SEROPREVALENCE OF HEPATITIS B, HEPATITIS C AND HUMAN IMMUNODEFICIENCY VIRUS AMONG BLOOD DONORS, PHITSANULOK REGIONAL BLOOD CENTER, THAILAND

Pipat Luksamijarulkul[1], Nantaporn Thammata[2] and Mujarin Tiloklurs[3]

[1]Department of Microbiology, Faculty of Public Health, Mahidol University, Bangkok 10400, Thailand; [2]Umphang Community Hospital, Tak Province, 63170, Thailand; [3]Thai Red Cross Society, Regional Blood Center, Phitsanulok Province, 65000, Thailand

Abstract. Human immunodeficiency virus (HIV), hepatitis C virus (HCV) and hepatitis B virus (HBV) infections are important blood-borne infections in many countries including Thailand. For epidemiological surveillance and controlling these infections, a cross-sectional group of 2,167 blood donors were screened for HBsAg, antibodies to HCV and HIV by enzyme immunoassay methods. The results revealed that the prevalence of HBsAg positive among studied blood donors was 4.61%, anti-HCV was 2.90% and anti-HIV was 0.69%. When the prevalence was classified by selected socio-demographic variables, it was found that variables including age, gender, marital status and occupation were significant for HBsAg positive rate ($p=0.0068$, $p=0.0019$, $p=0.0048$ and $p=0.0017$, respectively). For anti-HCV prevalence, studied variables including educational level, occupation and domicile were significant ($p<0.0001$, $p=0.0027$, and $p<0.0001$, respectively), while only educational level was a significant variable for anti-HIV prevalence ($p=0.0021$). These findings suggest that we should present integrated information and educational programs for preventing and controlling HBV, HCV and HIV transmission among this target group.

INTRODUCTION

Human immunodeficiency virus (HIV), hepatitis C virus (HCV) and hepatitis B virus (HBV) infections are important public health problems in many countries including Thailand (Lee, 1997; Cohen, 1999; Holland *et al*, 2000; Nur *et al*, 2000; Luksamijarulkul *et al*, 2000). The morbidity and mortality associated with HIV infection is largely a consequence of T helper dysfunction. Infected patients with a progressive immunosuppression are characterized by the absence of delayed-type hypersensitivity to common recall antigens (Dolan *et al*, 1995). HIV infection affected more than 35 million people world-wide in the year 2000 (MacNell and Anderson, 1998; Rosenberg *et al*, 2001), whereas, the prevalence of HCV infection and HBsAg carriers appear to be more than 5 times and 10 times, respectively as many as HIV infection. In the year 2000, HCV infected approximately 170 million and HBsAg carriers were more than 400 miillion people world-wide (Cohen, 1999; Mahoney and Kane, 1999; Holland *et al*, 2000). Moreover, the complications from HCV and HBV carriers are quite serious, *ie* 10-40% will develop chronic hepatitis and gradual progression to liver cirrhosis and hepatocellular carcinoma (Tanikawa, 1994; Moradpour and Wands, 1995; Mahoney and Kane, 1999). HIV and HBV transmission include the parenteral route and sexual contact, whereas, the major route of HCV transmission is via the parenteral route and the minority is via sexual contact (Stary, 1992; Mahoney and Kane, 1999; Luksamijarulkul *et al*, 2000). In Thailand, the highest risk groups of HBV, HCV and HIV infections were injecting drug users (IDUs) and female sex workers (FSWs) (Ungchusak *et al*, 1995; Luksamijarulkul and Plucktaweesak, 1996a,b; Luksamijarulkul and Daengbubpha, 1997; Luksamijarulkul *et al*, 1998; Kitayaporn *et al*, 1998). IDUs and the clients of FSWs have increased chances of acquiring HIV and/or HBV and/or HCV infections if they do not use condoms every time of sexual relations.

Both of these infected groups can transmit the infections to the general population. In general, voluntary blood donors have some socio-demographic characteristics like the general population. This study investigated the prevalence of HIV, HCV antibodies and HBsAg carrier rate among Thai blood donors.

