

Full Length Research Paper

An evaluation of the risk of acquiring malaria from a single unit of blood in North of Pakistan

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Malaria is one of the most important transfusion associated infections in many parts of the world, particularly the developing countries where it is endemic. This study estimates the risk of acquiring malaria from a single unit of blood in North of Pakistan. A prospective study was conducted to investigate transfusion transmitted malaria in three major blood banks of Peshawar, Pakistan. A total of 1558 (1534 males and 24 females) healthy volunteer blood donors were screened for the presence of malarial parasites in thick and thin smears using microscopy. Nine donors (0.577%) were found positive for malarial parasite, with trophozoites and gametocytic stages of *Plasmodium falciparum* (1) and *Plasmodium vivax* (8). Majority of the donors (82.09%) belonged to age group 15 - 30 years. Donors who suffered from malaria in recent years were 28 in number and 3 of them were found positive for malaria in the present study. The results of the present study indicated that transfusion transmitted malaria is a risk in malaria endemic regions like Pakistan. Further research on this aspect using more sophisticated and advanced diagnostic techniques like enzyme-linked immunosorbent assay (ELISA) and polymerase chain reaction (PCR) are required for proper assessment of actual situation and control of transfusion transmitted malaria in Pakistan.

Key words: Transfusion, malaria, blood-borne infections, screening, microscopy, blood banks.

INTRODUCTION

Blood is required for transporting oxygen and other essentially required substances to tissues and carrying waste products from these tissues in the body. There is still no perfectly reliable man-made substitute for human blood. That is the reason why transfusion holds a vital position in the subject of hematology. Blood transfusion is the process of transferring blood or blood-based products into the circulatory system of one person from another person. In transfusion, the recipients receive whole blood or parts of blood like red blood cells (RBCs), platelets plasma or other components of the blood. Blood trans-

fusion is required for millions of people throughout the world, particularly during surgery, after an accident, in severe anemia, or those who have very low platelet counts because of certain medical conditions and/or treatments (www.who.int/opics/blood-transfusion/en/).

Apart from immunological incompatibility reactions, transmission of blood-borne infections is another most important transfusion associated hazard in many parts of the world, particularly the developing countries. Knowledge of the infectious agents, especially those, which are endemic in a particular region, is essential for reducing the risk of transmission of these agents. Dangerous infectious agents associated with transfusion include human immunodeficiency virus (HIV), hepatotropic viruses (Hepatitis B and C virus), West Nile virus and agents responsible for Leishmaniasis, Toxoplasmosis, Chagas' disease, Babesiosis and malaria. Although, a number of different infections have been reported to be transmitted by transfusion, on a global scale, malaria remains one of the most common transfusion-transmitted infections. The first recorded incident of transfusion-transmitted infection

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Abbreviations: ELISA, Enzyme-linked immunosorbent assay; PCR, polymerase chain reaction; RBCs, red blood cells; HIV, human immunodeficiency virus; TTM, transfusion transmitted malaria; KTH, Khyber Teaching Hospital; IRNUM, Institute of Radiotherapy and Nuclear Medicines.

Table 1. Malarial parasite (MP) screening using microscopy in different age groups in blood donors (n = 1558).

Age groups	Total	Male		Female	
		No (%age)	MP +ve	No (%age)	MP +ve
15 - 30 years	1290	1269 (98.37%)	08	21 (1.63%)	01
31 - 46 years	254	251 (98.81%)	00	03 (1.19%)	00
47 - 62 years	14	14 (100%)	00	00 (0.00%)	00
Total	1558	1534	08	24	01

was malaria (Kitchen and Chiodini, 2006).

Transfusion transmitted malaria (TTM) is a greater threat because *Plasmodium* species can survive for at least 3 weeks in refrigerated blood and even in frozen blood (Seed et al., 2005). A policy of holding blood up to two weeks, to achieve a relative protection from TTM, is occasionally employed, while donations used for preparing plasma, plasma components or derivatives devoid of red blood cells are excluded from the application of this policy (Wells and Ala, 1985).

Transmission of diseases through blood transfusion in Pakistan is an important aspect that needs urgent attention. According to an estimate, approximately 1.5 million units of blood are transfused annually all over Pakistan, where 50% transfusions are being carried out in the private sector (Rahman and Javaid, 2004). At present, public sector blood banks in Pakistan do not routinely screen for malaria. Reliance is placed on pro-active approach of appropriate donor selection and deferral criteria. Provision of safe blood is a basic human right and the responsibility lies on the Government to regulate the transfusion services and make them reliable in this connection. The public health importance of TTM necessitates research in this part of the globe. The aim of this study was to assess the prevalence and risk of TTM in Peshawar, Pakistan.

