening, with ISS>18 with haemodynamic instability <sup>[3]</sup>. Polytrauma usually expressed using injury severity score (ISS) with polytrauma being defined as an ISS of  $\geq 16$  or  $\geq 18$  <sup>[4]</sup>.

In the past decades, major improvements are made to manage the polytraumatized patients caused a significant reduction in mortality from 40% in 1970s to around 10% in 2000 <sup>[5]</sup>.

Before 30 years, the modality of treatment for multiple injured patient with fractures was to maintain the fractured limb in a splint, until the patient is stabilized enough to undergo surgery for fracture fixation <sup>[6]</sup>. In the recent years, epidemiologic studies from the Trauma Registry of the German Society of Trauma Surgery shows a bimodal distribution of mortality with a first and a second peak occurring within 0 to 6 hours and 1 to 6 days, respectively. And thus concept of “early total care” and “damage control” orthopaedic surgery has evolved for persisting unstable physiological state despite adequate resuscitative measures <sup>[7, 8]</sup>.

The “Advanced Trauma Life Support” (ATLS) protocol of the American College of Surgeons Committee on Trauma has established a standard procedure algorithm for the initial assessment and management of polytraumatised patients in the past 3 decades in > 30 countries worldwide <sup>[9]</sup>. Polytrauma is a challenge being common in incidence and they are difficult to manage <sup>[10, 11]</sup>.

**Trentz defines:** “A syndrome of multiple injuries exceeding a defined severity (ISS  $\geq$ 17) with sequential systemic reactions (systemic inflammatory response syndrome (SIRS) for at least 1 day) that may lead to dysfunction or failure of remote organs and vital systems, which have not themselves been directly injured”.

In trauma haemorrhage is most common in long bone fractures, may be concealed or revealed and causes hypovolemic shock, hypoperfusion at tissue levels leads to inadequate oxygen delivery resulting in hypoxia, anaerobic metabolism and lactic acid production. Lactic acid production occurs in all tissues which includes, skeletal muscles, Brain, RBCs and kidneys even at baseline levels under normal healthy oxygen rich conditions, the highest level of production is found in skeletal muscles and lactic acid cleared rapidly at the rate of 320 mmol/litres/hour by liver metabolism, by reconversion of lactate back to pyruvate <sup>[12]</sup>.

## Methodology

### Study design

Prospective study.

### Study population

Patients with long bone fractures admitted in orthopedic department.

### Inclusion criteria

- Skeletally matured individuals (above 18 years of age).
- Open and closed shaft of femur fracture.
- Patient who give informed consent.

### Exclusion criteria

- Vascular injury.
- Patients with sepsis.
- People from high altitude.
- Diabetic Ketoacidosis (DKA) patients.
- Alcoholic patients and liver dysfunction patients.
- Patients with history of head injury and seizures.
- Burns and smoke inhalation patients.
- Malignancy.

## Study sample size

Based on the study conducted by PAL JD *et al.*, the average lactate value of the trauma patients is  $3.06 \pm 0.4$  mmol, the sample size can be calculated as follows by assuming equal variances and standard deviation.

$n = Z_{\alpha/2} SD/d$  where,

$n$  = sample size

$Z_{\alpha} = 1.96$  = standard table value for 95% CI  $n = (1.96)^2 (0.04)^2$

SD = standard deviation

$(0.08)^2$   $d$  = relative precision = 2.5% of mean

$n = 96.04$  considering the dropout rate of 10%, final sample size can be calculated as

