

## Original Article

# Frequency of neonatal hyperglycaemia at Gaafar Ibnauf Children's Hospital: Clinical aspects and short term outcome

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## ABSTRACT

Hyperglycaemia has become a significant risk factor for morbidity and mortality of the smaller fragile infants surviving the neonatal period. Its risk is inversely related to gestational age, birth weight and baby's clinical condition. The aim of this study was to determine the frequency, some clinical aspects and immediate outcome of hyperglycaemia in neonates admitted to the neonatal intensive care unit (NICU) at Gaafar Ibnauf Children's Hospital, Khartoum. The study was a prospective, descriptive and hospital-based, conducted during the period of 1st January to 31st December 2014. Eighty-five neonates out of 345 had neonatal hyperglycaemia with a frequency rate of (24.6%). Fifty-two (61.2%) were males (male: female ratio=1.6:1), 61.2% of the babies were in the age group (0—7) days, and 25.9% in age group (8—14) days. Forty-two (49.4%) were preterm, while 43 (50.6%) were term babies. Four (4.7%) of the mothers had diabetes, and 6(7.1%) had hypertension.

Neonatal sepsis was a predominant risk factor of hyperglycaemia occurring in 67 babies (78.8%), followed by respiratory distress syndrome in 28 (32.9%) babies. Ten babies (11.8%) were diagnosed as acute kidney injury, four babies (4.7%) had hypernatraemic dehydration and seven babies (8.3%) were having hypoxic ischemic encephalopathy. Out of 85 hyperglycaemic neonates death was reported in 10 babies (11.8%), 75 (88.2%) survived. All cases had transient hyperglycaemia; therefore insulin intervention was not necessary. Currently, at Gaafar Ibnauf Children's Hospital, specific protocol for management of hyperglycaemia is lacking. Further studies are recommended to assess long term sequels of hyperglycaemia in neonates.

### Keywords:

Hyperglycaemia; Neonate; Gaafar Ibnauf Children's Hospital; Sudan.

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## INTRODUCTION

The definition of hyperglycaemia in neonates is defined as blood glucose >125 mg/dL (6.9 mmol/L) or plasma glucose >150 mg/dL (8.3 mmol/L). These glucose levels are frequently observed during glucose infusions in newborns, especially in extremely preterm infants, and may require intervention [1].

The risk of hyperglycaemia is inversely related to gestational age and birth weight and increases with the severity of accompanying illnesses [2,3].

Trials of postnatal corticosteroids for prevention of chronic lung disease showed increased risk of hyperglycaemia and glycosuria mostly from use of dexamethasone [4]. Late onset bacterial and fungal infection has also been reported to have association with hyperglycaemia [4,5]. Associated adverse outcomes of hyperglycaemia include death, [1,4,6] intraventricular haemorrhage, retinopathy of prematurity, [7-9] necrotizing enterocolitis, [4] bronchopulmonary dysplasia and prolonged length of hospital stay. More severe outcomes were reported when the hyperglycaemia was prolonged [1,6].

The following group of infants should be screened for hyper-(and hypo-) glycaemia: Infants born <35 weeks' gestation, infants receiving intravenous (IV) fluids or total parenteral nutrition, sick infants and infants with glycosuria.

Systematic review of trials of early insulin infusion for treatment of neonatal hyperglycaemia found that the use of an insulin infusion reduced the hyperglycaemia but increased death before 28 days and increased the risk of hypoglycaemia. The reduction in hyperglycaemia was not accompanied by significant effects on major morbidities; and the effects on neurodevelopment are awaited [10,11].

Hyperglycaemia is a significant risk factor for morbidity and mortality. Knowledge regarding hyperglycaemia, aetiology, risk factors, diagnosis and management is continuously being updated. Therefore, there is a need for such a study to update the

knowledge and practice among health professionals who deal with neonatal hyperglycaemia. To the best of our knowledge there is no previous study in Sudan and there is no specific protocol for management of hyperglycaemia in neonates.

The specific objectives of this study were to calculate the frequency of hyperglycaemia in neonate admitted to the Neonatal Intensive Care Unit (NICU) at Gaafar Ibnauf Children's Hospital, Khartoum. Also other objectives were to determine any relationship between hyperglycaemia and birth weight, gestational age, medication during pregnancy, family history of diabetes mellitus, type of fluid and medication administered to the baby and also to determine the immediate outcome and to suggest some recommendations for prevention.

