

NEW INVESTIGATORS



Original Research

Haematological parameters of blood donors with erythrocytosis

Paramètres hématologiques des donneurs de sang souffrant d'érythrocytose



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ABSTRACT

Background: It is mandatory for all blood donors to have their haemoglobin values tested before blood donation. High haemoglobin levels may indicate an underlying hidden pathological condition.

Aim: Our aim was to assess the frequency of erythrocytosis in blood donors and its correlation with other haematological parameters.

Methodology: All blood donors found to have high pre-donation haemoglobin levels during a nine-month period were included. Full blood counts and peripheral blood films were performed in addition to pre-donation screening, and all data were analysed using SPSS software version 23.0.

Results: The prevalence of blood donors with erythrocytosis was 7.8% (n=175). The range of haemoglobin for blood donors with erythrocytosis was between 13.9 and 19.1 g/dL (mean 16.0 g/dL). The highest haemoglobin level recorded for male and female

RÉSUMÉ

Contexte: Il est impératif que tous les donneurs de sang fassent vérifier leurs valeurs d'hémoglobine avant le don de sang. Des taux élevés d'hémoglobine peuvent indiquer une pathologie cachée sous-jacente.

Buts: Notre objectif était d'évaluer la fréquence d'érythrocytose chez les donneurs de sang et sa corrélation avec d'autres paramètres hématologiques.

Méthodes: Tous les donneurs de sang dont les taux d'hémoglobine étaient élevés avant le don au cours d'une période de neuf mois ont été inclus. Des numérations sanguines complètes et des frottis de sang périphérique ont été réalisés en plus du dépistage avant le don et toutes les données ont été analysées à l'aide du logiciel SPSS version 23.0.

Résultats: La prévalence des donneurs de sang souffrant d'érythrocytose était de 7,8% (n = 175). La plage d'hémoglobine pour les donneurs de sang présentant une érythrocytose était comprise entre

donors was 19.1 g/dL and 16.2 g/dL respectively. Positive correlation was noted between the number of donations and haemoglobin among blood donors.

Conclusion: There were significant variations in the haematological parameters in blood donors with erythrocytosis. Erythrocytosis in blood donors may indicate an underlying disease state. Donors identified with erythrocytosis should be referred for appropriate investigations.

13,9 et 19,1 g / dL (moyenne de 16,0 g / dL). Le taux d'hémoglobine le plus élevé enregistré chez les donneurs de sexe masculin et de sexe féminin était de 19,1 g / dL et 16,2 g / dL respectivement. Une corrélation positive a été notée entre le nombre de dons et **Conclusion:** Il y avait des variations significatives dans les paramètres hématologiques chez les donneurs de sang atteints d'érythrocytose. L'érythrocytose chez les donneurs de sang peut indiquer un état pathologique sous-jacent. Les donneurs identifiés avec une érythrocytose doivent être référés pour des investigations ap-

INTRODUCTION

Erythrocytosis is defined as an increase in the number of erythrocytes in whole blood.¹ It is suspected when an individual presents with a haemoglobin (Hb) or haematocrit (HCT) above the normal reference range. (Hb level is above 18.5 g/dL or the packed cell volume (PCV)/HCT is greater than 0.52 L/L in males; and 16.5 g/dL or 0.48 L/L in females, respectively).¹ Erythrocytosis encompasses a number of disorders characterized by increased circulating red blood cells (RBCs) which can be classified into relative and absolute erythrocytosis.² Absolute erythrocytosis can be attributed to congenital or acquired causes. Acquired erythrocytosis may be due to a clonal haematological disease (for example, polycythaemia vera) or secondary to other causes, either hypoxia related or factors unrelated to hypoxic drive. The remaining are classified as unexplained group idiopathic erythrocytosis.² In current practice, little attention is paid to blood donors with high haemoglobin levels compared to the anaemic donors, despite the fact that erythrocytosis may be a sign of a disease and a risk factor for vascular accidents. Detection and evaluation of blood donors with high Hb and HCT values are ways in which blood banks could contribute as a part of donors' health care; a way of advancing preventive medicine and early detection of disease.³

