

Screening of Neonates for Glucose-6 -Phosphate Dehydrogenase Deficiency

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Abstract

Context: Glucose - 6 - phosphate dehydrogenase (G-6-PD) is an enzyme that participates in the first step of Hexose monophosphate pathway of glucose metabolism. Deficiency of this enzyme is most common genetic disorder in India. Its deficiency causes hemolysis which eventually lead to acute hemolytic anemia and neonatal jaundice. The hemolysis in these deficient patients are triggered by bacterial, viral infections, drugs like aspirin and chloroquine, foods like fava beans. Period from after birth to first 4 weeks is the neonatal period and the child is called a neonate. There is no cure for G-6-PD. Early detection and prevention of hemolytic episodes by avoiding the triggers is the only cure for this deficiency. **Aim:** To screen the neonates for glucose -6-Phosphate dehydrogenase deficiency so as to prevent the morbidity and mortality occurring due to this deficiency. **Material and Methods:** Hundred neonatal blood sample were obtained from the Labour room, of the Hospital. The samples were analysed by Dye Decolourization method. **Statistical Analysis:** Pie Diagram is used to show the number of affected neonates found in screening. **Results:** Of the hundred samples, one was found to be G-6- PD deficient and two were found to be G-6-PD deficiency carriers. **Conclusion:** G-6-PD deficiency testing should be done as a screening procedure in the whole country as early diagnosis and prevention is the only way of treating this deficiency disorder and avoiding its complications.

Keywords: Glucose - 6 - phosphate dehydrogenase (G-6-PD); Deficiency; Neonate; Hemolysis; Screening.

Introduction

Glucose-6-phosphate dehydrogenase (G-6-PD) deficiency is most common of all clinically significant enzyme defects.[1] This deficiency is X-linked which occurs due to mutations in coding region of G-6-PD gene. Almost all of the 140 different mutations known are *single missense point* mutations. Exact incidence not known but several studies have reported incidence between 1-20%.[2] G-6-PD catalyzes first step in HMP shunt. NADPH produced keeps Glutathione in its reduced state which

protects red blood cells from oxidative damage; [3] so in G-6-PD deficiency reduced glutathione will not be formed and red blood cells will not be protected from oxidative stress which will lead to haemolytic crisis on exposure to different triggers. Triggers for haemolytic crisis: Infections (viral & bacterial), Drugs (Aspirin & chloroquine), Chemicals (naphthalene[4]) & certain foods(Fava beans[3]).

Early detection and prevention of haemolytic episodes by avoiding the triggers in newborn babies is the only cure.

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Aim

To screen the neonates for glucose-6-phosphate dehydrogenase deficiency so as to prevent the morbidity and mortality occurring due to this deficiency.

Material and Methods

Site of Collection of Blood Sample

From the Labour room of Hospital, hundred neonatal cord blood samples were collected in ethylene diamine tetracetic acid (EDTA) bulb. These samples were then analysed in the laboratory by the Dye decolorization method (Qualitative).

Principle

G-6-PD present in red cell haemolysate act on glucose-6-phosphate and reduces NADP to NADPH which with the help of PMS reduces blue coloured 2, 6 Dichlorophenol Indophenol into colorless form. Rate of decolorization is proportional to enzyme activity.

Reaction can be represented as:

1. Glucose-6-phosphate + NADP \longrightarrow 6-Phosphogluconic acid + NADPH.
2. NADPH + 2,6-Dichlorophenolindophenol \longrightarrow NADP + Reduced 2,6-

Dichlorophenolindophenol.

Interpretation

Time taken for colour change from initial deep blue to reddish purple is noted.

- Follow up to a maximum of 6 hours with 30 minute interval.
- Decolorization Time:
 1. Normal subjects : 30 -60 minutes.
 2. G-6-PD deficient subjects: 140 min - 24 hrs.
 3. G-6-PD carriers: 90 min.

Observation & Results

Total number of samples collected and examined = 100.