$n = 96.04 + 10\%$  of 96.04

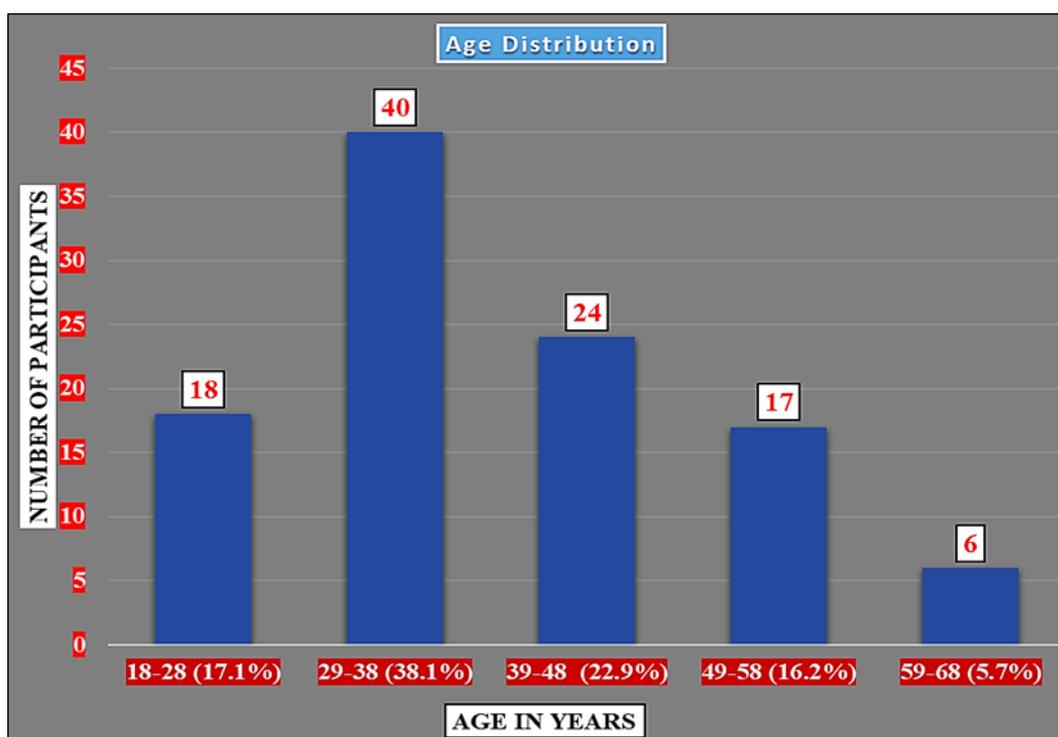
$n = 105$

The sample size is 105.

## Sampling method

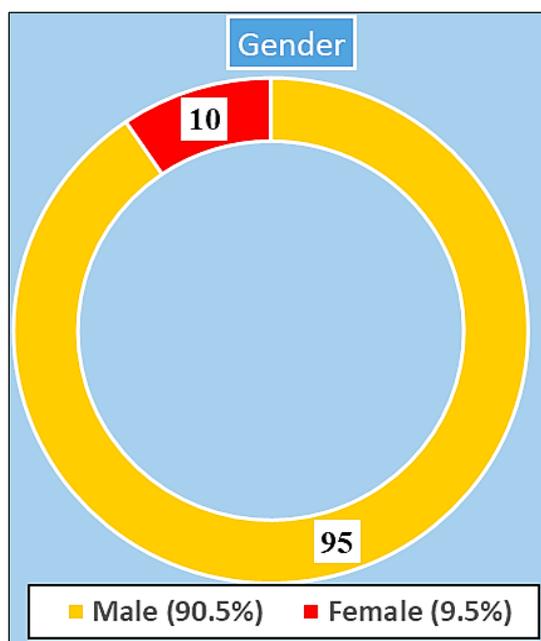
Simple random sampling technique is used to select the study participants.

## Results



**Fig 1:** Distribution of the study participants by age (n=105)

- Majority of the participants were in the age group of 29-38 years (38.1%).
- Mean age of study participants was 38 and minimum was 21 years and maximum was 67 years.



**Fig 2:** Gender-wise distribution of the study participants (n=105)

- Among the study population majority were males (90.5%).

**Table 1:** Systolic blood pressure among study participants (n=105)

Systolic blood pressure	Frequency (N)	Percentage (%)
100-140 mmHg	87	82.9%
<100mmHg	18	17.1%
>140mmHg	0	0
Total	105	100 %

- Systolic blood pressure was low among 17.1% of the study participants during admission. None had higher SBP.