AIM

This study aimed to assess the frequency of erythrocytosis in blood donors and its correlation with other haematological parameters since the diagnosis and clinical assessment of blood donors with erythrocytosis can unmask an underlying pathological diseases.⁴

METHODOLOGY

This pilot cross sectional study was conducted among blood donors at transfusion medicine units in two hospitals over a nine-month period from 1 February 2016 until 31 October 2016. The study received ethical clearance from the Medical Research and Ethics Committee (MREC), Ministry of Health and School of Medicine Science Research and Ethical Committee for Human Research. The study population was sourced from blood donors in Hospital Sultanah Aminah Johor Bahru (HSAJB) and Hospital Universiti Sains Malaysia (HUSM) who had donated blood during study period.

The selection of the participants included in the study was based on these inclusion criteria:

1: All whole blood donors with erythrocytosis detected by both HemoCue[®] Hb 301 (HemoCue AM, Sweden) and Sysmex XE-5000[™] (Sysmex Corporation, Japan).

2: The upper limit for Hb was chosen according to a previous local study done by Roshan *et al*, in 2009: Men; Hb > 16.5 g/dL (12.0-16.5 g/dL) and women; Hb > 13.8 g/dL (9.8-13.8 g/dL).

All donors who had erythrocytosis detected by HemoCue[®] Hb 301 were invited to participate in this study. Approximately 3mL of peripheral blood was collected in EDTA anticoagulated tubes (BD Becton Dickinson, USA) for full blood count (FBC) analysis which consisted of measurement of Hb concentration, total RBC count, HCT, mean cell volume (MCV), mean cell haemoglobin (MCH), total white blood cell (WBC) count and platelet count. A Sysmex XE-5000[™] fully automated haematology analyser was used for the FBC and haemogram. Peripheral blood films were prepared manually according to the standard technical manual of the laboratory and stained using Wright's stain. Data were entered and analysed using statistical package program SPSS version 23.0 windows. Descriptive statistics for categorical variables expressed as frequency and percentage whereas numerical variables expressed as mean and standard deviation (SD) for normal distribution data. Simple Linear Regression (SLR) and Multiple Linear Regression (MLR) were used for association analysis in numerical variables. A p-value < 0.05 was considered significant.

RESULTS

Overall, 2238 potential donors reported to the transfusion medicine units, of which 310 were detected to have high Hb levels by HemoCue[®] 301. One hundred and seventy five (56.5%) were confirmed to have erythrocytosis by Sysmex XE-5000[™] and were included in this study. All further analyses and descriptions are relevant to participants with erythrocytosis according to results from Sysmex XE-5000[™]. The prevalence of erythrocytosis among our blood donors was 7.8%. Among 2238 donors, 54.7% were male and 45.3% were female. The number of donors with erythrocytosis according to age group are shown in figure 1. The demographic data of the 175 donors with erythrocytosis included in this study are shown in table 1. The range of Hb using Sysmex XE-5000[™] for blood donors with erythrocytosis was between 13.9 and 19.1 g/dL with a mean Hb value of 16.0 g/dL (SD 1.52). 19.1 g/dL with a mean Hb value of 16.0 g/dL (SD 1.52). The high-

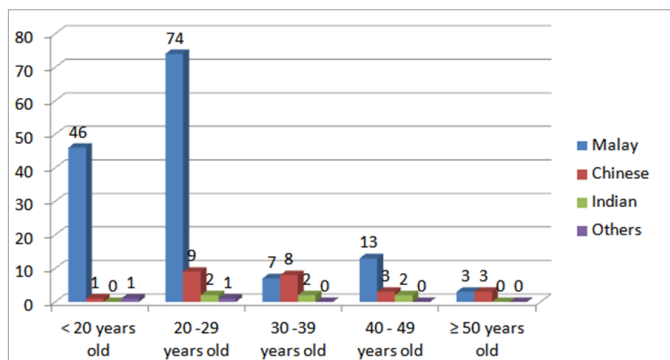


Figure 1: Number of donors with erythrocytosis according to age group.

