Original Research Paper

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Incidence of G6PD Deficiency and Its Association with Neonatal Jaundice in Babies Born at A Tertiary Care Hospital in Meghalaya

Paediatrics

KEYWORDS :G6PD deficiency, jaundice, incidence, Meghalaya

Chandreshkumar Bavchandbhai Paneliya	DNB Pediatrics, Senior Resident, Nazareth Hospital, Shillong, Meghalaya, India
*** Richard Mario Lurshay**	DNB Pediatrics, Senior Resident, Nazareth Hospital, Shillong, Meghalaya, India, * Corresponding Author
Santanu Deb	MD, Senior Consultant & HOD, Dept. of Pediatrics, Nazareth Hospital, Shillong, Meghalaya, India
Palash Ranjan Gogoi	MD, Consultant, Dept. of Pediatrics, Nazareth Hospital, Shillong, Meghalaya, India

ABSTRACT

G6PD deficiency is a deficiency of an enzyme called glucose-6-phosphate dehydrogenase in red cells. G6PD deficiency is by far the most common genetic disorder in India. We undertook a prospective, case control, observational study from January 2013 to January 2014 to to find the incidence of erythrocytic G6PD deficiency in all babies born at Nazareth Hospital during the study period and to find out the association between G6PD deficiency and the appearance and severity of neonatal jaundice in such babies. A total of 2400 newborns were screened. Incidence of G6PD deficiency was 18 per 1000 live births. Amongst the ethnic groups, G6PD deficiency was 1.9% among the Khasis, 1.9% in Assamese newborns and 4% amongst Bihari newborns. There was a higher frequency of neonatal jaundice amongst babies who were G6PD deficient compared to non G6PD deficient babies, though the severity of jaundice was similar.

Introduction

G6PD deficiency, a hereditary predisposition to hemolysis, is the most common of all clinically significant enzyme defects in the whole of human biology. It is estimated to affect approximately 400 million people worldwide (World Health Organization, 1989) with the highest prevalence rates in tropical Africa, the Middle East, tropical and subtropical Asia, some parts of the Mediterranean and in Papua New Guinea. G6PD deficiency is by far the most common genetic disorder in India (Verma & Bijarnia, 2002). Though the exact incidence in India is not known, various studies have reported an incidence ranging from 2% to 27.9% in different communities (Mohanty, Mukherjee & Colah, 2004).

Children with G6PD deficiency usually present with prolonged neonatal jaundice or later in life with acute hemolytic crises. The disease as such causes significant morbidity and mortality in childhood. There are no primary prevention interventions available for this disease and the only way to avoid the adverse outcomes is to recognize such children early in life and prevent exposure to agents which can trigger hemolysis. Several agents have been identified as triggers for hemolysis, viral and bacterial infections being the most common. Certain drugs (*e.g.* aspirin, chloramphenicol, chloroquine, primaquine, sulphonamide etc.) and chemicals (naphthalene and henna) have been implicated as hemolytic trigger. (Ali NA, al-Naama, Khalid, 1999; Santucci K, Shah, 2000).

Aims & Objectives

1. This study aims to find the incidence of erythrocytic G6PD deficiency in all babies born at Nazareth Hospital during the study period.
2. To find out the association between G6PD deficiency and the appearance and severity of neonatal jaundice in such babies.

Materials & Methods

Study Design: A Prospective, case control, observational study

Setting: Hospital based; Nazareth Hospital, Shillong.

Duration of Study: 1 year from mid-January 2013 to mid-January 2014.

Inclusion Criteria:

Newborns delivered in labor room or operation theatre in Nazareth Hospital, after attaining informed consent from the mother / father / guardian.

Exclusion criteria:

1. Newborns whose parents refused consent.
2. Still born babies.

Methodology:

1. Blood samples were collected in EDTA from the umbilical cord immediately after the delivery. Cord blood was examined for G6PD activity using quantitative (G-Six) test.
2. G-SIX test is a ready to use, three component reagent system of the detection of G6PD deficiency in human blood using the WHO recommended methemoglobin reduction method.
3. All G6PD deficient neonates were followed up clinically for appearance and severity of jaundice and at same time matched control were selected for corresponding cases. Controls were matched to cases in following aspects like gestational age, sex, birth weight, without ABO & Rh incompatibility, without sepsis and without respiratory distress. Controls were followed up clinically for appearance and severity of jaundice as cases.
4. The Test of significance & chi-square test was calculated for the corresponding variables & relationship between G6PD deficiency and variables of gestational age, sex, religion, ethnicity, neonatal jaundice were examined and their statistical correlations were done using Microsoft excel and SPSS v 22. Test of significance was done by comparison of two sample proportions manually.
5. All G6PD deficient babies were admitted in the postnatal ward for a minimum of 7 days and were examined for appearance of jaundice clinically and if

required, serum bilirubin were estimated. Appropriate treatment modality as per hospital protocol were given to those babies whose total serum bilirubin was significantly elevated (15 mg/dL or more).