**Table 2:** Diastolic blood pressure among study participants (n=105)

Diastolic blood pressure	Frequency (N)	Percentage (%)
60-90 mmHg	77	73.3%
<60 mmHg	28	26.7%
>90mmhg	0	0
Total	105	100%

- Diastolic blood Systolic blood pressure was low among 26.7% of the study participants during admission. None had higher DBP.

**Table 3:** Pulse rate among study participants (n=105)

Pulse rate	Frequency (N)	Percentage (%)
60-100 beats/min	92	87.6%
<60 beats/min	0	0
>100beats/min	13	12.4%
Total	105	100 %

- Majority of the study participants had the normal pulse rate. Only 12.4% had increased pulse rate.

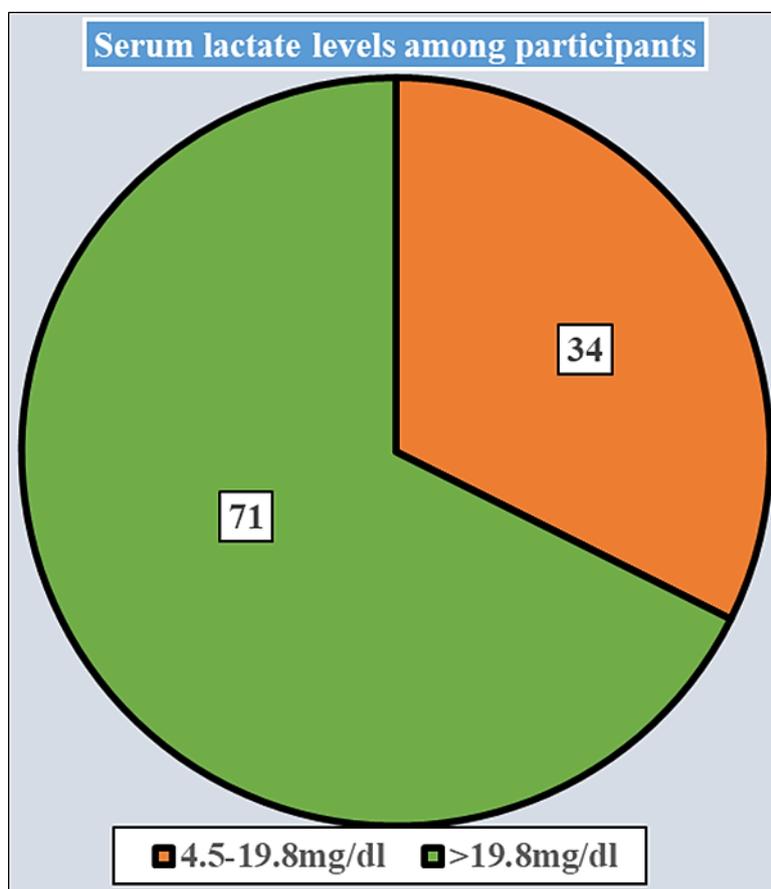
**Table 4:** Respiratory Rate among study participants (n=105)

Values	Frequency (N)	Percentage (%)
12-18 breaths/min	77	73.3%
<12 breaths/min	0	0
>18 breaths/min	28	26.7%
Total	105	100%

- Around 26.7% of the study participants had tachypnea.

**Table 5:** Temperature among study participants (n=105)

Values	Frequency (N)	Percentage (%)
Afebrile	105	100%
Febrile	0	0
Total	105	100%

**Fig 3:** Serum lactate levels at the time of admission

- At the time of admission, majority (67.6%) had high serum lactate levels. None had less than 4.5mg/dl.

**Table 6:** Mode of management

Mode of management	Frequency (N)	Percentage (%)
ILN femur	105	100%

- All the patients (100%) were treated by Interlocking nail fracture fixation surgery.

