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Epidemiology and detection of human immunodeficiency virus among pregnant women in Hong Kong

香港孕婦中人類免疫力缺乏病毒的流行病學與檢測

Objectives. To determine the epidemiology of human immunodeficiency virus infection among pregnant women and the neonatal outcomes in Hong Kong.

Design. Retrospective observational study composed of two parts: record review of pregnant women and unlinked anonymous screening of cord blood from neonates.

Setting. Two human immunodeficiency virus clinics and the Government Virus Unit.

Participants. Female patients attending the two clinics who became pregnant and neonates who underwent routine metabolic screening by the Government Virus Unit between 1992 and 1999.

Main outcome measures. The outcomes of neonates born to women who had human immunodeficiency virus infection during pregnancy.

Results. Forty-one human immunodeficiency virus–related pregnancies were recorded among 32 infected women. Fifteen pregnancies were terminated, of which 14 were in women who knew their infection status before conception. Twenty-six pregnancies continued to term, resulting in 26 live births. Twelve babies were born to women who knew their infection status before delivery. One baby was confirmed to be infected. Six women were given zidovudine for prophylaxis against vertical transmission and none of the babies were infected at birth. Of the remaining 14 human immunodeficiency virus–related pregnancies, the mothers' status became known only at a later date and nine (64.3%) babies were confirmed to be infected at the age of 18 months or older. The rate ratio of giving birth to an infected baby was 8.18 from mothers who did not know their status antenatally. Unlinked anonymous screening showed that the seroprevalence rate for human immunodeficiency virus in pregnant women was 0.032% (1/3125) in Hong Kong in 1999.

Conclusions. Human immunodeficiency virus–related pregnancy is not rare in Hong Kong and the majority of infected mothers were not identified and treated. Detection of these pregnancies will be invaluable for the prevention of mother-to-child transmission. Universal antenatal screening of human immunodeficiency virus antibody is proposed as an effective strategy.

目的：確定香港孕婦中人類免疫力缺乏病毒傳染的流行病學和出生結果。

設計：由兩部份組成的回顧性觀察研究：孕婦的病歷總覽和嬰兒臍帶血的非聯擊性的匿名檢查。

安排：兩個人類免疫力缺乏病毒診所及政府病毒科。

參與者：1992 年至 1999 年間，在兩個診所就診的孕婦和由政府病毒科進行常規檢查的新生嬰兒。

主要結果測量：在懷孕期感染人類免疫力缺乏病毒婦女的嬰兒之出生結果。

結果：在 32 名感染婦女中發現了 41 宗與人類免疫力缺乏病毒有關的懷孕

Key words:
Disease transmission, vertical;
HIV infections/transmission;
Hong Kong;
Neonatal screening;
Prenatal diagnosis

關鍵詞：
疾病傳播，垂直的；
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個案。15宗已終止懷孕，其中14名婦女妊振前已知道自己的感染狀況。其餘26宗繼續懷孕，並分娩出26個嬰兒，其中12個嬰兒的母親在分娩前已知其感染狀況。一名嬰兒證實受到感染。6名婦女服用了預防母嬰傳播的zidovudine，因而他們的嬰兒出生時未受到感染。其餘14宗涉及人類免疫力缺乏病毒的懷孕中，母親後來才知道自己受感染，其中9(64.3%)名嬰兒在出生後18個月或以後亦被證實受到感染。其他產前不知其感染狀況的孕婦中，受感染嬰兒的出生比率是8.18。非聯擊性匿名檢查顯示，1999年香港孕婦中對人類免疫力缺乏病毒的血清患病率為0.032% (1/3125)。

結論：涉及人類免疫力缺乏病毒的懷孕在香港並非少見，且大多數受感染的母親尚未被識別和治療。查出這些孕婦對預防母嬰傳播相當重要。所以進行普性產前人類免疫力缺乏病毒抗體檢查是一項有效的策略。

Introduction

According to the Joint United Nations Programme on human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS), nearly 3 million children's lives have been claimed in the AIDS epidemic, and another 1 million children are living with HIV today.[1] In countries like Hong Kong, where all blood products are regularly screened and clean syringes and needles are widely available, mother-to-child transmission (MTCT) is virtually the only source of infection for children.

