Original research article

A case-control study to evaluate the precision of pallor in the diagnosis of anemia

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Abstract

Background: The diagnosis and management of anemia largely depends on clinical assessment for pallor. Pallor is explained as decreased colour of the skin and mucous membranes.

Aim: the aim of this study was to evaluate the accuracy of pallor in the diagnosis of anemia in children aged 6 months to 5 years.

Material and methods: A case control study was conducted in the Department of Paediatrics, Nalanda Medical College and Hospital, Patna, Bihar, India for 15 Months . 200 children in the age group of 6 months to 5 years were included in the study. Pallor was assessed in four sites namely conjunctiva, tongue, nail bed and palm under day light. After history and physical examination, blood sample was taken for haemoglobin estimation and other relevant investigations. All samples were collected within 3 hours of physical examination. Anemia was diagnosed according to WHO criterion (Hb<11 g/dl in 6 months- 5 years).[7] Anemia was divided into mild (Hb: 10-10.99 g/dl), moderate (Hb: 7-9.99 g/dl) and severe (Hb: <7g/dl).

Results: Two hundred patients were included in the study of which 100 were assigned as cases (pallor-study group) and 100 as controls (no pallor group). Both the groups were matched in terms of age and gender. There were 72 male and 28 females in pallor group whereas 64 and 36 in non pallor group. Age distribution as<1 year, 1-3 years and 3-5 years in 35%, 28% and 37% respectively in pallor group. In control group these were 25%, 44% and 31%. Out of 100 patients with pallor, 80 had anemia, whereas non-pallor control group had only 25 anemics. Sensitivity and specificity of pallor for anemia detection were 74.6% and 78.4% respectively. Positive predictive value and negative predictive values stand at 81.39% and 69.77% respectively. The mean hemoglobin in pallor group was 9.87±2.7 g/dl and in non-pallor group it was 11.95±1.12 g/dl. In the study group (with pallor), pallor was identified in 70 (70%) in conjunctiva, 55 (55%) in tongue, 74(74%) in nailbed and 84 (84%) in palm. 52 cases had pallor in all 4 sites. Maximum sensitivity, specificity and predictive values were found for palmar pallor. Tongue turned out to be least sensitive for identifying pallor. All the four sites were found to have statistically significant correlation with anemia (p value<0.001). Sensitivity of pallor in all the four sites was found to have positive correlation with severity of anemia. To detect severe anemia sensitivity of conjunctival

pallor was 100%. Iron deficiency anemia was the etiology in 80% of cases. Hemolytic anemia and leukemia in 2% each, chronic diseases and malaria in 2%, others were the causes in 10%. Other causes included megaloblastic anemia, hypothyroidism, autoimmune hepatitis, CMV infection and acute bleeding. Pallor at each site was tried to correlate with etiology . However, no statistically significant correlation was found.

Conclusion: Pallor was found to be very useful in detecting anemia, also it had more specific than sensitive value. The best predictor site for pallor for diagnosing anemia was palm.

Keywords: Anemia, Children, Hemoglobin, Pallor.

Introduction

Anemia is a major public health problem in India with almost 7 in 10 children aged 6–59 months being anemic.[1] The Integrated Management of Childhood Illness (IMCI) recommends the use of simple clinical sign like palmar pallor to diagnose anemia.[2] This recommendation was based mainly on the studies where purpose was to identify severe anemia with hemoglobin (Hb) < 5 grams and moderate anemia with Hb 5- <8 grams.[3] 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. Iron-deficiency anemia is a global health problems and a common medical condition seen in everyday clinical practice. Although the prevalence of iron-deficiency anemia has recently declined, iron deficiency continues to be the top-ranking cause of anemia worldwide, and iron-deficiency anemia has a substantial effect on the lives of young children in both low-income and developed countrie.[4]Most of the cases are of the iron deficiency type and many factors are responsible for this.

 1. Diet
2. Low birth weight
3. Various infections
4. Bowel disorders interfering with the dietary intake and intestinal absorption of iron
5. Haemolytic anemia like Thalassemia and other hemoglobinopathies.

The integrated Management of Childhood Illness (IMCI) strategy developed by the WHO recommends the use of palmar pallor as the initial screening tool.[5] Anaemia is related to impaired physical growth and mentaldevelopment.[6] It is also associated to a higher risk of infant and child mortality, particularly when it co-exists with malnutrition and other risk factors.6 It is therefore important to make a timely and accurate diagnosis and initiate an early intervention to reduce the negative impact of anaemia. The laboratory diagnosis of anaemia through any of several techniques is not widely available and its cost is often unaffordable in poor areas of the world. Even while describing pallor, vague terms like mild, probable etc. are used. There are hardly any studies assessing the accuracy of pallor for detection of anemia in Indian pediatric population. This study was undertaken with the objectives of evaluating the usefulness of pallor in four anatomical sites to detect anemia, to correlate pallor with grades of anemia and with the etiology of anemia.