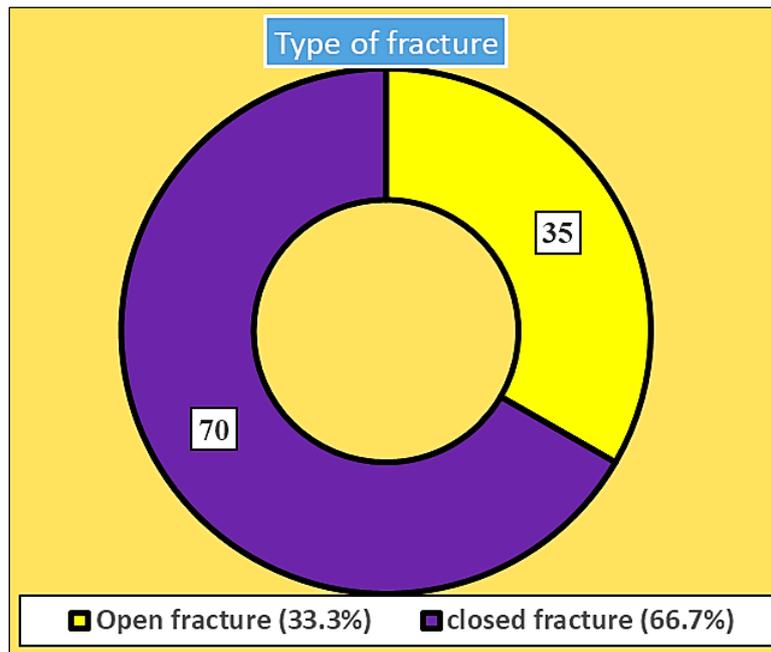


Fig 4: Type of fracture

- Majority had closed type of fracture of femur (66.7%)

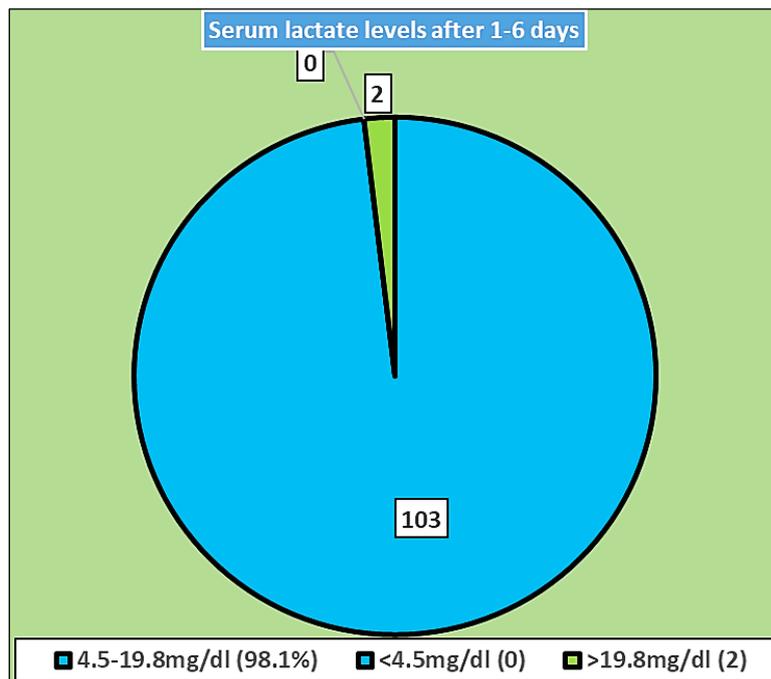


Fig 5: Serum lactate levels after 1-6 days of admission

- Only 2% had higher Serum lactate levels after 1-6 days of admission.

**Discussion**

Evaluation of serum lactate levels in a single long bone fracture was conducted among 105 patients from the inpatient department. During admission, demographic factors related to the injury was collected and the vitals were checked to evaluate the hemodynamic status of the participants. Serum lactate levels were checked during admission and was followed up after

1-6 days to assess the levels favourable for better outcomes following interventions. All the patients had single long bone fracture i.e., fracture of the shaft of femur and all were treated by Interlocking nail fracture fixation surgery. In this study majority of the patients were in the age group of 29-38 years (38.1%), Literature supports this evidence, as young active individuals are affected mostly. Majority of the participants were males (90.5%).