## PATIENTS AND METHODS

This was a prospective, cross-sectional, descriptive and hospital-based study. It was conducted at Gaffar Ibn Auf Referral Paediatrics Hospital, which is largest specialized referral paediatric hospital in Sudan. Its NICU has 16 incubators, 9 cots, two mechanical ventilators and two nasal continuous positive airway pressure (NCPAP) machines and high flow oxygen. The study was carried out in the period from 1st January to 31st December 2014. It included all neonates admitted to NICU who were found to have hyperglycaemia. Neonates whose parents refused to participate in the study were excluded.

Sample size was calculated by statistician to satisfy the first objective of the study. It was calculated to be

$$N = 4 \left[ \frac{\pi_{Plan}(1 - \pi_{Plan})}{\omega^2} \right] Z_{1-\alpha/2}^2$$

Where: N is the required sample size,  $\pi_{Plan}$  is an anticipated population proportion,  $\alpha$  is the significant level,  $Z_{1-\alpha/2}$  is the value from the normal distribution related to and representing the confident interval.  $\omega^2$

is the width of the confidence interval.

Data was collected from patients and patients' records. The information was filled into pre-designed questionnaire, which included personal data, weight, gestational age, risk factors and other related factors together with intervention and immediate outcome. Random blood sugar (RBS) was measured by Accu-check glucometer and was confirmed by the laboratory. The definition of hyperglycaemia was taken as blood sugar >125 mg/dl (6.9 mmol/L) or plasma glucose >150 mg/dl (8.3 mmol/L).

The study was approved by the ethical committee of the Sudan Medical Specialization Board, Council of Paediatrics. Permission was taken from the Hospital Administration and a verbal consent was obtained

from the neonates' parents.

Data was analysed by computer using Statistical Package for Social Sciences (SPSS version 21). The results were presented in tables and figures. A medical statistician performed the calculation of the sample size and analysis of the data.

## RESULTS

Eighty-five babies were found to have hyperglycaemic among 345 neonates admitted to NICU, during the study period. Therefore, the frequency rate was calculated to be 24.6%. The clinical characteristics of the study group are summarized in Table 1.

**Table 1 - Clinical characteristics of the study group**

Characteristics	Frequency	Percent
<b>Gender</b>		
Male	52	61.2
Female	33	38.8
<b>Total</b>	<b>85</b>	<b>100.0</b>
<b>Age (days)</b>		
1-7	52	61.2
8-14	22	25.9
15-21	9	10.6
22-28	2	2.4
<b>Total</b>	<b>85</b>	<b>100.0</b>
<b>Gestational age</b>		
Preterm	42	49.4
Term	43	50.6
<b>Total</b>	<b>85</b>	<b>100.0</b>
<b>Weight (kg)</b>		
< 1	11	12.9
1-1.5	25	29.4
1.6-2.4	22	25.9
2.5-3.5	24	28.2
> 3.5	3	3.5
<b>Total</b>	<b>85</b>	<b>100.0</b>

Maternal illness during pregnancy of hyperglycaemic neonates included hypertension in six mothers (7.1%) and diabetes mellitus in four mothers (4.7%). Seventy-five (88.2%) mothers were found to have no chronic illness during pregnancy to be well. Family history of diabetes was reported in twenty-nine cases (34.1%). Premature rupture of membranes occurred in twenty mothers (23.5%). The reported causes of admission of