6. On the day of discharge, leaflet containing instruction of Drugs & Food to be avoided were given to those parents whose babies were G6PD deficient.

Results & Discussion

Screening for G6PD deficiency in newborns was conducted in the Nazareth Hospital, Shillong, Meghalaya for one year from mid-January 2013 to mid-January 2014. A total of 2400 newborns were screened in the present study. In all newborns, cord blood was collected in EDTA bulb and tested for G6PD activity using quantitative (G-Six) test.

In the present study, G6PD deficiency was seen in 43 out of 2400 newborns (1.8%). So incidence of G6PD deficiency was 18 per 1000 live births. Simultaneously with respect to this G6PD deficient newborns, there were 456 nonG6PD deficient controls who were matched according to gestational age, birth weight, sex and risk factors.

12 out of 43 (28%) G6PD deficient newborns developed significant neonatal jaundice (total serum bilirubin 15 mg/dL or more) while 15 out of 456 (3.2%) nonG6PD deficient controls developed significant neonatal jaundice. This difference was not statistically significant.

Among 43 G6PD deficient newborns, 28 (65%) newborns were male and 15 (35%) newborns were female. The difference in the incidence of G6PD deficiency in males (2.04%; n=28) and females (1.32%; n=15) was not statistically significant ($p > 0.05$).

The mean level of G6PD was 18.5 ± 8.83 U/g Hb at 37°C in the normal newborns whereas the mean level of G6PD in 43 G6PD deficient newborns was 4.01 ± 1.75 U/g Hb at 37°C.

G6PD deficiency was more in term babies compared to preterm babies and this difference was statistically significant.

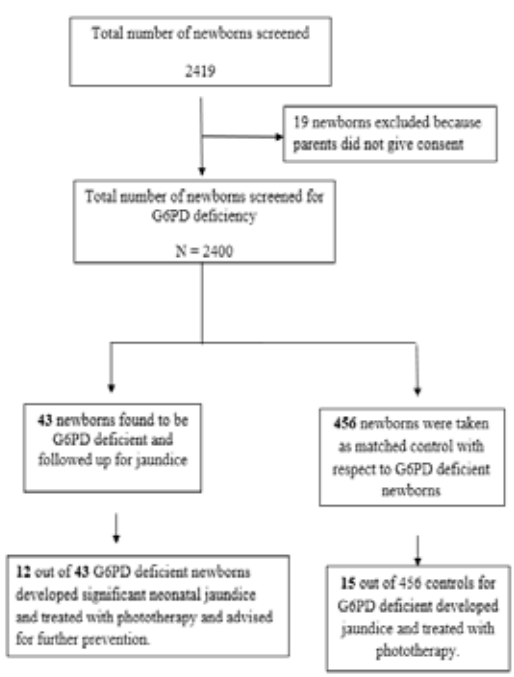

Figure 1: STROBE diagram of the study population

Incidence of G6PD deficiency with respect to Ethnicity

Ethnicity	Number of all newborns screened (n=2400)	Number of G6PD deficient (n=43)
Assamese	106	2 (1.9%)
Bengali	72	0
Bihari	74	3 (4%)
Garo	6	0
Jaintia	193	2 (1%)
Khasis	1874	36 (1.9%)
Manipuris	6	0
Nepali	23	0
Punjabi	9	0

Table 1: G6PD deficiency was similar in babies who are ethnically Khasis & Assamese while higher in Bihari and lower in Jaintia compared to 1.8% of total incidence but this difference was not statistically significant. (Critical ratio = 1.0; $p > 0.05$, comparison between Khasis and non Khasis)

In the present study, of a total of 12 neonates with G6PD deficiency and neonatal jaundice **(Figure 2)**, 7 newborns were male whereas 5 newborns were female. Out of 28 males with G6PD deficiency, 7 male newborns had significant neonatal jaundice, an incidence 25%. Out of 15 female newborns with G6PD deficiency, 5 female newborns had a significant neonatal jaundice, an incidence 33%.

The mean maximum serum bilirubin level in the G6PD deficient group was 18.3 ± 3.0 mg/dL at 74 ± 12hr of life whereas mean maximum serum bilirubin level in the non-G6PD deficient control group was 17.4 ± 1.8 mg/dL at 70 ± 10hr of life. This difference was not statistically significant.

The mean duration of phototherapy in the G6PD deficient group was 3 days ± 12hr whereas mean duration of phototherapy in the nonG6PD deficient control group was 3 days ± 16hr. This difference was not statistically significant.

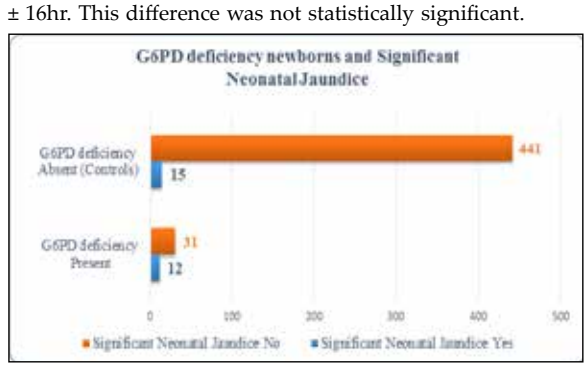

Figure 2: depicts that significant neonatal jaundice was observed more among G6PD deficient newborns compared to non G6PD deficient newborns.