MATERIALS AND METHODS

Study design, study population and laboratory methods

The design was a cross-sectional study of 2,167 blood donors who attended the Regional Blood Center, Phitsanulok Province, Thailand. This regional blood center had the responsibility to collect blood and blood products, then distribute them to other provinces in the central and northern regions of Thailand. All studied blood donors who attended the Center during July to December 1999 and voluntarily participated were interviewed by using structured questionnaires including socio-demographic variables and some risk behaviors. Before interview and blood donation, donors had received the study information and knowledge towards HIV, HCV and HBV infections. After that, donors were required to fill the informed consent forms. Blood specimens were collected from studied blood donors for screening anti-HIV, anti-HCV, and HBsAg by enzyme immunoassays. The determination of anti-HIV and HBsAg were followed by Behring Enzymnost anti-HIV and HBsAg 5.0 with almost 100% sensitivity and specificity. Anti-HCV antibody screening was followed by ABBOTT HCV EIA 3.0 (the third generation) with 99-100% of sensitivity and 99.6% of specificity. The cut-off values for anti-HIV, anti-HCV, and HBsAg positivity followed the criteria of the diagnostic kits. In case of anti-HIV and anti-HCV antibodies, a specimen is considered positive if the antibodies are positive on repeated testing.

Data analysis

Data from interviews and laboratory results were analyzed and presented by descriptive statistics including percentage, mean and standard deviation. Testing of the homogeneity of the distribution of prevalence classified by socio-demographic variables used the chi-square test. The critical level of $\alpha = 0.05$ was considered to indicate statistical significance.

RESULTS

General characteristics of studied blood donors

Of 2,167 blood donors, 49.25% were 16-30 years of age. The mean age of donors was 32.07 years, ranging from 16 to 60 years. The male to female ratio was about 4:1. Approximately 53% were married. Almost 23% had completed primary school, while 41.35% had completed vocational level and higher education. About 33% were police and military, and 31.64% were laborers and agriculture workers. More than a half of the donors (59.39%) came from the urban areas of the northern provinces of Thailand. Details are shown in Table 1.

Prevalence of HBsAg

Prevalence of HBsAg positive among 2,167 studied blood donors was 4.61%. When the prevalence was classified by some socio-demographic variables, it was found that the prevalence classified by age, gender, marital status and occupation was significantly different ($p=0.0068$, $p=0.0019$, $p=0.0048$ and $p=0.0017$ respectively). Studied donors with age $\leq$ 30 years had higher HBsAg prevalence than other age groups (5.90% and 3.37%). Male donors had higher prevalence than female donors (5.36% and 1.77%). Donors who were single had higher prevalence than married donors (6.05% and 3.40%). Donors with occupations as police and military, and laborers and agriculture workers had higher prevalence than donors with other occupations (6.57%, 4.67% and 2.67% respectively). Details are shown in Table 2.

Prevalence of anti-HCV antibody

Prevalence of anti-HCV antibody among 2,167 studied blood donors was 2.90%. When

Table 1
General characteristics of 2,167 studied blood donors.

General characteristics			Number	Percentage
Age group (years)	:	16-30	1,063	49.25
		31-45	863	39.86
		45-60	236	10.89
		$\bar{X}$ ± SD = 32.07 ± 10.14 years (Min =16, Max = 60)		
Gender	:	Male	1,716	79.18
		Female	451	20.82
Marital status	:	Single	992	45.77
		Married	1,159	53.49
		Windowed/Divorced	16	0.74
Education	:	Primary level	496	22.88
		Secondary level	775	35.77
		Vocational level and Undergraduate level	896	41.35
Occupation	:	Police and military	731	33.74
		Laborer and agriculture worker	686	31.64
		Government and private officers	399	18.42
		Student and housewife	351	16.20
Domicile	:	Urban area	1,287	59.39
		Rural area	880	40.61
Income/month (baht)	:	≤ 10,000	964	44.49
		> 10,000	1,203	55.51
Blood group	:	A	433	19.98
		B	787	36.32
		AB	156	7.19
		O	791	36.51
Total			2,167	100.00