est Hb level recorded for male and female donors were 19.1 g/dL. 19.1 g/dL with a mean Hb value of 16.0 g/dL (SD 1.52). The highest Hb level recorded for male and female donors were 19.1 g/dL and 16.2 g/dL respectively. The data on haematological parameters of blood donors with erythrocytosis is reflected in table 3 and 4.

Table 1: Demographic data of donors with erythrocytosis. (n=175)

Variable	Frequency n (%)	Mean	Range
Age (years)		25.66	17-55
Sex			
Male	92 (53%)		
Female	83 (47%)		
Ethnicity			
Malay	143 (82%)		
Chinese	24 (14%)		
Indian	6 (3%)		
Others	2 (1%)		
No of donations		4.8	
1 – 20	167		
21 – 40	5		
41 – 60	2		
61 – 80	0		
>80	1		

Table 2: Descriptive data on haematological parameters of blood donors with erythrocytosis. (n=175)

Variables	Mean	SD	Range
Hb (g/dL)	15.99	1.52	13.9 – 19.1
RBC (x 10 ¹² /L)	5.48	0.56	4.31 – 7.52
HCT (%)	47.64	4.20	37.2 – 55.4
MCV (fl)	87.32	4.13	63.4 – 97.3
MCH (pg)	29.39	2.26	20.9 – 33.7
WBC (x10 ⁹ /L)	8.20	2.36	3.19 – 20.11
Neutrophil (x10 ⁹ /L)	4.52	1.82	0.88 – 13.63
Lymphocyte (x10 ⁹ /L)	2.80	0.85	1.04 – 5.41
Monocyte (x10 ⁹ /L)	0.59	0.21	0.25 – 1.13
Eosinophil (x10 ⁹ /L)	0.53	0.47	0.02 – 1.25
Basophil (x10 ⁹ /L)	0.03	0.02	0.01 – 0.11
Platelet (x10 ⁹ /L)	292.5	71.25	159 – 468

Table 3: Haematological parameters according to gender.

Variable	Male Mean (SD)	Female Mean (SD)	p-value
Hb (g/dL)	17.31 (0.62)	14.53 (0.58)	< 0.001
RBC (x10 ¹² /L)	5.84 (0.45)	5.09 (0.36)	< 0.001
HCT (%)	50.59 (2.80)	44.37 (2.87)	< 0.001
MCV (fL)	87.54 (4.79)	87.09 (3.24)	0.473
MCH (pg)	28.83 (1.83)	28.91 (2.59)	0.007
WBC (x10 ⁹ /L)	7.97 (2.35)	8.45 (2.35)	0.179
Platelet (x10 ⁹ /L)	264.56 (60.66)	323.41(69.62)	< 0.001

There was a statistically significant positive correlation between the number of donations and Hb level, among blood donors with erythrocytosis. We observed that the higher the number of donations, the higher was their Hb level (table 4). Our centre also performed therapeutic venesection for patients, but in this study we only included healthy blood donors.

Table 4: Correlation between the number of blood donations with the degree of erythrocytosis among blood donors with elevated haemoglobin levels.

Variable	Pearson Correlation Coefficient (r)	Direction	p-value
Number of donations	0.201	Positive	0.008

*Pearson Correlation; level of significant p<0.01 (two-tailed).