MATERIALS AND METHODS

Samples of blood were collected from donors visiting three major transfusion service centers in Peshawar. These included two Government Hospitals, Khyber Teaching Hospital (KTH), Institute of Radiotherapy and Nuclear Medicines (IRNUM) and one private transfusion center, Fatimid Foundation, Peshawar.

KTH is a tertiary care teaching and training facility for undergraduate and postgraduate medical students. IRNUM is the only hospital of North West Frontier province, where radiotherapy and nuclear medicine facilities are available. IRNUM is playing a pivotal role in the diagnosis and management of malignant and benign diseases. Fatimid Foundation, a non-profitable organization is the pioneer of voluntary blood transfusion services in Pakistan. Even in terms of quantitative output of blood and blood products, Fatimid Foundation is the leader of blood transfusion services in Pakistan that provides this facility each month to thousands of patients (majority of whom are children) suffering from dreadful blood disorders that is, thalassaemia, hemophilia and other blood disorders including leukaemias and lymphomas. None of these centers routinely screen blood or blood products for malaria.

A questionnaire was prepared for recording information of properly selected voluntary non - remunerated blood donors.

Age, sex, locality, previous illness due to malaria, socio-economic status and blood groups were all noted.

A total of 1558 (503 from IRNUM, 500 from KTH and 555 from Fatimid Foundation) blood smears were prepared from the donors. Both thick and thin blood smears were made on the same slide. Slides were stained with Giemsa stain, while screening was done under microscope using 100x objectives with oil immersion. Slides were screened for the presence of malarial parasite (MP) by a senior technician and then counter checked by another senior and trained technician and the results were matched.

RESULTS

A total of 1558 blood donors were screened for the presence of malarial parasite. Microscopy of blood films showed nine (0.577%) positive cases of malaria. The slides showed trophozoites and gametocyte stages of *Plasmodium vivax* and *Plasmodium falciparum*, respectively.

Four of the positive cases were found among the donors coming to Fatimid Foundation, all harboring trophozoite ring stages of *P. vivax*, two at IRNUM with trophozoite and gametocytes stages of *P. vivax*, whereas, three positive cases at KTH with trophozoites of *P. vivax* (two cases) and gametocytes of *P. falciparum* (one case).

Regarding age of the donors, 1290 (82.80%) belonged to the age group 15 - 30 years (Table 1). While 254 (16.30%) belonged to 31 - 46 and 14 (0.90%) of donors belonged to the age group of 47 - 62 years. All the nine positive cases were found in young people. Similarly, most of the donors were males, that is, 1534 (98.46%) with eight positive cases, while among 24 (1.54%) females, one positive case was recorded (Table 1).

Four cases were found positive among blood group A⁺, two among blood group B⁺ and one among B⁻, AB⁺ and O⁺, respectively. No positive case was found among the rest of the blood groups (Figure 1).

Socioeconomic status of blood donors revealed that 428 (27%) belonged to lower class with no such specific source of income, thus spending life below the poverty level (Figure 2). Donors belonging to middle class were 971 (63%), while 159 (10%) belonged to the upper class.

Donors of the upper class were mainly from the neighboring country, Afghanistan. Amongst the 9 donors who were screened positive for malaria, 4 belonged to the lower class, 2 to the middle, while 3 belonged to the upper class.

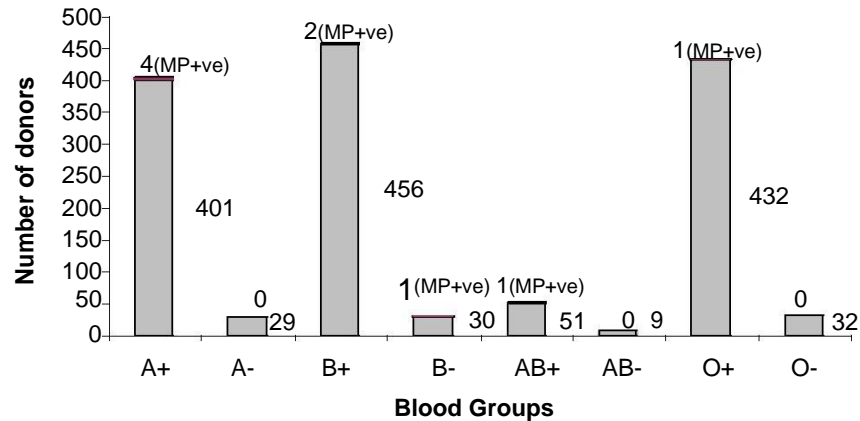


Figure 1. Malarial parasite found in microscopy in blood donors (n = 1558) having different blood groups.