the prevalence was classified by some socio-demographic variables, it was found that the prevalence classified by educational level, occupation and domicile was significantly different ($p < 0.0001$, $p=0.0027$, and $p < 0.0001$ respectively). Studied donors who finished primary education had higher anti-HCV prevalence than donors who finished secondary education and higher education (7.06%, 1.81% and 1.56% respectively). Donors with occupation as laborers and agriculture workers had higher prevalence than donors with occupations as police, military and others (4.52%, 2.87% and 1.47% respectively). Donors who came from rural areas had higher prevalence than donors who came from urban areas (4.77% and 1.63%). In addition, the prevalence of anti-HCV classified by blood group was not significantly different ($p=0.0599$). However, when the prevalence classified by blood group was compared between blood group A and blood group O, it was found that donors with blood group A had significantly higher anti-HCV prevalence than donors with blood group O (4.62% and 1.89%, $p=0.0107$), as shown in Table 3.

Prevalence of anti-HIV antibody

Prevalence of anti-HIV positive among 2,167 studied blood donors was 0.69%. When the prevalence was classified by some socio-demographic variables, it was found that the prevalence classified by education level was significantly different ($p=0.0021$). Studied donors who finished primary education had higher anti-HIV prevalence than donors who

Table 2
Prevalence of HBsAg positive among 2,167 studied blood donors classified by some socio-demographic variables.

Socio-demographic variables		No. of tested	No. (%) of positive for HBsAg	p-value from χ^2 test
Age group (years)	: ≤ 30	1,068	63 (5.90)	0.0068[a]
	> 30	1,099	37 (3.37)	
Gender	: Male	1,716	92 (5.36)	0.0019[a]
	Female	451	8 (1.77)	
Marital status	: Single	992	60 (6.05)	0.0048[a]
	Married and others	1,175	40 (3.45)	
Education	: Primary level	496	26 (5.24)	0.2216
	Secondary level	775	41 (5.29)	
	Vocational level and higher	896	74 (4.43)	
Occupation	: Police and military	731	48 (15.00)	0.0017[a]
	Laborer and agriculture worker	686	32 (4.67)	
	Others	750	20 (2.67)	
Domicile	: Urban area	1,287	54 (4.19)	0.3079
	Rural area	880	46 (5.23)	
Income/month (baht)	: ≤ 10,000	964	54 (5.60)	0.0633
	> 10,000	1,203	46 (3.81)	
Blood group	: A	433	18 (4.16)	0.2449
	B	787	30 (3.81)	
	AB	156	6 (3.20)	
	O	791	46 (5.81)	
Total		2,167	100 (4.61)	

[a]Significant difference at $\alpha = 0.05$.

finished secondary level and higher education (1.82%, 0.52% and 0.22% respectively). Details are shown in Table 4.

DISCUSSION

HBV, HCV and HIV infections are important blood-borne and sexually transmitted infections throughout the world including Thailand (Lee,1997; Cohen,1999; Holland *et al*, 2000; Nur *et al*, 2000; Luksamijarulkul *et al*, 2000). Both sexual and parenteral routes were the predominant modes of HBV and HIV transmission, while the major mode of transmission of HCV was the parenteral route and sexual transmission was a minor factor in the spread of HCV (Stary, 1992; Mahoney and Kane, 1999; Luksamijarulkul *et al*, 2000). It has been found that prevalence of HBsAg, anti-HCV and anti-HIV among blood donors or the general population varied from country to country. Previous studies reported that the HBsAg carrier rate varied from approximately 1.9% in Europe and America to 8-15% in Asian countries (Ko *et al*, 1991; Assateerawatt *et al*, 1992; Lee, 1997; Nur *et al*, 2000), while the anti-HCV prevalence ranged from 0.2-1% in Europe and North America and 0.3-3.1% in Asia (Boonmar *et al*, 1995; Cohen, 1999; Nur *et al*, 2000). Recently, the HIV infection rate among blood donors or the general population has tended to decrease in many countries, most are lower than 1% (Thanprasertsuk and Auwanit, 1996; MacNell and Anderson, 1998; Nur *et al*, 2000). In this study, the prevalence of HBsAg positive individuals among studied blood donors was 4.61%, anti-HCV was 2.90% and anti-HIV was

Table 3
Prevalence of anti-HCV among 2,167 studied blood donors classified by some socio-demographic variables.

