Original Article

Glucose-6-Phosphate Dehydrogenase (G6PD) Deficiency in Neonates Presenting with Jaundice at Tertiary Care Hospital Sukkur

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ABSTRACT

Background: Glucose-6-phosphate dehydrogenase (G6PD) deficiency is the most important disease of the hexose monophosphate pathway. G6PD is an X-linked recessive enzymopathy that is a well-known cause of hyperbilirubinemia that may be severe enough to cause kernicterus, or death in neonates. Early detection of this enzymopathy and close surveillance of the affected newborns may be important in reducing the risk of severe hyperbilirubinemia. This emphasizes the necessity of neonatal screening of G6PD deficiency.

Objective: To detect the frequency of glucose-6-phosphate dehydrogenase (G6PD) deficiency in neonates presenting with Jaundice.

Study design: Retrospective study.

Place and duration of Study: This study was conducted at Paediatric department of Ghulam Muhammad Mahar Medical College Hospital (GMMMCH), Sukkur from March 2011 to June 2012.

Materials and Methods: This retrospective study was conducted in paediatric department of GMMMCH, Sukkur from March 2011 to June 2012. Two hundred forty cases of neonatal Jaundice of both sexes admitted to hospital were enrolled in the study. Detailed history and clinical examination was recorded. All the neonates were subjected to be estimation of serum bilirubin (Total, Direct and Indirect) and G6PD qualitative detection.

Results: Out of 240 icteric neonates, 192 (80%) were males and 48 (20%) were females. Twenty nine (12.1%) neonates were found to be G6PD deficient. The age of presentation of G6PD deficient neonates was between 2nd to 4th day of life. In G6PD deficient patients, male to female ratio was 8.7:1. Serum total bilirubin level of 10-40 mg/dl was found in these G6PD deficient neonates.

Conclusion: G6PD deficiency is quite high in neonates presenting with Jaundice. The diagnosis is simple and if left undetected may cause serious consequences in situations of oxidant stress.

Key Words: Neonates, Jaundice, G6PD deficiency.

INTRODUCTION

Glucose-6-phosphate dehydrogenase (G6PD) deficiency is an X-linked inherited disorder. A total of 400 million persons are affected by this disorder worldwide most commonly affects people of African, Asian, and Middle-Eastern origin [1-8]. G6PD deficiency is one of the commonest enzyme deficiencies in humans [9, 10]. Homozygotes and heterozygotes can be symptomatic, although the disease typically is more severe in persons who are homozygous for the deficiency[11-13]. G6PD catalyzes the first step in the pentose monophosphate pathway, to produce nicotinamide adenine dinucleotide phosphate hydroxide (NADPH) [3, 10]. NADPH protects cells from oxidative damage. Precipitants of cellular damage include; infection, drugs, and ingestion of fava beans[1, 2]. Red blood cells are at greater risk of damage as these cells lack the cellular organelles such as mitochondria that produce NADPH[2, 3 and 11]. Oxidant damage of hemoglobin leads to the precipitation of hemoglobin, which may be morphologically recognized as Heinz bodies[2].

Infants with G6PD deficiency may have significant hyperbilirubinemia and may require phototherapy or exchange transfusion to prevent kernicterus. Hemolysis is not the main determinant of neonatal jaundice in G6PD-deficient babies[14].

Infants with the severe variant of glucose-6-phosphate dehudrogenase (G6PD) deficiency may develop hyperbilirubinaemia sufficiently severe to cause kernicterus and death, acute haemolysis on exposure to oxidant stress, congenital non-spherocytic haemolytic anaemia and, rarely, increased susceptibility to bacterial infection. In spite of these potential problems, G6PD deficiency is often not included among screening programmes for inherited disorders[15].

G6PD deficient newborns are more prone to develop neonatal jaundice which is, on its own, no more severe than jaundice from other causes[16, 17]. In cases of oxidant stress due to various drugs, bees stings or Fava beans the patient may develop life threatening acute haemolytic crises[18].

It was observed by some of the authors that the frequency of G6PD deficiency is more in icteric patients than in nonicterics. Therefore we evaluated G6PD deficiency in infants presenting with jaundice.

MATERIALS AND METHODS

Study Design: It was hospital based retrospective study.
Study Duration: From March 2011 to June 2012
Study Location: Paediatric department of Ghulam Muhammad Mahar Medical College Hospital

Inclusion Criteria: Total of 240 cases of jaundiced neonates, aging 1st day of life to 30 days were included in the study.

Exclusion Criteria: Premature Jaundiced neonates, those with neonatal sepsis and neonates with direct hyperbilirubinemia were excluded from the study.

Assays: After taking detailed history and clinical examination, all the jaundiced neonates were subjected to the estimation of bilirubin (Total, Direct and Indirect) and G6PD qualitative test. The test was performed by using the BinaxNow G6PD test provided by Binax/Inverness medical USA.
The BinaxNow G6PD test is an in vitro enzyme chromatographic test for the qualitative detection of G6PD enzyme activity in human venous whole blood. The BinaxNow G6PD test is a visual screening test used for differentiating normal from deficient G6PD activity levels in whole blood.