G6PD deficiency	Significant Neonatal Jaundice		Total
	Yes	No	
Present	12	31	43
Absent (Control)	15	441	456
Total	27	472	499

G6PD deficient newborns and Significant Neonatal Jaundice

Table 2: showing relation between G6PD deficiency and neonatal jaundice. Out of 43 G6PD deficient newborns, 12 developed significant neonatal jaundice (Total serum

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bilirubin (TSB): 15 mg/dL or more). Simultaneously 456 matched newborns as control for G6PD deficient newborns was taken and 15 out of 456 developed significant neonatal jaundice. Chi-Square (χ^2) test was carried out and suggested that observed value of 45.7 was greater than the 5% level of χ^2 with one degree of freedom (3.84) ($P < 0.05$). So significant neonatal jaundice was more observed among G6PD deficient newborns compared to non G6PD deficient newborns.

Discussion

Comparison of incidence with other studies

Incidence of 1.8% in the present study was much lower than that in the studies by *Dash S et al. (2005)*, *Bisoi S et al (2012)*, *Louicharoen (2005), Lam (2003), Jiang (2006) and Kawamoto (2006)*. This incidence was comparable with that found in Pakistan by *Ali (2005)*.

However, it was much higher than that in the studies by *Kageoka (1985), Suzuki (2007) and Joseph (1999)*. The total number of newborns screened for G6PD deficiency in the present study was 2400 which was much higher than most studies carried out in India.

Comparison of Ethnic factors:

Considering ethnicity, G6PD deficiency was found amongst 1.9% Khasis, in 1.9% Assamese, in 4% Biharis, in 1 % Jaintias and none in the Bengalis amongst the newborns screened. In Assam study by *Flatz et al (1972)*, G6PD deficiency was found in 4.3% of Assamese, 7% of Khasis. 3.6% Bengalis were found G6PD deficient in study by *Chatterjee (1966)* in Kolkata. In West Bengal study by *Bisoi et al (2012)*, 13.04% Bengalee and 17.5% among non-Bengalees were G6PD deficient.

G6PD deficiency and its association with neonatal jaundice:

Out of 43 G6PD deficient newborns, 12 (28%) G6PD deficient newborns developed significant neonatal jaundice who required phototherapy as mode of treatment of neonatal jaundice. None required exchange transfusion as all G6PD deficient babies was under strict clinical & biochemical follow up (total serum bilirubin measurement) by pediatrician. 15 (3%) out of 456 matched controls developed significant neonatal jaundice. Significant neonatal jaundice was observed among more G6PD deficient newborns compared to non G6PD deficient newborns, which was found to be statistically significant. In the study by *Anil Narang et al (1997)*, out of 260 hyperbilirubinemic neonates 43 (16.5%) were found to be G6PD deficient and in the study by *Aditi Dholakia et al (2012)*, found that out of 150 hyperbilirubinemic neonates, 16 (10.6%) were G6PD deficient.

In present study, appearance of significant neonatal jaundice was at 74 ± 12 hours of life among G6PD deficient and 70 ± 10 hours among non G6PD deficient babies. In the studies carried out by *Mondal et al (2012)* and by *Kuruvilla et al (1998)*, significant neonatal jaundice appeared at 60 ± 10 and 61.4 hours of life among G6PD deficient babies respectively.

With respect to mean peak total serum bilirubin (TSB) level, in present study it was 18.3 ± 3 mg/dL among G6PD deficient and 17.4 ± 1.8 mg/dL among non G6PD deficient babies. This difference was not found to be statistically significant. Similarly studies by *Catherine et al (2009)* and by *Moiz et al (2012)*, mean peak TSB level was 16 mg/dL and 16.7 mg/dL among G6PD deficient respectively and 13 mg/dL and 13.8mg/dL among non G6PD deficient babies respectively.

In the present study, mean duration of phototherapy was 72 ± 12 hours among G6PD deficient and 72 ± 16 hours among non G6PD deficient babies. This difference was not found to be statistically significant. In a study by *Pao et al (2005)*, it was 91 ± 31 hours among G6PD deficient and 55 ± 38 hours among non G6PD deficient babies.

CONCLUSION

In the present study, incidence of G6PD deficiency was 43 per 2400 (1.8%) newborns screened. This incidence is 18 per 1000 live births. This incidence is also lower than the reported incidence in other Indian studies. Nevertheless, a newborn screening program to detect G6PD deficiency would be of benefit to help establish the actual incidence of this deficiency in various parts of our country. As there was a higher frequency of neonatal jaundice amongst babies who were G6PD deficient, it is recommended that clinicians ensure a strict clinical & biochemical clinical & biochemical follow up to monitor for jaundice in these neonates.

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