Socio-demographic variables		No. of tested	No. (%) of positive for anti-HCV	p-value from χ^2 test
Age group (years)	: ≤ 30	1,068	32 (3.00)	0.9083
	> 30	1,099	31 (2.82)	
Gender	: Male	1,716	55 (3.21)	0.1464
	Female	451	8 (1.77)	
Marital status	: Single	992	31 (3.13)	0.1964
	Married and others	1,175	32 (2.72)	
Education	: Primary level	496	35 (7.06)	< 0.0001[a]
	Secondary level	775	14 (1.81)	
	Vocational level and higher	896	14 (1.56)	
Occupation	: Police and military	731	21 (2.87)	0.0027[a]
	Laborer and agriculture worker	686	31 (4.52)	
	Others	750	11 (1.47)	
Domicile	: Urban area	1,287	21 (1.63)	< 0.0001[a]
	Rural area	880	42 (4.77)	
Income/month (baht)	: ≤ 10,000	964	38 (3.94)	0.0148[a]
	> 10,000	1,203	25 (2.08)	
Blood group	: A	433	20 (4.62)[b]	0.0599
	B	787	23 (2.92)	
	AB	156	5 (3.21)	
	O	791	15 (1.89)[b]	
Total		2,167	63 (2.90)	

[a]Significant difference at $\alpha = 0.05$.
[b]There was significant difference between blood group A and blood group O, p=0.0107.

0.69%. Previous studies in Thai blood donors showed 2.5-4.3% of HBsAg positive, 1.5-4.5% of anti-HCV positive and about 1% of anti-HIV positive depending on the studied regions (Tanprasert *et al*, 1993; Ungchusak *et al*, 1995; Boonmar *et al*, 1995). Surprisingly, the low anti-HIV prevalence among this studied group was found. It might be due to the decreasing trend of HIV infection in Thailand and/or that the donors who had risk behaviors related to HIV infection were screened before donation.

The prevalence of HBsAg positive tended significant increase by age. This finding supported the studies of Taylor *et al* (1989) and Luksamijarulkul *et al* (1995), that prevalences of anti-HCV and anti-HIV among this studied group were not significant by age. The positive rates of HBsAg, anti-HCV and anti-HIV among male blood donors were relatively higher than those among female blood donors (5.36% *vs* 1.77% for HBsAg, 3.21% *vs* 1.77% for anti-HCV and 0.76% *vs* 0.44% for anti-HIV), but there was a significant difference only of HBsAg positive rate, p=0.0019. This evidence might be due to some risk behaviors of male, *ie* outside socialization, extramarital sex relation and alcohol consumption as a risk factor for seeking femal sex workers without condom use (Stary *et al*, 1992; Luksamijarulkul and Plucktaweesak, 1996; Gilson *et al*, 1998). Donors with marital status single had significantly higher HBsAg positive than married blood donors (4.05% and 3.45%, p=0.0048), while anti-HCV and anti-HIV positive rates among single and married blood donors were not significantly different. Our findings showed that

Table 4
Prevalence of anti-HIV among 2,167 studied blood donors classified by some socio-demographic variables.

Socio-demographic variables			No. of tested	No. (%) of positive for anti-HIV	p-value from χ^2 test or Fisher's exact test
Age group (years)	:	≤ 30	1,068	9 (0.84)	0.5661
		> 30	1,099	6 (0.55)	
Gender	:	Male	1,716	13 (0.76)	0.7498
		Female	451	2 (0.44)	
Marital status	:	Single	992	9 (0.91)	0.3956
		Married and others	1,175	6 (0.51)	
Education	:	Primary level	496	9 (1.82)	0.0021[a]
		Secondary level	775	4 (0.52)	
		Vocational level and higher	896	6 (0.36)	
Occupation	:	Police and military	731	6 (0.82)	0.1992
		Laborer and agriculture worker	686	7 (1.02)	
		Others	750	2 (0.27)	
Domicile	:	Urban area	1,287	7 (0.54)	0.4574
		Rural area	880	8 (0.91)	
Income/month (baht)	:	≤ 10,000	964	8 (0.83)	0.6663
		> 10,000	1,203	7 (0.58)	
Blood group	:	A	433	3 (0.69)	0.9926
		B	787	5 (0.64)	
		AB	156	1 (0.64)	
		O	791	6 (0.76)	
Total			2,167	15 (0.69)	