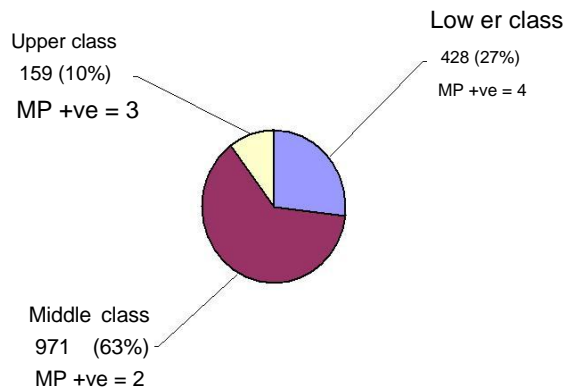


Figure 2. Socio-economic status of blood donors (n = 1558).

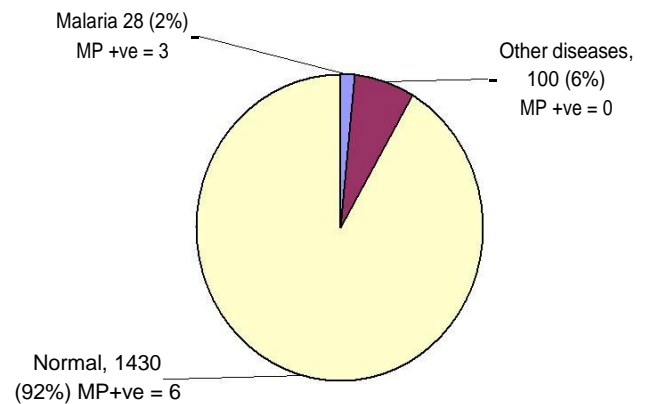


Figure 3. Previous history of illness of blood donors (n = 1558).

Among the studied donors, 60 were from foreign countries including Afghanistan (55) and one donor each from Saudi Arabia, Dubai, Kuwait, Sudan and Italy. None of such donors were positive for malaria, though one of the donors had suffered from malaria in the recent years.

Previous history of illness showed that 128 (8.2%) donors had previously suffered from various infectious diseases including hepatitis A and malaria. Donors with previous history of malaria were 28 in number and three of the positive cases were found among these donors (Figure 3). Donors without any history of a transmissible infectious disease were 1430 (92%) and 6 positive cases were found among them. Chi-square test showed positive correlation of previous record of malaria in donors and presence of malaria parasite in the blood at the time of donation ($p < 0.05$).

DISCUSSION

TTM in non endemic countries may not be a very serious problem, however, in certain geographical locations (endemic

areas), transmission of malaria by blood transfusion poses a real threat (Dover and Schultz, 1971). In the presence of greater concern for transfusion-transmitted hepatitis and HIV infection, the transmission of other diseases, particularly malaria are largely ignored or due attention is not being paid. Malaria is a serious threat because post-transfusion malaria may not only compound the already deplorable health condition of recipients but may also be fatal; the need for effective donor selection guidelines cannot be overstated (Uneke et al., 2006).

Transmission of malaria in Pakistan is a disturbing problem that needs urgent attention. There is little data available regarding transfusion associated infections in this country, perhaps due to lack of a system of reporting both infectious and non-infectious adverse reactions (Rahman and Javaid, 2004). A study carried out by Rahman et al. (2003) reported the incidence of malaria transmission between properly selected voluntary non-remunerated blood donors and found it to be zero. While in other parts of the world, the frequency of post transfusion malaria has been estimated to vary from less

than 0.2 cases per million in non-endemic countries to 50 or more cases per million in endemic countries (Bruce-Chwatt, 1985). A number of reports from areas in sub-Saharan Africa consistently indicated relatively high prevalence (above 33%) of malaria parasite in transfused blood (Kinde-Gazard et al., 2000).