Material and methods

A case control study was conducted in the Department of Paediatrics, Nalanda Medical College and Hospital, Patna, Bihar, India for 15 Months. after taking the approval of the protocol review committee and institutional ethics committee.

Methodology

Purposive sampling technique was used. Parental consent was obtained from all the study participants. 200 children in the age group of 6 months to 5 years were included in the study. Children were excluded if they did not meet age criteria, those with shock and if they were

already diagnosed with anemia. Detailed history and examination were done. History was collected from the mothers as well as child. Pallor was assessed in four sites namely conjunctiva, tongue, nail bed and palm under day light. Conjunctiva was examined by everting the lower palpebral conjunctiva. Pale conjunctiva is those with very less or no evidence of red color on the anterior rim, which matched the fleshy color of the posterior aspect of palpebral conjunctiva. Tongue was examined on the dorsal surface. Nailbeds without pressing was looked for nailbed pallor. Palmar surface and creases were compared with examiner's palm to detect pallor. Children with pallor at any one site were taken as study group (n=100) and without pallor at all four sites as controls (n=100). After history and physical examination, blood sample was taken for haemoglobin estimation and other relevant investigations. All samples were collected within 3 hours of physical examination. Anemia was diagnosed according to WHO criterion (Hb<11 g/dl in 6 months- 5 years).[7] Anemia was divided into mild (Hb: 10-10.99 g/dl), moderate (Hb: 7-9.99 g/dl) and severe (Hb: <7g/dl).

Results

Two hundred patients were included in the study of which 100 were assigned as cases (pallor-study group) and 100 as controls (no pallor group). Both the groups were matched in terms of age and gender. There were 72 male and 28 females in pallor group whereas 64 and 36 in non pallor group. Age distribution as<1 year, 1-3 years and 3-5 years in 35%, 28% and 37% respectively in pallor group. In control group these were 25%, 44% and 31%.

Out of 100 patients with pallor, 80 had anemia, whereas non-pallor control group had only 25 anemics. Sensitivity and specificity of pallor for anemia detection were 74.6% and 78.4% respectively. Positive predictive value and negative predictive values stand at 81.39% and 69.77% respectively. The mean hemoglobin in pallor group was 9.87±2.7 g/dl and in non-pallor group it was 11.95±1.12 g/dl.

Table 1: Relation of anemia with pallor at all sites.

	No anemia	Mild anemia	Moderate anemia	Severe anemia	
	N (%)	N (%)	N (%)	N (%)	P value
Conjunctiva (n=70)	9 (12.86)	11 (15.71)	37 (52.86)	14 (20)	<0.001
Tongue (n=55)	7(12.72)	9(16.36)	29 (52.73)	10 (18.18)	<0.001
Nail bed (n=74)	10 (13.51)	18 (24.32)	33 (44.59)	13 (17.56)	<0.001
Palm (n=84)	8 (9.52)	23 (27.38)	41 (48.80)	12 (14.28)	<0.001

In the study group (with pallor), pallor was identified in 70 (70%) in conjunctiva, 55 (55%) in tongue, 74(74%) in nailbed and 84 (84%) in palm. 52 cases had pallor in all 4 sites. Maximum sensitivity, specificity and predictive values were found for palmar pallor. Tongue turned out to be least sensitive for identifying pallor.

Pallor was correlated with grades of anemia in all four sites (Table 1). All the four sites were found to have statistically significant correlation with anemia (p value<0.001). Sensitivity of pallor in all the four sites was found to have positive correlation with severity of anemia. To detect severe anemia sensitivity of conjunctival pallor was 100% (Table 2).

Iron deficiency anemia was the etiology in 80% of cases. Hemolytic anemia and leukemia in 2% each, chronic diseases and malaria in 2%, others were the causes in 10%. Other causes included megaloblastic anemia, hypothyroidism, autoimmune hepatitis, CMV infection and acute bleeding. Pallor at each site was tried to correlate with etiology (Table 3). However, no statistically significant correlation was found.

Table 2: Sensitivity of each site in detecting grades of anemia

Sites	Anemia		
	Mild (%)	Moderate (%)	Severe (%)
Conjunctiva	21	76	100
Tongue	19	61	88
Nailbed	34	68	93
Palm	42	81	93

Table 3: Association of site of pallor with etiology

Sites	Iron def	Hemolytic anemia	Chronic diseases	Leukemia	Malaria	Others	P value
Conjunctiva (n=70)	69	2	3	2	3	10	0.236
Tongue (n=55)	58	2	2	2	2	10	0.14
Nail bed (n=74)	71	2	2	2	2	9	0.125
Palm (n=84)	85	2	3	2	3	11	0.436