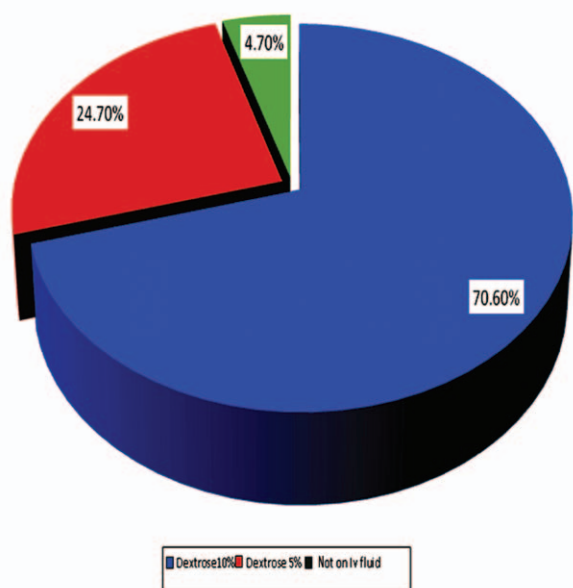
babies who subsequently developed hyperglycaemia to NICU were sixty-seven (78.8%) neonatal sepsis, twenty-eight (32.9%) respiratory distress syndrome (RDS), ten (11.8%) acute kidney injury. Other causes included jaundice thirty-nine (45.9%), hypoxic ischemic encephalopathy (HIE) in seven (8.3%, Table 2).

**Table 2 - Diagnosis upon admission of hyperglycaemic neonates**

Causes of admission	Frequency	Percent
Neonatal Sepsis	67	78.8
Respiratory distress syndrome	28	32.9
Acute kidney injury	10	11.8
Hypernatraemic dehydration	4	4.7
Necrotizing enterocolitis	2	2.4
Meningitis	2	2.4
<b>Jaundice</b>		
Conjugated	5	5.9
Unconjugated	34	40.0
<b>Hypoxic ischemic encephalopathy</b>		
Grade II	6	7.1
Grade III	1	1.2

Seventy four neonates (87.1%) were nil per oral (NPO), 7(8.2%) were breast feed and 4(4.7%) had artificial formula. The type of intravenous fluid

received by those neonates was either 10% glucose (in 70.6%), 5% glucose (in 24.7%), or no IV fluid (in 4.7%; Figure 1).

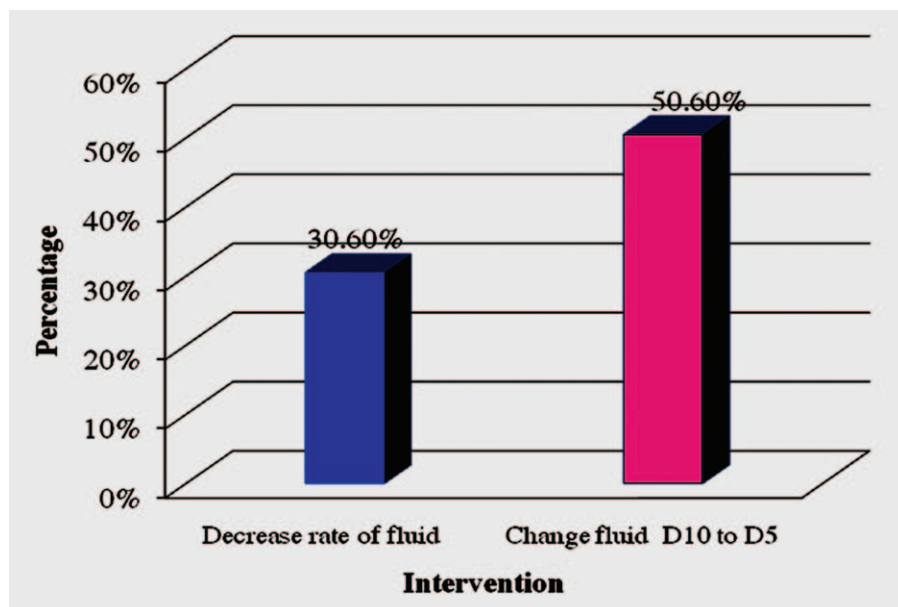


**Figure 1- Type of fluid administered to hyperglycaemic neonates.**

**IV - Intravenous**

Twenty (23.5%) neonates were given aminophylline, while one neonate (1.2%) was given steroid. The type of intervention provided for hyperglycaemic neonates was either change of the type of fluid from D10 to

D5 (in 50.6%) or reducing the rate of fluid (in 30.6%; Figure 2). Out of 85 hyperglycaemic neonates, death was reported in 10 (11.8%).