Hemodynamic status of the trauma patient is one of the important factor determining the orthopedic management of the fractures. (Bon Grey). It was found in this study that systolic blood pressure was low among 17.1% and diastolic blood pressure was low among 26.7% of the study participants. Even Collins JA *et al.*, on his study on in-apparent hypoxemia in casualties with wounded limbs, found that many of the patients were severely (33%) hypovolemic. In a retrospective study conducted by Fu YG *et al.*, in a tertiary paediatric hospital between May 2012 and Jun 2018 among children found that 21.1% had hypotension. Study by Javali RH *et al.*, done among trauma patients on the Initial Assessment of Arterial Lactate and Base Deficit as Predictors of Outcome in Trauma Patients, it was observed that on admission 9% had hypotension, 34% had tachycardia <sup>[13]</sup>.

In this present study, the pulse rate was found high among 12.4% of the participants. Similarly in a study by Bhumireddy CS *et al.*, done among patients with long bone fracture to check the association between serum lactate levels and fat embolism, it was found that 3 among 4 patients with fat embolism and increased serum lactate levels had tachycardia. A study by Javali RH *et al.*, done among trauma patients, showed 34% had tachycardia. Respiratory rate was found high among 26.7% of the participants during admission. Temperature was found normal among all the patients during admission <sup>[14]</sup>.

The serum lactate levels are the best quantitation available currently for the degree of shock. (Collins). In this study serum lactate levels were high among the 67.6% of the study population, during admission and among 2% of the patients after 1-6 days of admission. Persistent rise in serum lactate levels was found less which indicates a favourable prognosis as the persistent rise indicates the ongoing shock, inadequate resuscitation or the presence of an occult chest injury. (Lamichhane P).

Whereas in a study by Regnier MA *et al.* the prognostic significance of blood lactate and lactate clearance in trauma patients, serum lactate levels were elevated in 56% of the trauma patients. In a study by Bhumireddy CS *et al.*, done among patients with long bone fracture to check the association between serum lactate levels and fat embolism, it was found that 35% (14 out of 40) had increased serum lactate levels following trauma <sup>[15]</sup>.

It was found in this study that there is a statistically significant difference between the serum lactate levels during admission and after 1-6 days after among patients with long bone fracture, so the delayed intervention for the fracture will be helpful for the better outcome of the surgery.

Chen X-ray conducted a study to find the effect of serum lactate levels at admission to the mortality after surgery found (31.4%) had higher serum lactate levels and when compared to patients with normal lactate concentrations, they had a higher postoperative mortality, longer hospital stays and a higher incidence of complications. Similarly, a study by Lamichhane P *et al.*, the levels of serum lactate in poly trauma and multitrauma patients, 27.8% and 38.3% had elevated serum lactate levels during admission polytrauma and multitrauma patients respectively. In that study mortality in those with elevated serum lactate levels was 40% and 7.7% among polytrauma and multitrauma patients respectively. The average time to surgery in patients with elevated lactate on admission was found to be around 7.9 days, when the patient was physically stable.

Manikis *et al.* studied 129 patients admitted to ICU and found that there was a significant difference in the mean lactate levels in survivors as compared to non-survivors. Abramson *et al.*, studied lactate clearance in 76 multi-trauma patients admitted to the ICU and concluded that the time needed to normalize lactate levels is a useful indicator in predicting prognosis in

severely injured patients. Following major trauma, there is a surge of pro-inflammatory mediators, notably interleukin-6, until about the fourth day. The 'second hit' of any surgical intervention following the 'first hit' of the trauma itself is thought to have a deleterious effect on the outcome if any intervention is undertaken within this window. In a retrospective analysis of polytrauma patients, Pape *et al.* found that patients operated at 6 to 8 days fared better than those operated between 2 to 4 days with respect to development of multi-organ failure. Also, it was found that initial blood lactate and lactate clearance predict mortality in trauma patients <sup>[16]</sup>.

## Conclusion

This study also concludes that at the time of admission majority of the patients will have an elevated serum lactate levels which will reduce after 1-6 days of admission. This was statistically proved to be significant, which might help in a favourable outcome of surgical procedures.

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