

# Correlation between the vitals and the serum lactate levels during admission of patients with long bone fracture

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## Abstract

There are only few studies assessing the prognostic value of blood lactate values on the outcome of high-risk, haemodynamically stable, trauma patients. A systematic, rapid & accurate field triage is necessary. Evidence is limited to suggest that tissue hypo perfusion & ischemia are limited to patients with SBP < 90mmHg. Recent studies shown that Systolic BP of less than 110 mm Hg may more accurately reflect the first physiologic response of shock. 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. Systolic and Diastolic blood pressure is negatively correlated with serum lactate levels during admission, i.e, lower the systolic and Diastolic blood pressure higher is the serum lactate levels. It was found statistically highly significant. Pulse rate and Respiratory rate were positively correlated with the serum lactate levels during admission, i.e, lower the pulse rate and respiratory rate higher will the serum lactate levels. It was found statistically highly significant.

**Keywords:** Serum lactate levels, haemodynamic, serum lactate levels

## Introduction

In polytraumatised individual, the cascade of physiologic adaptations occurs and to maintain homeostasis after severe trauma is a multifaceted phenomenon. This mainly involves the cardiorespiratory and immune systems. Recent advances shows detection of polymorphisms and haplotypes of genes related to inflammatory molecules. The cardiovascular adaptation leads to early clinically observations described as the three phases of hypo dynamic flow, the hyper dynamic flow, and the recovery <sup>[1]</sup>.

During this hemodynamic change, activation of the immune system occurs and the development of systemic inflammatory response syndrome (SIRS) and counter anti-inflammatory response syndrome (CARS) may be seen, if untreated leads to adult respiratory distress syndrome (ARDS), multiple organ dysfunction (MOD), or even death. The most appropriate action for minimizing the impact of the second hit to the physiology decreases mortality and posttraumatic complications [2].

Lactate production occurs in all tissues like RBCs & kidneys, brain, skeletal muscles. It also occurs normally in baseline conditions under oxygen rich level. In normal conditions, lactate is rapidly cleared by liver metabolism & by reconversion of lactate to pyruvate. This helps in keeping blood lactate level within normal limits, normally serum lactate ranges between 0.5 mmol/L to 2.2mmol/L or 4.5mg/dL to 19.8mg/dL.

In a hypo perfusion state, pyruvate is metabolized to lactate because of anaerobic condition and producing less number of adenosine triphosphate (ATP) molecules. Blood lactate levels start rising as early as thirty minutes after major injury. Persistent increase may lead to lactic acidosis which can cause respiratory failure, multi organ dysfunction or death following major trauma [3].

Lactic acidosis thus indicates occult or overt hypo perfusion. Resuscitation in polytrauma patients aimed to normalization of vital signs such as blood pressure, urine output & heart rate. But, these parameters have been proved to be inadequate in detecting the endpoint of resuscitation. The ideal marker should be able to assess resolution of hypo perfusion. There have been few studies to date, evaluating the significance of elevated blood lactate in detecting occult hypo perfusion or persistent occult hypo perfusion associated with increased morbidity & mortality. Studies proven that early correction can to improve clinical outcome [4].

There are only few studies assessing the prognostic value of blood lactate values on the outcome of high-risk, haemodynamically stable, trauma patients. A systematic, rapid & accurate field triage is necessary. Evidence is limited to suggest that tissue hypo perfusion & ischemia are limited to patients with SBP < 90mmHg. Recent studies shown that Systolic BP of less than 110 mm Hg may more accurately reflect the first physiologic response of shock. Therefore, for patients with SBP of 90-110 mmHg close monitoring is needed to identify occult shock [65]. Here comes the usefulness of serum lactate in recognizing patients with occult hypo perfusion or early shock secondary to haemorrhage [5].

Shock is responsible for inadequate oxygen delivery leads to tissue hypoxia causes anaerobic metabolism and increase of lactate production. Lactate can be used as diagnostic and prognostic biomarker in sepsis and trauma. Lactic acidosis may persist despite controlling haemorrhage, due to flow demand mismatch, vasoconstriction, shock or other dysfunctional responses [6].

