COMPARING THE RANDOM BLOOD GLUCOSE LEVEL IN PATIENTS WITH SINGLE AND MULTIPLE LONG BONE FRACTURES.

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ABSTRACT

BACKGROUND: Long bone fractures either single or multiple present frequently to the emergency. The metabolic response to trauma elicits various markers amongst which is hyperglycaemia. Determination of hyperglycaemia in these two sets of patients is however yet to be fully evaluated.

OBJECTIVE: To compare the random blood glucose levels in patients with single and multiple long bone fractures.

DESIGN: Prospective comparative cross-sectional study

SETTING: Obafemi Awolowo University Teaching Hospitals Complex, Ile-Ife, Osun state Nigeria.

PATIENTS AND METHOD: Ninety cases of patients with traumatic single and multiple long bone fractures had their random blood glucose levels evaluated at three different times and were all treated.

MAIN OUTCOME MEASURE: Random blood glucose level before,during and after resuscitation.

RESULTS: Ninety patients were recruited into the study with 65 and 25 of them having single and multiple long bone fractures respectively. Young males with closed Tibia fractures following road traffic accidents accounted for majority (30%) of the single fractures while those with floating knee accounted for the majority (8.8%) of multiple long bone fractures. The mean Random blood glucose at presentation, 12 hours and 24 hours after presentation were 7.7,7.1 and 5.9 (mmol/l) respectively. There was a statistically significant difference in the random blood glucose levels between patients with single and those with multiple long bone fractures.

CONCLUSION: Patients with multiple long bone fractures appear to mount a higher metabolic response to trauma. Hyperglycaemia can be reduced with prompt and adequate resuscitation. Thus routine random glucose checks for all trauma patients should be done and serve as marker for injury severity and adequacy of resuscitation.

KEY WORDS: Random Blood Glucose, Single and Multiple Long Bone Fractures.

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INTRODUCTION

The long bones of the human body include the humerus, radius and ulna, femur, tibia and fibula. These long bones may be fractured following trauma. In a study done in 2008 in Ibadan, the tibia was noted to be the commonest long bone fractured accounting for 66% of fractures [1].The incidence of long bone fractures following trauma in Nigeria has been put at 62.5% [2] while in a study done in Ile-Ife, the incidence is 35.6% [3]. Studies have shown that males are more predisposed to trauma than females due to their engagement in more activity.[4] The young and middle age group are the most affected in trauma due to their more active nature [1,5] while long bone fractures due to falls are commoner in the elderly[5] .Road traffic accidents are the commonest cause of long bone fractures.[2] Traumatized patients with single or multiple long bone fractures mount a metabolic response which aims to restore the homeostasis in the body to normal.[6]

In 1942, Cuthbertson described the phases of the physiologic changes which occur following trauma[7]. He described the ebb and flow phases. The ebb phase occurring very early however shortlived lasting about 24 hours and the flow phase which has initial catabolism and thereafter anabolic changes. These changes must be recognised and dealt with early following trauma[7] and adequate resuscitation is important to attenuate the response[8].

The triggers of the metabolic response following long bone fractures include haemorrhage, pain

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and inflammation. These factors act in concert to increase the serum levels of the counter regulatory hormones (glucagon, catecholamine's, growth hormone,) which subsequently cause a rise in glucose level. [9,10]

The development of hyperglycaemia following trauma which is now called the 'diabetes of injury' was first described by Claude Bernard in 1877 in which he also outlined the benefits of insulin therapy in trauma patients[11]. Hyperglycaemia has also been shown to increase with advancing age in trauma patients.[12]

Hyperglycaemia following long bone fractures thus serves as a marker of the severity of the injury and also serves as a prognostic indicator of the severity of trauma[13,14]. The World Health Organisation has provided a guideline for the normal level of blood glucose as shown below. The normal random glucose level is 79-140mg/dl (4.4-7.8 mmol/l)[8]

THE UNMET NEEDS

The need to control hyperglycaemia is important and known but has remained a challenge[15]. This has made care givers to seek different options to overcome this barrier in care giving[15,16].

In a study done in Ile-Ife in 2011, it was noted that the calcium level of patients rise following trauma[17]. Similar studies are yet to be done in our environment on the glucose levels in patients with long bone fractures and how different it is from patients who have multiple long bone fractures and therefore may be severely injured.