During the present survey, among the studied donors, 25 donors had suffered from fever in the last six months, while 28 were found to have suffered from malaria, thus, showing a previous history of malaria (Figure 3). All these blood donors having the previous history of malaria had still donated blood which was against the law promulgated by provincial assembly on October 7, 1999 and enforced on October 13, 1999, to regulate the transfusion of safe blood and its product in Peshawar, Pakistan. Deferral policy of at least three years needs to be introduced for those donors who have suffered from serious infectious diseases including malaria. There are reports of sale of infected blood by many private blood banks in Pakistan (Daily Dawn, 2004). These blood banks had no mechanisms for proper selection of donors, maintenance and safety of equipment and sufficient staff for receiving blood donations and handling as prescribed by the law. Shortage of blood at the city hospitals have forced patients to contact the privately-owned blood banks for their requirements, which often added to their problems, but many of these cases went unreported.

Positive cases of malaria were found mostly in young male donors who also comprised the highest number of donors (Table 1). Uneke et al. (2006) during their survey on TTM in South Eastern Nigeria found that the prevalence of malaria decreased with age and individuals aged 20 - 25 years were mostly infected. These individuals not only constituted the most infected population (48.5%), but also the dominant blood donor population (62.8%). In a study conducted in Columbia, males were found to be more infected with malaria parasites than females (59% vs. 41%) (Bonilla and Rodriguez, 1993), however, in the Caribbean and Ghana, more females were infected (Vlassoff and Bonilla, 1994).

The number of blood donors in this study was highly correlated with the socio-economic status (Figure 2). Majority of the blood donors came from less affluent social classes, living in poor hygienic conditions. Bruce-Chwatt (1982) found that TTM was common in countries where blood donation has become a commercial transaction and where the blood donors belong to less affluent social classes. Similarly, in sub-Saharan Africa including Nigeria, most of the donors are low-income earners; maybe commercial donors live in places where vector transmission of malaria is high (Enosolease et al., 2004).

No correlation between blood groups and incidence of malaria could be found in the present study. Although the relationship between blood group and susceptibility to malaria has been studied by several researchers, these studies have been unable to link ABO blood groups to the incidence of malaria parasitemia and results have been

contradictory (Martin et al., 1979; Montoya et al., 1994). However, in a study comparing distribution of blood groups in malaria patients conducted in India, it reported that blood group B showed the highest susceptibility (41.8%) amongst the infected cases, followed by group A (29%), group O (22.2%) and group AB (7%) (Gupta and Chowdhuri, 1980).

Travelers from endemic regions are also one of the causes of TTM. In the present study, one of the donors had a previous record of malaria just 10 days before donating blood, when he was outside the country. The criteria of exclusion or deferral of donors are variable throughout the world. Donors in Europe are excluded for 5 years on history of malaria if they test positive for anti-malarial antibody; in the US, UK and Denmark it is however 1 year, in Ireland it is 3 years without antibody testing (Maier et al., 2000).

Simple microscopic technique was used in this study for the detection of malarial parasite. Advanced diagnostic technique would have certainly changed the findings. The number of cases of TTM is considerably reduced in some malaria endemic countries, when they improved the diagnostic techniques of screening malarial parasites. In Qatar, *P. falciparum* spot immunofluorescence test was found more effective when 4.5% positive cases were found as compared to Giemsa technique which detected only 0.3% positive cases (Oner et al., 2004).

Rehman et al. (2003) studied the risk of TTM in Pakistan using serological methods, they found 5% of patients positive who were missed by peripheral blood films. Same situation was observed by Kazemi et al. (2005) who studied hundred samples from healthy blood donors who lived in Chabahar, south eastern Iran. Three positive cases were detected, all of which had been reported negative by microscopic examination and thus showing that by using PCR, TTM in endemic areas could be properly detected and controlled. Similarly, Amer et al. (2005) reported the improved screening of blood donors for malaria in Qatar. It was found that *falciparum* spot immunofluorescent test (IF) showed 4.5% (6367) of positive cases and was more effective than Giemsa stained thick and thin smear techniques which showed 0.3% (95845) positive cases and two undiagnosed cases caused TTM.

Results of the present study indicated that TTM is a risk in malaria endemic regions. Advanced diagnostic techniques are required for proper assessment of actual situation and control of TTM in Pakistan.

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