Table 4: Sensitivity, Specificity, Positive Predictive and Negative Predictive

0.00%	Sensitivity	Specificity	Positive Predictive	Negative Predictive
Conjunctiva	56.25%	87%	86%	62.50%
Tongue	45.77%	93.75%	86.98%	58.23%
Nailbed	58.12%	87.85%	86.23%	62.87%
Palm	65.88%	90.85%	90.15%	70.33%

Discussion

Anemia is common in this age group especially iron deficiency because of increased demands of iron and reduced oral intake. Bad feeding habits, especially during the weaning period, results in replacement of breast milk by foods that are poor in iron and other nutrients, including vitamin B12 and folic acid which exacerbate the problem.[8] In 2012 a study on anemia was conducted in rural Maharashtra by Kumar et al and observed that maximum anemia cases were in age group 1-5 years.[9] According to NFHS-III survey, almost 7 in 10 children aged 6-59 months are anemic, including 40 percent who are moderately anemic and 3 percent who are severely anemic.[10] The NFHS–IV survey showed some improvement with 58% anemics compared to earlier 70%.[11,12] In our study among 200 children, Age distribution as<1 year, 1-3 years and 3-5 years in 35%, 28% and 37% respectively in pallor group. No statistically significant correlation was found with age and pallor although increased pallor occurrence was observed in <3years. Pallor and anemia were found to be more in males. Difference may be because of different growth patterns resulting in increased demand. Many studies found no association between anemia and gender whereas other authors reported that anemia is more common in boys.[8,13-15] A study in rural Maharashtra found that anemia prevalence was more in males.[9] Out of 100 children with pallor, 80 had anemia. Like most of the studies pallor was strongly associated with anemia.[9,16] Sensitivity of pallor for anemia is found to be 74.6% and specificity 78.4%. Pallor was found to be more specific than sensitive. Most of the studies indicate that pallor at each site is associated with significantly lower hemoglobin concentration. The relative performance of different anatomical studies was not consistent among studies, sensitivity varied from 81% to 29% in different population.

In the study group (with pallor), pallor was identified in 70 (70%) in conjunctiva, 55 (55%) in tongue, 74(74%) in nailbed and 84 (84%) in palm. All four sites had statistical correlation with anemia.

Palmar pallor was found to be the most sensitive and specific site for pallor followed by nailbed. Sensitivity was the least for tongue pallor and specificity wasthe least for conjunctiva and nailbed. Over all pallor was found to be more specific test rather than sensitive. Specificity ranged from 87-93.75%, sensitivity 45.77-65.88%.

A meta-analysis of 11 studies was done by Chalco et al concluded that none of the clinical signs were highly accurate for the diagnosis of anemia, but pallor was found to be more specific than sensitive.[17] Pooled estimates of sensitivity ranged from 29.2 to 80.9% and estimates of pooled specificity varied from 67.7 to 90.8%. They concluded that that pallor correlates well with the Hb estimation as only 7.5% of the anemic children were not detected clinically. One study reported sensitivity, specificity, and positive predictive value (PPV) of palmar pallor as an indicator for anemia at 50%, 93%, and 92%, respectively which is close to the values observed in present study.[18]

Conjunctival pallor was missed in many patients because of the congestion associated with febrile illness. Also because of the congestion associated with crying while palpating. Tongue also will be congested in many infections, which probably can be attributed to low positive predictive value. Pigmentation largely affects sensitivity of pallor sites especially palmar pallor. Because of racially homogenous sample, that variation was not studied by us. There is variation in looking for palmar pallor. It is recommended to look at palmar creases for pallor. In this study palmar surface and creases was compared with examiner's palm to look for pallor. In one Bangladesh study, the site of the palmar pallor was assessed over the thenar eminence without extending the fingers and found that palmar pallor did not work as well as conjunctival pallor for the detection for severe or some anemia.[19] In clinical approach many times pallor is graded as two or three. Such grading of pallor into 2 or 3 was done in some studies.[16,19,20]

Pallor at each site was correlated with various etiologies like iron deficiency, malaria, leukemia, thalassemia. However, no significant correlation was found with any etiology. Few studies have found correlation with malaria and thalassemia. Study by Kalter and associates reported that anemia was more easily diagnosed in children with malaria.[19] Yalcin and colleagues reported that pallor of the conjunctiva is the most accurate in the cases of beta thalassemia with good sensitivity and specificity regardless of age and gender.[21]Another study concluded that palmar pallor is easy to recognize and might be helpful for health workers as an indicator not only for anemia but also for malarial parasitaemia whereas this clinical sign cannot replace thorough laboratory diagnostics.[22] A study was done in Kenya to correlate palmar pallor with parasitic infestations and to establish palmar pallor as an indicator of anthelminthic treatment. They concluded that palmar pallor is associated with anemia but not with intestinal helminth infection.[18]

Conclusion

Pallor was found to be very useful in detecting anemia, also it had more specific than sensitive value. The best predictor site for pallor for diagnosing anemia was palm.

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