[a]Significant difference at $\alpha = 0.05$.

prevalences of anti-HCV and anti-HIV among studied blood donors who finished only primary school (7.06% and 1.82%) were significantly higher than those among studied blood donors who finished secondary school and higher education (1.56-1.81% for anti-HCV and 0.36-0.52% for anti-HIV), while HBsAg positive rate was not significant in this regard. This evidence supported that individuals with low education had higher risk behaviors, such as, tattooing, injecting drug use and extramarital sex relations without condom use (Stary *et al*, 1992; Luksamijarulkul and Plucktaweesak,1996; Luksamijarulkul *et al*, 2001).

Studied blood donors with occupations as police and military, laborer and agriculture worker had relatively higher HBsAg, anti-HCV and anti-HIV prevalences than those with other occupations. However, this evidence was statistically significant only in HBsAg and anti-HCV prevalence rates, p=0.0017 and p=0.0027, respectively. Moreover, blood donors who came from rural areas had significantly higher anti-HCV positive rates than those who came from urban areas (4.77% and 1.63%, p<0.0001) and those with monthly incomes less than 10,000 baht had significantly higher prevalence of anti-HCV than those with monthly income more than 10,000 baht (3.94% and 2.08%, p=0.0148). This indirectly indicated that the higher prevalence of anti-HCV should be correlated with the low socio-economic conditions supported by several studies (Songsivilai *et al*, 1997; Luksamijarulkul *et al*, 2001). Most blood donors living in rural areas had finished only primary school were illiterate. It suggested that we should

give valuable information and education for preventing and controlling HCV transmission. However, this was not significant for HBsAg and anti-HIV.

Surprisingly, we found that the prevalence of anti-HCV among blood donors with blood group A (4.62%) was relatively higher than those with other blood groups (2.92% for blood group B, 3.21% for blood group AB and 1.89% for blood group O). When we compared studied blood donors with blood group A and blood group O, it was found that the prevalence of anti-HCV among donors with blood group A was significantly higher than that among donors with blood group O (p=0.0107). No previous study of an association between blood group and HCV infection. However, this evidence was not significant for HBsAg and anti-HIV positive rates.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the Director and staff of the Thai Red Cross Society, Regional Blood Center, Phitsanulok Province, Thailand and all participants in this study.

REFERENCES

Assateerawatt A, Suvatte V, Tanphaichitr VS. Long term efficacy of hepatitis B immunoprophylaxis in neonates at risk: using different vaccine and schedule. *J Med Assoc Thai* 1992; 75: 328-36.

Boonmar S, Sawanpanyalert P, Miyamura T. Risk factors for hepatitis C virus infection among blood donors in an HIV-epidemic area in Thailand. Bangkok: The 13th National Seminar on Epidemiology, 1995: 146-7.

Cohen J. The scientific challenge of hepatitis C. *Science* 1999; 285: 26-30.

Dolan MJ, Clerici M, Platt SP, *et al*. *In vitro* T cell function, delayed-type hypersensitivity skin testing, and CD_4^+ T cell subset phenotyping independently predict survival time in patients infected with human immunodeficiency virus. *J Infect Dis* 1995; 172: 79-87.

Gilson RJ, De Ruiter A, Waite J, *et al*. Hepatitis B virus infection in patients attending a genitourinary medicine clinics: risk factors and vaccine coverage. *Sex Transm Dis* 1998; 74: 110-5.

Holland CA, Ma Y, Moscicki B, Durako SJ, Levin L, Wilson CM. Seroprevalence and risk factors of hepatitis B, hepatitis C, and human cytomegalovirus among HIV-infected and high-risk uninfected adolescents: findings of the REACH Study Adolescent Medicine HIV/AIDS Research Network. *Sex Transm Dis* 2000; 27: 296-303.

Kitayaporn D, Vanichseni S, Mastro TD, *et al*. HIV-1 incidence, subtypes, and follow up in a prospective cohort of injecting drug users in Bangkok, Thailand. *Thai AIDS J* 1998; 10: 219.