AIM

1. To determine the relationship between Random blood glucose levels and long bone fractures.
2. To Compare the random blood glucose level in patients with single and multiple long bone fractures.

METHODS

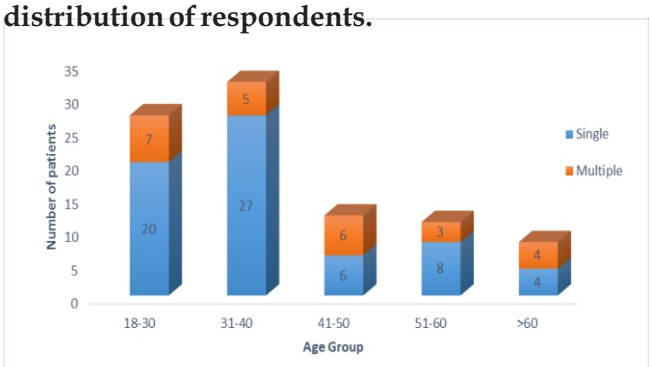
The study was a prospective comparative cross sectional study done over a 12 month period after obtaining . Ethical clearance. Inclusion criteria was patients 18 years and above who sustained traumatic long bone fractures. Exclusion criteria included known diabetics, patients who had been referred or resuscitated elsewhere, patients with stress or pathologic fractures. A sample size of 90 was determined and patients on arrival to our emergency department were resuscitated using the Advanced Trauma Life support and the nature of their long bone fracture noted as either single or multiple. At initial resuscitation, fluids were set up, fractures splinted and analgesics given, all aimed at mitigating the metabolic response to trauma, also the Random blood sugar was determined and recorded as G1, 12 hours later, the G2 was recorded and G3 recorded at 24 hours when the patient must have been more stable. Patients had treatment of their fractures as best determined by the caregiver.

Patients were stratified into two groups viz;
Measurement of the RBS levels in patients with single long bone fractures.
Measurement of the RBS levels in patients with multiple long bone fractures
The RBS values were recorded as follows < 7.8 mmol/l- Normal >7.8 mmol/l – Hyperglycaemia.

RESULTS

During the study period, 90 patients who fulfilled the inclusion criteria were recruited into the study consecutively after initial stabilization and obtaining consent. The Modal age group was 31-40 years with 32 patients making up 32.2 % while those above 60 years were 8 patients with a percentage of 8.9 %. This is outlined in the figure 1 below.

Figure 1: Composite Bar chart showing Age distribution of respondents.



Concerning gender distribution,60 (66.7%) were males and 30 (33.3%) females giving a male to female ratio of 1.2 :1. This is also shown in the composite bar chart below (Fig. 2).

Figure 2. Composite Bar chart showing sex distribution of respondents.

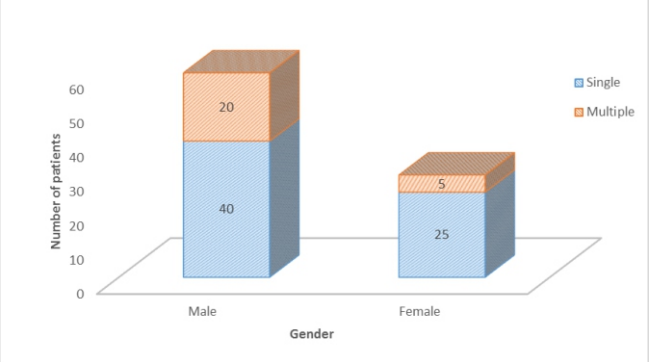


Figure 3: Bar chart showing percentage total number of bones fractured

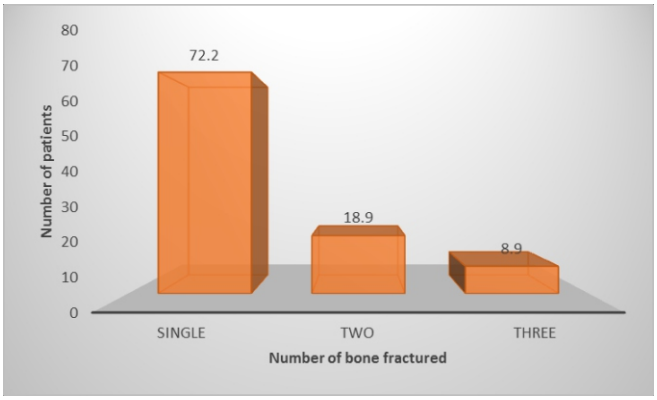


Figure 3 above is a bar chart showing the number of bones fractured. It is observed that among those with multiple long bones fractured,17 (18.9%) had two long bones fractured while 8 patients (8.9%) had three long bones fractured. No patient had more than 3 long bones fractured.

