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Screening for anaemia in children's of age group 6 months to 5 years using palmar pallor and digital hemoglobinometer by finger prick method

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Abstract---Background: Screening for anemia in children's under five years of age using palmar pallor and Digital hemoglobinometer by finger prick method. Methodology: A total of 200 subjects were enrolled from outpatient department of ACS Medical College. Children of the age group 6 months to 5 years were considered in the study. Out of the total, 84 were boys and 116 were girls. Blood samples were collected from the subjects using a finger prick method and measured using Digital Haemoglobinometer. Data was collected and result was analysed using SPSS software. Results: Out of the 200 children examined, 91 (45%) were found to be no palmar pallor, 102 (51%) were some palmar pallor and 7 (4%) were severe anemia (severe palmar pallor), Whereas using Digital Haemoglobinometer, 64 (34%) no anemia (Hb \geq 11 mg/dL), 115 (57%) children's were found to be anemic (Hb <11 mg/dL) and 18 (9%) were severe anemia with haemoglobin levels <7 mg/dL. The age of the children ranged from 6 months to 5 years with mean age of 3 years. Conclusion: Digital Hemoglobinometer (DH) can significantly reduce misdiagnosis of anaemia compared with clinical assessment alone.

Keywords---anaemia, children, digital hemoglobinometer, palmar pallor.

Introduction

Anemia is a common disorder, affecting a third of the world population most of whom live in resource poor countries. ¹ Although diagnosis of anemia can easily be done by traditional Sahli's haemoglobinometer, or more recently by electronic cell counters, yet physicians and healthcare workers try to detect anaemia by looking at conjunctival, tongue, palmar, pallor or nailbed pallor. ² Often physicians use clinical assessment of pallor as a screening test, and order hemoglobin test if one or more sites suggest presence of pallor. This is especially true of crowded outpatients' departments of public hospitals, where most doctors either believe that accurate estimation of hemoglobin is either not worth the time and effort needed to obtain it or do not have access to facilities to measure hemoglobin.

Iron deficiency anaemia has major health and economic consequences. In adults, it leads to a substantial loss of productivity. During pregnancy, it is associated with low birth weight, preterm labor, infant, and maternal mortality. ³ Anemia in children may lead to low cognition level, faltered growth and development, weakened immune system, a decline in school performance and reduced ability to live a productive adult life. Severe cases, if not detected and treated appropriately may even result in fatality. ⁴

The Integrated Management of Neonatal and Childhood Illness (IMNCI) recommends the use of simple clinical sign like palmar pallor to diagnose anemia. ⁵ This recommendation was based mainly on the studies where purpose was to identify anemia with haemoglobin Hb <11mg/dL and severe anemia with Hb <7mg/dL. ⁶ Validity of anemia detection may differ in different settings due to differences in the prevalence of anemia rates, different causes of anemia, and many other factors like different skin pigmentation and so forth that can influence interpretation of palmar pallor. The data about the validity of palmar pallor assessment for detection of anemia from different settings may help improve global understanding about the method of detection. Hence, this study was conducted to study the screening for anaemia under 5 years of age children presenting with palmer pallor using Digital hemoglobinometer by finger prick method.

Materials & Methods

The study was conducted from April 2022 to July 2022 at A.C.S. medical college and hospital, velappanchavadi, Chennai, Tamil Nadu, India. Ethics approval was obtained from the Institutional ethics committee. A total of 200 subjects were enrolled. Children of the age group 6 months to 5 years were considered in the study. Out of the total, 84 were boys and 116 were girls, children's with minor illness such as fever of short duration, cough, viral warts, mild impetigo, etc., were included in the study. Children's having icterus, shock, edema, on treatment for anemia, recently investigated for anemia, children's with known blood disorders

like sickle cell disease, leukemia, thalassemia, haemolytic anemia etc., children's with local application (dye on palms eg. Henna) were excluded from the study.

After obtaining informed consent from parents/Guardian a drop of blood from the cleaned test site (finger tip) is obtained by finger prick method and collected using capillary transfer tube. Blood from the capillary tube is applied to the specimen application area on the test strip. Haemoglobin and the haematocrit values will be displayed in digital haemoglobinometer following 4 to 15 seconds of sample application. Data was collected and the result was analysed using SPSS software.

Children's subjected to anemia screening using invasive digital haemoglobinometer were in parallel screened for anemia using palmar pallor. Children's were examined under good day light, palmar surface and creases were compared with examiners palm to detect pallor on palms. Pallor was defined as "some palmar pallor" if the child's palmar surface was pale and "severe palmar pallor" if the palmar surface was very pale or so pale that it looked white. Data from invasive digital haemoglobinometer and palmar surface reading was collected and result was analysed using SPSS software. Children's with Hb level <11mg/dL using invasive digital haemoglobinometer and children's with some palmar pallor and severe palmar pallor were subjected to anemia workup with complete blood count using Hematology analyzer and smear study.

Mission hemoglobinometer

This is a portable battery- operated POC device that uses disposable test strips, manufactured by ACON biotech. It detects azide -methemoglobin level at a wavelength of 525 nm using reflectance photometry. Both capillary and venous blood can be used and the test results are displayed on a digital display panel.