Ko YC, Li SC, Yen YY, Yeh SM, Hsieh CC. Horizontal transmission of hepatitis B virus from siblings and intramuscular injection among preschool children in a familial cohort. *Am J Epidemiol* 1991; 133: 1015-23.

Lee MW. Hepatitis B virus infection. *N Engl J Med* 1997; 337: 1733-45.

Luksamijarulkul P, Maneesri P, Kittigul L. Hepatitis B seroprevalence and risk factors among school-age children in a low socioeconomic community, Bangkok. *Asia Pac J Public Health* 1995; 8: 158-61.

Luksamijarulkul P, Plucktaweesak S. High hepatitis C seroprevalence in Thai intravenous drug abusers and qualitative risk analysis. *Southeast Asian J Trop Med Public Health* 1996a; 27: 654-8.

Luksamijarulkul P, Plucktaweesak S. Anti-HIV prevalence and the comparison of some known behaviors between male IDUS with and without anti-HIV, seeking for methadone treatment at 2 governmental hospitals. *Chula Med J* 1996b; 40: 989-97.

Luksamijarulkul P, Daengbubpha A. Hepatitis C antibody prevalence and risk factors of some female sex workers in Thailand. *Southeast Asian J Trop Med Public Health* 1997; 28: 507-12.

Luksamijarulkul P, Chompoonuch C, Isaranurug S. Antibodies to human immunodeficiency virus, P_{24} antigen and risk behaviors among some groups of female sex workers. *Chula Med J* 1998; 42 : 599-607.

Luksamijarulkul P, Khemnak P, Pacheun O. Human immunodeficiency virus and hepatitis C virus infections among patients attending sexually transmitted disease clinics, Regional 2, Thailand. *Asia Pac J Public Health* 2000; 12: 41-5.

Luksamijarulkul P, Khemnak P, Luksamijarulkul S. A

case-control study of hepatitis C virus infection among sexually transmitted disease patients. *Chula Med J* 2001; 45: 413-21.

MacNell JM, Anderson S. Beyond the dichotomy: Linking HIV prevention with care. *AIDS* 1998; 12(suppl 2): S19-26.

Mahoney FJ, Kane M. Hepatitis vaccine. In: Plotkin SA, Orenstein NA, eds. Vaccines. 3 rd. Philadelphia: WB Saunders 1999: 158-82.

Moradpour D, Wands JR. Understanding hepatitis B virus infection. *N Engl J Med* 1995; 332: 1092-3.

Nur YA, Groen J, Elmi AM, Ott A, Osterhaus AD. Prevalence of serum antibodies against bloodborne and sexually transmitted agents in selected groups in Somalia. *Epidemiol Infect* 2000; 124: 137-41.

Rosenberg SD, Goodman LA, Osher FC, *et al*. Prevalence of HIV, hepatitis B, and hepatitis C in people with severe mental illness. *Am J Public Health* 2001; 91: 31-7.

Songsivilai S, Jinathongthai S, Wongsena W, Tiangpitayakorn C, Kharakul T. High prevalence of hepatitis C infection among blood donors in Northeastern Thailand. *Am J Trop Med Hyg* 1997; 57: 66-9.

Stary A, Kopp W, Hofmann H, Heller-Vitouch C, Kunz C. Sero-epidemiologic study of hepatitis C virus in sexually transmitted disease risk groups. *Sex Transm Dis* 1992; 19: 252-8.

Tanikawa K. Relationship between hepatitis C and alcoholic liver disease. *Asian Med J* 1994; 37: 165-70.

Tanprasert S, Somjitta S, Prechakul L. Three-year trend of HBsAg screening in donate blood: National Blood Center, Thai Red Cross Society. *Chula Med J* 1993; 37: 111-7.

Taylor R, Montaville B, Levy S *et al*. Hepatitis B infection in Vanuata: Age acquisition for infection and possible routes of transmission. *Asia Pacific J Public Health* 1989; 3: 205-12.

Thanprasertsuk S, Auwanit W. Blood services in the era of AIDS epidemic: another view point. *Thai AIDS J* 1996; 7: 1-15.

Ungchusak K, Tongthay A, Sangwonley O. The 13th round of HIV sentinel serosurveillance in Thailand, June 1995. *Thai AIDS J* 1995; 7: 177-89.