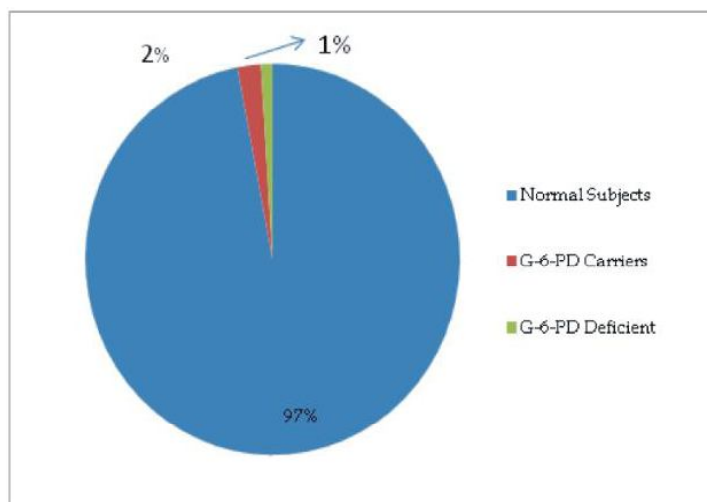
Out of 100 samples: 1 sample was found to be G-6-PD deficient (male newborn).

2 samples were found to be G-6-PD carriers (female newborn)

97 samples had normal G-6-PD levels.

Discussion

The gene for G-6-PD deficiency is located on terminal region of the long arm of the X-chromosome at position q28. It is a X-linked condition which usually manifest in males carrying mutant gene. The phenotype in



females may be normal homozygote, G-6-PD deficient homozygote or heterozygous.[5,6] Random X -chromosome inactivation result in two RBC populations in female heterozygotes. [7] Several variants of G-6-PD deficiency were encountered in different regions of India during extensive screening programmes. Different groups of researchers have evaluated the scope of G-6-PD deficiency in different regions of country. WHO has quoted the incidence of G-6-PD deficiency in India from 0.2-19%. In other studies e.g; Deshmukh *et al* study and Nishi Madan *et al* study incidence of G-6-PD deficiency was 6% and 1.37% respectively.[8] Various incidences of G-6-PD deficiency in various subjects may be due to differences in Screening test solution and associated incidence of Malaria and Haemoglobinopathies in various regions.[9] Calculating the sensitivity and specificity of this screening method is out of scope of this study, but based on previous reports the neonatal cord blood G-6-PD deficiency screening had acceptable sensitivity(85.7) and high specificity(98.1%).[10]

Conclusion

The early characterization of G-6-PD deficiency provides an etiological diagnosis for neonatal jaundice, as well as the opportunity to give the newborn's family information concerning the prevention of complications and mortality associated with G-6-PD deficiency. Considering its high incidence in our country, a neonatal screening programme for G-6-PD deficiency should therefore be taken into account in the National Health Schemes.

References

1. World Health Organization. Report of the Working Group - Glucose-6-phosphate dehydrogenase Deficiency. *Bull World Health Organ.* 1989; 67: 601-611.
2. Handa R, Singh N, Chander J. Erythrocytic G-6-PD deficiency in Bania community in Punjab. *J Associated physicians India.* 1992; 40(1): 13-14.
3. DK Dennery PA, Selden DS, Stevenson. Neonatal Hyperbilirubinemia. *N Eng J Med.* 2001; 344:581-590.
4. Cappelini MD, Fiorelli G. G-6-PD deficiency. *Lancet.* 2008; 371(9606): 64-74.
5. Beutler E. The genetics of Glucose-6-phosphate dehydrogenase Deficiency. *Semin Hematology.* 1990; 27: 137-164.
6. Luzzato L. Glucose-6-phosphate dehydrogenase Deficiency and hemolytic anemia. In Nathan DEC, Oski FA, eds. *Hematology of Infancy and childhood.* Philadelphia, PA: WB Saunders Co.; 1993, 674-695.
7. Beutler E, Yeh M, Fairbanks VF. The normal human female as a mosaic of X chromosome activity. Studies using the gene for G-6-PD deficiency as a marker. *Proc Natl Acad Sci USA.* 1969; 48: 9-16.
8. World Health Organization. Standardization of procedures for the study of G-6-PD deficiency. Geneva: 1967.
9. Nishi Madan, Talwar n, Maheshwari A, Sood SK. Incidence of G-6-PD deficiency in a hospital population of delhi. *Indian J Med Res.* 1981; 73: 425-429.
10. Kher M, Solanki BR, Parande C, Junnarkar RV. G-6-PD deficiency at Nagpur and in surrounding areas. *Indian Medical Gazette.* 1967;