Figure 1: Mission hemoglobinometer

Results

Out of the 200 children examined, 84(44%) were boys and 116 (58%) were girls. The age of the children ranged from 6 months to 5 years with mean age of 3 years. The mean haemoglobin level was 8.0 mg/dL ranging from 4 to 11 mg/dL. Among the children examined, 64 (34%) no anemia (Hb \geq 11 mg/dL), 115 (57%) children's were found to be anemic (Hb <11 mg/dL) and 18 (9%) were severe anemia with haemoglobin levels <7 mg/dL

Table 1: Anemia and haemoglobin levels

| Classification | Haemoglobin levels | Number of subjects (%) |
|----------------|--------------------|------------------------|
| No anemia | \geq 11mg/dL | 64 (34%) |
| Anemia | <11mg/dL | 115 (57%) |
| Severe anemia | <7 mg/dL | 18 (9%) |

Table 2: Palmar pallor classification

| Classification | Total (n = 200) |
|----------------|-----------------|
| No pallor | 91 (45%) |
| Some pallor | 102 (51%) |
| Severe pallor | 7 (4%) |

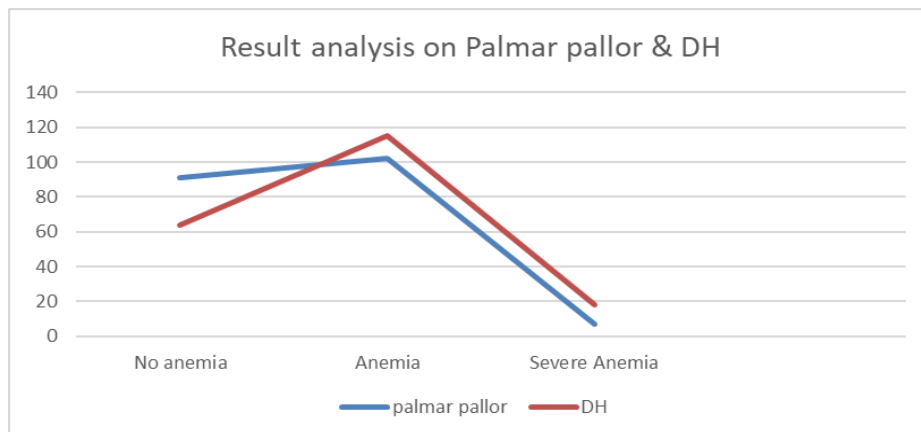


Figure 2: Comparison chart on palmar pallor and DH

The subjects were categorised into no pallor, some pallor and severe pallor. The children with no pallor were 95 whereas the number of children with severe pallor were 9.

Discussion

Millions of children are affected by anemia worldwide and more than half of them due to iron deficiency. Moreover, iron deficiency sets in much before the appearance of frank anemia. Thus, the prevalence of iron deficiency is estimated to be two times higher than that of anemia.^{3,7} Owing to the deficiency in laboratory methods, most patients with anemia present with complications.

Therefore, screening is vital for early diagnosis. HemoCue is by far the most widely used POC device for hemoglobin measurement. Neufeld et al. studied the validity of HemoCue using capillary blood among the adult population of Mexico and compared it with CellDyn as a gold standard method using venous blood.⁸ In our study, Out of the 200 children examined, 84 (44%) were boys and 116 (58%) were girls. The age of the children ranged from 6 months to 5 years with mean age of 3 years. The mean haemoglobin level was 8.0 mg/dL ranging from 4 to 11 mg/dL. Among the children examined, 64 (34%) no anemia (Hb \geq 11 mg/dL), 115 (57%) children's were found to be anemic (Hb <11 mg/dL) and 18 (9%) were severe anemia with haemoglobin levels <7 mg/dL.

A study by Aggarwal AK et al, studied the validity and interobserver agreement of palmar pallor examination to diagnose anemia in children under 5 years of age in India. In a village in Northern India, hemoglobin estimation was done for 80 children using cyanomethemoglobin method. Two examiners, a physician and a health worker, trained in IMNCI evaluated children for palmar pallor. Sensitivity and specificity and Kappa statistics were calculated. Health worker diagnosed palmar pallor with sensitivity of 30.8–42.8% and specificity of 70–89%. Similar figures for doctor were 40–47% and 60–66%, respectively. Kappa agreement between a health worker and a physician was 0.48 (95% CI = 0.298–0.666) and then increased to 0.51 when categories of severe pallor and mild pallor were merged. While using palmar pallor as clinical sign for anaemia, children with no pallor should also be followed up closely for possible detection of missed cases during follow-up.⁹

Digital Hemoglobinometer is a device in response to the need for a “simple, cheap, and robust device to measure hemoglobin by health workers outside the laboratory.” Digital Hemoglobinometer (HCG TRIESTA laboratory) is palm-sized nanobioelectronic device with self-calibration sensors that takes <60 s for each hemoglobin estimation. The Digital Hemoglobinometer System is based on the principle of reflectance photometry. Capillary, venous, or arterial whole-blood sample can be used for the hemoglobin estimation with the requirement of only 8 ml of blood sample. It has a rechargeable battery of 3.6 V that makes its suitable for usage in places with poor electricity supply. This device can be used in temperature range of 5–45°C. The device can store up to 1000 results for date and time, and easy record maintenance is possible using mobile application. The range of measurement is 0–25 mg/dl.¹⁰ In our study, the subjects were categorised into no pallor, some pallor and severe pallor. The children with no pallor were 28 whereas the number of children with severe pallor were 4.

Rechner et al., among neonates;¹¹ Lardi et al., among patients undergoing aortic surgery in the theater;¹² and Radtke et al., among blood donors,¹³ also showed the utility of Digital Hemoglobinometer comparable to gold standard. Whereas, studies conducted by Bhaskaram et al., among apparently healthy children of 1–6 years do not support the use of the HemoCue in their various study populations.

Conclusion

Invasive Digital Hemoglobinometer have high diagnostic accuracy compared with clinical assessment (palmar pallor). DH also have few other advantages like time consumption (in fractions), portable, low cost, can be implemented in mass screening programmes and outpatient Department of various setups. DH also proven with high sensitivity in detection and accuracy.

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