## Methodology

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.

## 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.

$n = Z\alpha^2 SD^2$  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

**Table 1:** Correlation between the vitals and the Serum Lactate levels during admission

	Pearson correlation	
	r value	p value
SBP	-.751	0.000
DBP	-.620	0.000
PR	.614	0.000
RR	.659	0.000

Systolic and Diastolic blood pressure is negatively correlated with serum lactate levels during admission, i.e., lower the systolic and Diastolic blood pressure higher is the serum lactate levels. It was found statistically highly significant. ( $p < 0.01$ )

- Pulse rate and Respiratory rate were positively correlated with the serum lactate levels during admission, i.e., lower the pulse rate and respiratory rate higher will the serum lactate levels. It was found statistically highly significant. ( $p < 0.01$ )

**Table 2:** Difference between the serum lactate levels during admission and after 1-6 days

	Mean	Std. Deviation	p value
S. Lactate-repeat S. Lactate (1-6 days)	4.4638	1.2989	0.000

- Paired sample t test was used to find the statistical significant difference between the serum lactate levels during admission and after 1-6 days.
- There was statistically significant difference (p value  $< 0.01$ ) between the serum lactate levels during and after 1-6 days of admission.

### Cross table

**Table 3:** Association between the type of fractures and levels of Serum Lactate during admission

Factors		Serum lactate levels		Total	p value
		Normal	High		
Type of fracture	Open	3	32	35	$p < 0.000$
	closed	31	39	70	
Total		34	71	105	

- Chi square test was used to analyze the association between type of fracture and the serum lactate levels and was found to be statistically significant.

### Discussion

In a study by Toole RV *et al.* on Resuscitation Before Stabilization of Femoral Fractures Limits Acute Respiratory Distress Syndrome in Patients With Multiple Traumatic Injuries Despite Low Use of Damage Control Orthopaedics, showed patients with multiple traumatic injuries, patients with multiple traumatic injuries including lung injury, each of the three subgroups, the lactate values decreased significantly between the time of admission and the time of the operative procedure ( $p \leq 0.05$ ), suggesting that significant resuscitation had occurred before the patient reached the operating room [7].

This study showed there was a negative correlation between the serum lactate levels and systolic and diastolic blood pressure whereas positive correlation between serum lactate levels and pulse rate and respiratory rate, similar to the study by Collins JA, on In-apparent hypoxemia in casualties with wounded limbs, it was found that higher arterial  $po_2$  with higher lactate levels, due to hyperventilation with severe metabolic acid loads [8].

In a study to find the association between the body temperature and serum lactate levels in hip fracture patients, Murtuzal F found that those with low body temperature had a significantly higher serum lactate than the eutermic participants.

Present study showed there is a statistically significant association between the type of fracture and serum lactate levels among the study participants [9].

In a study by Bon *et al.* it was found that in patients with multiple fractures, early fracture fixation was needed to reduce the post-operative complications such as ARDS, Fat embolism syndrome or need for post-operative ventilation, pneumonia etc., whereas the timing of the fracture fixation did not adversely affect the outcome in isolated femur fracture.

In a study by Grey B *et al.* on early fracture stabilization in the presence of subclinical hypo perfusion, 50% (36 out of 72) had normal vital signs, in that 53% (19 out of 36) had high serum lactate levels, it was also found that high serum lactate levels were significantly associated with postoperative morbidity and was concluded that delaying the surgery should be considered <sup>[10]</sup>.

## Conclusion

From the study it was concluded that the type of fracture and the levels of serum lactate (statistically significant) during admission might help in further management decisions. Vital signs like systolic and diastolic blood pressure negatively correlated with serum lactate level. On the other hand respiratory rate and temperature showed a positive correlation with serum lactate levels. These correlations will help us to clinically evaluate the patient better.

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