Table 1: Descriptive Statistics and mean random glucose level

RBS Level	n	Minimum (mmol/l)	Maximum (mmol/l)	Range (mmol/l)	Mean +/-	Std. Deviation
G1 at presentation	90	1.40	18.70	17.3	7.7481	4.24446
G2 12hrs later	90	3.00	17.60	14.6	7.1400	2.69030
G3 24 hrs later	90	2.60	20.70	18.1	5.9930	2.02435

It is observed that The mean G1 was 7.7 +/- 4.2.The mean G2 was 7.1 +/- 2.7 and the mean G3 was 5.9 +/- 2.0.

Table 2: Objective 1: RBS and Single Long bone fractured

RBS (mmol/l)	G1	G2	G3
< 7.8	48(73.85 %)	53 (58.8%)	60 (66.7%)
➢ 7.8	17 (26.15%)	12 (13.3%)	5 (5.5%)

Table 3: Objective 2: RBS and Multiple long bones fractured

RBS	G1	G2	G3
< 7.8	12 (48%)	8 (8.9%)	20 (22.2%)
➢ 7.8	13 (52%)	17 (18.9%)	5 (5.5%)

Table 4: Objective 3: Analysis, comparing RBS of single and multiple Long bone fractures

	X^2	p	Remark
G1	9.245	0.05	Significant
G2	2.315	0.023	Significant
G3	12.12	0.001	Significant

It is noted from the tables above that the RBS levels dropped consistently from time of presentation and as resuscitation continued to 24 hours afterwards irrespective of the long bone fractured. It is also noted that the RBS levels were higher in patients with multiple long bone fractures compared with those with single long bone fractures.

DISCUSSION

Long bone fractures are a common presentation in adults at the emergencies and in this study, road traffic accidents were the commonest cause of long bone fractures accounting for 83.3% as it is also the commonest cause worldwide [5] Similar to a study done at Ibadan Nigeria in 2008 [1], the tibia in this study was noted to be the commonest long bone fractured accounting for 41.5% of the single long bone fractures. In a study done by Ikem in 2001 at Ile-Ife, he noted that the Tibia was the commonest long bone with open fractures[18]. This may be attributed to the tibia being the most distal long bone of the body hence prone to injuries, also the tibia in its distal part is subcutaneous which also predisposes it to fractures. In this study, males accounted for majority of the patients in both groups. For those with single long bone fractures, there were 40 (44.4%) males and 25 (27.7%) females, while for those with multiple long bone fractures, there were 5(5.5%) females and 20(22.2%) males. This is similar to a study conducted in 2005 by Bochichio et al [4], this is because males are more active, engage in more travels and sports generally. The study also showed that the young were more affected

followed closely by the middle age group. This corroborates the study in Nigeria and abroad [1,5] and may be attributed to the young being more active .It is also noted in this study that more patients presented with single long bone fractures in all the age groups except for the 41-50 and above 60 age groups which had equal number of both single and multiple long bone fractures. Thus single long bone fractures are commoner presentation in our environment and seen more in the young. This may be attributed to individuals who see the accident coming and try to protect themselves to limit the severity of injury.

For patients presenting with long bone fractures, they were all resuscitated according to the ATLS protocol as documented by Navaro et al in 2014 [19] this helped to mitigate the metabolic response. It is seen from the results that majority of the patients at presentation (G1) had normoglycaemia (56.7%) while there was an equal number of those with hyperglycaemia and impaired glucose levels (16.7%), this may be due to the more number of closed fractures seen in this study (64.4%) hence patients mounting a lower metabolic response than in open fractures where there may be more soft tissue injury and blood loss due to higher energy and thus patients mounting a higher metabolic response. Also, those who had single long bone fractures were more (72.2%) than those with multiple long bone fractures (27.8%) thus mounting a lower metabolic response. This was illustrated in a study done in 2013 were it was noted that those who had more severe injuries mounted a higher metabolic response [20]. It is possible that those with less severe injuries have single long bone fractures as against those with multiple long bone fractures who were less in number in this study. In our environment, most patients with very severe injuries may die at the scene of accident or on their way to the hospital this may be the case in this study and was documented in 2006 by Thanni [2].