**Figure 2 - Intervention provided for hyperglycaemic neonates**

## DISCUSSION

The frequency of neonatal hyperglycaemia in this study was 24.6%. This is higher than what was reported by Najati [12] who found a prevalence of hyperglycaemia of 13.5% in 2008 in Iran. Our higher frequency may be due to the fact that the study was done in a referral hospital that receives the critically ill patients from the whole of Sudan. Males were predominant (61.2%) with male to female ratio of 1.6:1 and this finding is comparable with what was reported by Falcão and Ramos (57.5%) in 1999 [2]. Preterms were nearly equal to term babies (49.4%), which was consistent with the same authors' report of 45%. Very low birthweight, less than 1500 grams, was found to be predominant (42.3%) which was compatible with previous studies in neonates with a birth weight less than 1500 grams where the

incidence of hyperglycaemia varies between 36 and 68%[6,13,14] and also agreed with previously reported findings that very low birth weight is a risk factor for neonatal hyperglycaemia [2,3]. Four mothers (4.7%) were diabetic which may be a risk factor for neonatal hyperglycaemia [15].

Family history of diabetes was found to be common (34.1%) which may be a risk factor for neonatal diabetes mellitus [16], but in the present study no patient had permanent hyperglycaemia and no sibling was reported to suffer from the disease. Other risk factors like neonatal sepsis and respiratory distress (Table 2) were similar to what was reported by previous studies which showed that sepsis was the main cause of hyperglycaemia (45%), while respiratory distress was causative in 27.2% [17]. Studies reported that, stress induced hyperglycaemia

is a known complication of neonatal sepsis, but sometimes it may become very difficult to distinguish it from neonatal diabetes mellitus [16].

Jaundice was a common cause of admission accounting for 45.9% of cases, but its association with hyperglycaemia was probably indirect through sepsis (Table 2).

Hypoxic ischemic encephalopathy was detected in 8.3% of cases. This is comparable to what was stated by Obasa et al [18] that asphyxia, respiratory distress and hypernatraemic dehydration are the associated primary pathologic conditions with hyperglycaemia. High percentage of neonates received dextrose 10% (70.6%) and (24.7%) received dextrose 5% (Figure 1). This agreed with what was reported by Obasa TO that, hyperglycaemia is thought to be associated with intravenous glucose infusion [17,18].

The incriminated drugs aminophylline was taken by 23.5%, while only one neonate (1.2%) received steroids. The neonates received aminophylline number was higher than that reported by Pati N K, who showed that 18.2% received aminophylline [17]. Interventions include changing the type of fluids from D10 to D5 in 50.6% or reducing the rate of fluids in 30.6%, while in 18.8% no intervention was needed (Figure 2). This first step in management agreed to that regarded by Sunehag AL, et al [19].

The outcome in hyperglycaemic neonates within 6 hours after admission was very good as in 88.2% hyperglycaemia was corrected, while 11.8% of newborns died due to other underlying causes. Mortality rate is less than that reported by van der Lugt et al [20] in 2010 who reported a mortality of 41% of hyperglycaemic neonates during admission. Other studies reported similar findings [21,22].

Despite management according to the type and rate protocol of the NICU, the current study showed high frequency rate of hyperglycaemia. This supports the strong association between clinical status of patients, gestational age, birth weight and neonatal

hyperglycaemia.

## CONCLUSIONS AND RECOMMENDATIONS

Neonatal hyperglycaemia, though not a primary diagnosis on its own, is associated with appreciable morbidity and mortality. The current study showed high frequency of neonatal hyperglycaemia, although all cases were of transient type. The incriminated medications received included dextrose 10% and aminophylline. The immediate outcome showed high percentage of hyperglycaemia correction and death was due to the underlying cause. The study revealed the absence of an agreed protocol for management of neonatal hyperglycaemia.

The authors recommend the following for reducing morbidity and mortality of neonatal hyperglycaemia:

- Blood glucose level should be measured as routine for any neonates admitted to NICU; especially for preterm neonates receiving IV fluid or total parenteral nutrition (TPN), sick neonates and neonates with glycosuria. Particular considerations should be taken for neonates with high risk to develop hyperglycaemia like those with sepsis, HIE and RDS.
- Further long-term studies are needed to assess long term outcome of neonatal hyperglycaemia.
- Establishing specific protocol and guidelines for management of neonatal hyperglycaemia are of paramount importance in NICU.

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