DISCUSSION

Measurement of haemoglobin before each blood donation is mandatory in blood centres across the world. Generally, deferral of blood donors due to high Hb is less than due to anaemia.⁵ As most of the related studies were done in European countries, this prompted us to conduct a similar study in Malaysia in order to evaluate the prevalence of erythrocytosis in our local blood donors. Thus, our study is the first such study done in Malaysia. The prevalence of erythrocytosis detected by HemoCue[®]301 and Sysmex XE-5000[™] among blood donors of 7.8%. All patients with erythrocytosis were deferred from blood donation and referred to the physician for further management of the underlying condition. The correlation of results between HemoCue[®]301 and Sysmex XE-5000[™] was not analysed. Previous study showed HemoCue[®] 301 provides a simple and reliable anaemia screening, however there was no study done for screening of erythrocytosis.⁶ Previous study showed poor correlation between these two methods.⁷ The incidence of erythrocytosis among our blood donors is much higher than a previous local study where the prevalence of deferred blood donors due to a high Hb was 1.7%.⁵ In Turkish and Iranian donors deferral due to a high Hb was also lower, at 2.8% and 2.4% respectively.^{8,9}

Our study found that most of the blood donors were Malays, followed by Chinese, Indian and other ethnic groups. A local study on blood donors also reported the same finding where blood donors were predominantly Malays, followed by Chinese and lastly other

racers.¹⁰ This can be explained by the fact that Malay is the largest population in Malaysia particularly in Kelantan.¹¹

Unlike previous studies, where a male predominance was noted,¹²⁻¹⁵ our study showed only an insignificant male predominance in erythrocytosis. Differences between male and female donor's erythropoiesis has been ascribed to influence of testosterone in males and cyclical menstrual loss in females. Haemoglobin concentrations are generally similar in pre-pubertal boys and girls but increase in boys after the age of 13 years, reflecting changes in testosterone concentrations.¹⁶ A lower body mass index in females was shown to have no association with Hb level,¹⁷ however body mass index was not calculated in our study.

Mean platelet counts were significantly higher in female donors compared to male donors. Our finding is mirrored by the similar reports of two local studies which demonstrated that significantly higher platelet counts were found in females compare to males.^{14,15} A study done on an Italian population also showed that, overall, women had significantly higher platelet counts than men. The mechanism responsible for the gender-related difference was unknown, but it is thought to be related to body iron stores. Loss of iron via menstruation in women leads to iron depletion which in turn indirectly stimulates the production of platelets.¹⁸ Our results also showed that no gender-specific differences were observed in WBCs and their subsets (neutrophils, lymphocytes, monocytes, eosinophils and basophils).

This study showed there was a statistically significant positive correlation between the number of donations and the Hb level among healthy blood donors with erythrocytosis. We observed that the higher the number of donations made by donors, the higher was their Hb level. Our finding is similar to a recent local study which reported a significant correlation between the Hb level and the number of donations.¹⁰ The postulated mechanism behind this is thought to be prolonged and continuous stimulation of myeloid cells by phlebotomies, which can induce inhibition of the feedback control of cells committed to erythropoiesis.¹⁹ Another postulated mechanism was that repeatedly high Hb levels in a healthy blood donor probably indicates an acquired JAK2 mutation in the donor.⁴ Other studies showed an inverse correlation between the number of donations and Hb level. A peer study showed that an increase in the number of donations per year in an individual will cause a decrease in Hb level.²⁰ Cigarette and shisha smokers can develop secondary polycythaemia due to increased levels of carboxyhaemoglobin in which causes clinically significant hypoxaemia and increased erythrocyte mass.²¹ According to study by Redhwan A. Al Naggar et al, 2014, in Malaysia, the prevalence of smoking cigarettes only, shisha only and both were 50.7%, 5.9% and 42% respectively. The highest numbers, 31.4% (n=75) of participants were 18 to 22 years of age,²² which is the age group where this study showed the highest number of patients with erythrocytosis.

CONCLUSION

There was significant variation in the haematological parameters in blood donors with erythrocytosis. Erythrocytosis in blood donors may indicate an underlying medical condition. Donors identified with erythrocytosis should be referred for appropriate investigations. We want to emphasize the importance of paying attention to the full blood count of all donors.

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