Principle of BinaxNow G6PD test: The BinaxNow G6PD test device consists of a lateral flow test strip comprised of a white sample pad and a reaction pad, which is located at the top of the strip. The reaction pad contains the reagents necessary for the G6PD enzymatic reaction and the subsequent reduction of a nitro blue tetrazolium dye into its concomitant blue formazan product. The resulting color change on the strip indicates enough G6PD activity is present to presume the sample is not deficient. For a deficient sample, there is no color change in the top half of the reaction pad.

RESULTS

The total number of patients who were jaundiced and having G6PD test performed were 240. There were 192 (80%) male and 48 (20%) female. Out of these 240 icteric neonates 29 (12.1%) were G6PD deficient. In G6PD deficient patients male to female ratio was 8.7:1 (Table 1)

Table No. 1: Frequency of G6PD deficiency

Group	Number	%age	Male	Female	M:F ratio
Total Patients	240	100%	192	48	4:1
G6PD Normal	211	87.9%	166	45	3.7:1
G6PD Deficient	29	12.1%	26	03	8.7:1

Majority of neonates having G6PD deficiency presented with jaundice between 2-4 days of life (Table 2).

Table No. 2: Age of presentation in G6PD neonates (n=29)

Age at presentation	Number of cases	%age
Up to 24 hours	02	6.9%
2nd day to 4th day of age	22	75.9%
After 4th day of life	05	17.2%
Total	29	100%

Serum total bilirubin range from 10mg/dl to 40mg/dl in these G6PD deficient neonates. Out of 29 G6PD deficient neonates, only 3 (10%) developed severe hyper bilirubinemia (serum total bilirubin level of > 20 mg/dl) (Table 3)

Table No.3: Serum Bilirubin total in G6PD deficient babies (n=29)

Grade	S. Bilirubin total	No. of patients	%age
Mild to moderate	<20 mg/dl	26	90%
Severe	>20 mg/dl	3	10%

DISCUSSION

The frequency of G6PD deficiency in this study was 12.1%. This figure correlates with other local studies like Khan et al[19] in 2002 reported G6PD deficiency in 13% at Peshawar, Imran et al[20] reported as 12%, Parveen et al[21] as 12.1% and Khattak et al[22] observed G6PD deficiency in 12% patients.
The results are, however, in contrast with other local studies, like Alvi et al[23] in 2006 observed 10% at Lahore, Rehman H et al[24] showed 8.2% and Rashid et al[25] in 2005 as 6%.
This is also a relatively high occurrence rate as compared to studies from India[26] (7.5%), Saudi Arabia[7] (2%) and Tehran[27] (2.1%). On the other hand, this frequency of G6PD deficiency in the jaundiced neonates is quite lower than the frequency reported from Thailand[28] (25.5%), China[29] (18.42%) and Nigeria[30] (38%). These variations may be due to demographic difference in the genetic make-up of societies. Socio-cultural differences, frequency of carrier individuals, sample size, method used for G6PD enzyme estimation and detection rate.
Majority of neonates with G6PD deficiency in one study presented with neonatal jaundice between 2nd and 4th day of life. This is supported by other similar studies conducted locally and internationally[30-32].
In our study in G6PD deficient patients, male to female ratio was 8.7:1. According to Khattak et al[22] (2006) the male to female ratio was 7:1 and another study by Khan et al[19] showed male to female ratio as 7.6:1. Majority (90%) of neonates with G6PD deficiency in our study

showed serum total bilirubin level below 20 mg/dl, Khan et al[19] also reported mean serum bilirubin levels as 18.7 mg/dl in G6PD deficient neonates.

CONCLUSION

As obvious from this study as well as other studies quoted, G6PD deficiency is quite high in neonates presenting with jaundice.

Limitations: The limitations of this study include, neonates were screened in a single centre and the study population was not large enough to draw a firm conclusion regarding the incidence in the community. However, this study gives an indication that G6PD deficiency represents a health problem in the Sukkur region and provides evidence for feasibility and justification for universal newborn screening in this area.

Recommendations: Early detection of G6PD deficiency should be done through mass screening programmes. It can avoid the incidence of permanent brain damage resulting from hyperbilirubineuria with subsequent kernicterus and death. The mass screening for G6PD would be invaluable in identifying babies at the time of their birth. This can easily be achieved by saving cord blood and performing the test on the sample without causing extra discomfort to infant. The identification of deficient babies would aid the health workers to counsel parents in avoiding exposure of their babies and themselves (if lactating) to oxidizing agents, to watch for jaundice and to bring jaundiced infant to hospital at their earliest. The mothers can also be advised to check for G6PD levels in other children.

For the screening program to be effective doctors, nurses, lady health workers and dais should be trained and home deliveries should be monitored.

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