Concerning the G2 scores, by which time resuscitation has commenced for 12 hours, it is observed that there was an increase in the number of patients with normoglycaemia from 56.7% in G1 to 63.3% in G2. There was however a reduction in the number of those with hyperglycaemia from 16.7% to 8.9%. This change in glucose levels towards normal can be said to be due to the ongoing resuscitation of the patients thus alleviating pain with analgesics, splinting fractures, reducing hypovolaemia with fluids and blood transfusion, all these tend to mitigate the metabolic response and drive the RBS towards normoglycaemia as documented in earlier studies [6,8]

Concerning the G3 scores, which were taken after 24 hours of resuscitation, it is observed that there was a steady rise in the number of those with normoglycaemia to 85.6% and those with impaired RBS dropped to 6.7%. The number of patients with hyperglycaemia also dropped further to 4.4%. At this point, it can be said that such patients were more stable, with homeostasis maintaining equilibrium and much less pain, little hypovolaemia and reduced inflammation. Thus metabolic response can be said to be resolving. Patients with hypoglycaemia were also seen to have a steady increase of RBS levels from 10% in G1 to 4.4% in G2 to 3.3% in G3. The resuscitative efforts helped to tilt the sugar levels towards normoglycaemia and this is corroborated in earlier studies().The reduction to normoglycaemia is also noted with the reduction in mean RBS levels from 7.7 +/- 4.2 G1 to 7.4+/- 2.6 G2 to 5.9 +/- 2.0 G3,this is similar to earlier studies done by Paladino et al [13].

If hyperglycaemia persists following trauma, this may increase the morbidity of the patient thus leading to poor wound healing and increased length of hospital stay [8]
Studies have shown that the earlier a patient arrives and receives treatment in the hospital, the better the outcome [22].Patients with multiple injuries tend to arrive the hospital and get treated earlier than those with single long bone fractures who do not rush immediately to hospital [23] .Our hospital is situated in the town with narrow roads and bordered by highways hence it serves as the first point of first aid and further treatment. Our facility also is the major teaching hospital in the state and serves as a major referral centre for most cases, hence the early arrival of patients.

On further analysis and comparing the RBS levels between single and multiple long bone fractures, it is noted that for G1, G2 and G3, given a degree of freedom of 3 and p value of <.05, the chi square values respectively are 12.735, 20.739,5.567 which indicates there is a significant difference in RBS levels between single and multiple long bone

fractures. This is similar to a finding done in 1989 by Young .B, when he studied same in head injured patients [24], similar studies done in 1982 however focused on insulin resistance and yielded similar results [25].

We can therefore say that there is a statistically significant difference in the RBS levels for single and multiple long bone fractures. This implies that even though patients present with hyperglycaemia following trauma, a patient with multiple long bone fractures will have higher RBS levels compared to those with single long bone fractures. Thus the metabolic response to trauma in multiply injured patients is more and will subsequently need more aggressive resuscitation in terms of pain control, fluids and splintage of fractures to mitigate the metabolic response.

CONCLUSION

1. The metabolic response to trauma is mounted following long bone fractures.
2. Random blood glucose levels increase following long bone fractures.
3. Hyperglycaemia is more in patients with multiple long bone fractures compared to those with single long bone fractures.
4. Adequate resuscitation of hyperglycaemic patients following long bone fractures brings normoglycaemia.

RECOMMENDATIONS

1. Random Blood Glucose check should be done routinely for all patients with traumatic long bone fractures.
2. Adequate resuscitation for such patients and more aggressive resuscitation for those with multiple long bone fractures.
3. Serial Random blood glucose level can be used as a marker for injury severity and adequacy of resuscitation following long bone fractures.
4. Further studies need to be carried out to compare Random Blood glucose levels in upper and lower limb fractures.

LIMITATIONS

1. Pre-injury glucose levels could not be determined which may have affected the results as some may have eaten just before the accident while others may not have eaten for a long time before the accident.
2. Patients who presented late may have taken food or drinks before arriving the hospital.

NB.

The study was carried out at minimal risk and no cost to the patient and the authors have no conflict of interest to declare.

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