In Hong Kong, the cumulative number of people with HIV infection was 1491 at the end of September 2000 and 487 (32.7%) people had developed AIDS. Two hundred and fifty-four (17.0%) were female and 11 (0.7%) perinatal transmissions were reported. The number of young women acquiring HIV infection in Hong Kong continues to rise, as reflected by the steady decline of the male to female reported HIV transmission ratio from 24.0:1 in 1990 to 2.7:1 in 1998 and 3.6:1 in 1999. In addition, more than three quarters of the cumulative reported female HIV infections were in women aged between 20 and 39 years.[2]

In 1994, interim findings from the landmark Pediatric AIDS Clinical Trials Group Protocol 076 Study indicated that the use of zidovudine (AZT) significantly reduced MTCT of HIV by two thirds.[3] This was followed by other studies that either elucidated the risk factors associated with transmission or evaluated alternative interventions to prevent MTCT.[4-9] It is imperative that these scientific findings be translated into standard clinical practice if their full impact on public health is to be realised.

A survey was conducted at the two largest HIV clinics in Hong Kong—the Special Medical Clinic at Queen Elizabeth Hospital (SMC-QEH) and the Special Preventive Programme of the Department of Health (SPP-DH)—which treat more than 95% of HIV-infected patients, and the unlinked anonymous screening (UAS) of cord blood from neonates in Hong Kong were determined to ascertain the local situation. Based on the results of these surveys, an appropriate prevention strategy is proposed.

Methods

This was a retrospective observational study composed of two parts. The first part was a retrospective review of all records from the SMC-QEH and SPP-DH, which provided care to the majority of local people with HIV infection. Case records of female patients who had a history of pregnancy between October 1992 and December 1999 were reviewed. The age of the women during pregnancy, ethnicity, obstetric history, mode of delivery, and HIV status were ascertained. The women's medical histories including antiretroviral therapy and antiretroviral prophylaxis to prevent MTCT were also noted. The babies' clinical outcomes were obtained from the relevant paediatric units if possible. The baby's HIV status was defined as positive only if the anti-HIV antibody remained positive when the child was 18 months or older. Linked data on the number of HIV infections diagnosed in mothers and children with vertically acquired HIV were collected. As those babies already known to have been infected with HIV and hence their mothers (captured in retrospect) were included in the analysis, the results would be unavoidably biased towards a higher vertical transmission rate among the group in which the diagnosis of HIV infection was made after the babies were born. Result analysis should be put in perspective with this constraint.

The second part of the study was a seroprevalence survey of HIV infection among pregnant women proceeding to live birth, derived from unlinked surveys using cord blood for metabolic screening of neonates. All positive results were confirmed by Western blot analysis. Samples were collected and analysed from 1990. A specific month in each year was usually

selected and cord blood samples from babies delivered in both public and private health care sectors were collected for analysis. Babies delivered in obstetric units that perform their own metabolic screening were not included. There are an estimated 50 000 to 60 000 annual deliveries in Hong Kong. It could be assumed that ≥60% of the total number of deliveries in the studied month were included in the survey.

The results were analysed by descriptive statistics and significance testing was performed with the assistance of computer programme EPI INFO 6 (Windows version 6, Epidemiology Program Office of the Centers for Disease Control and Prevention, Geneva, Switzerland).

Results

Linked data retrospective record review

Forty-one HIV-related pregnancies were recorded between the two clinics. The number of HIV-positive women involved was 32. The ethnicity of the 32 women is shown in Fig 1. Thai and Chinese women accounted for about 80% and the others were Indonesian, Filipino, Burmese, and Portuguese. The mean age of the women was 25.2 years.

The outcomes of the HIV-related pregnancies were divided into two groups: termination of pregnancy and full-term pregnancy. Fifteen pregnancies ended in termination and 93.3% (14/15) of the women knew their HIV status before becoming pregnant. Twenty-six HIV-infected women continued their pregnancies with 26 babies born. There were no twin pregnancies or stillbirths.

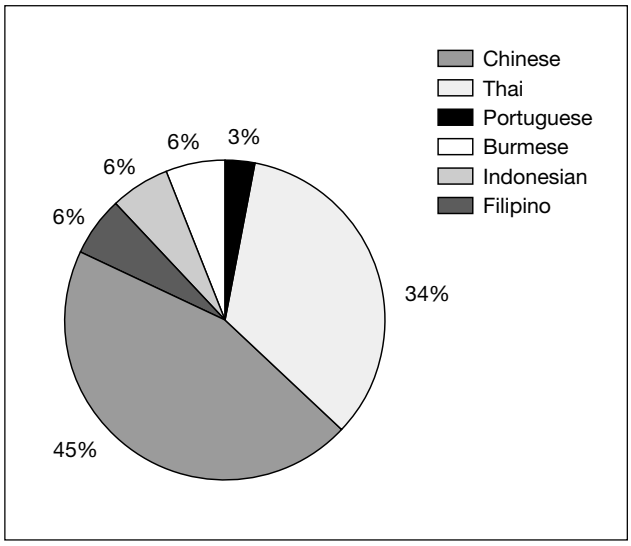
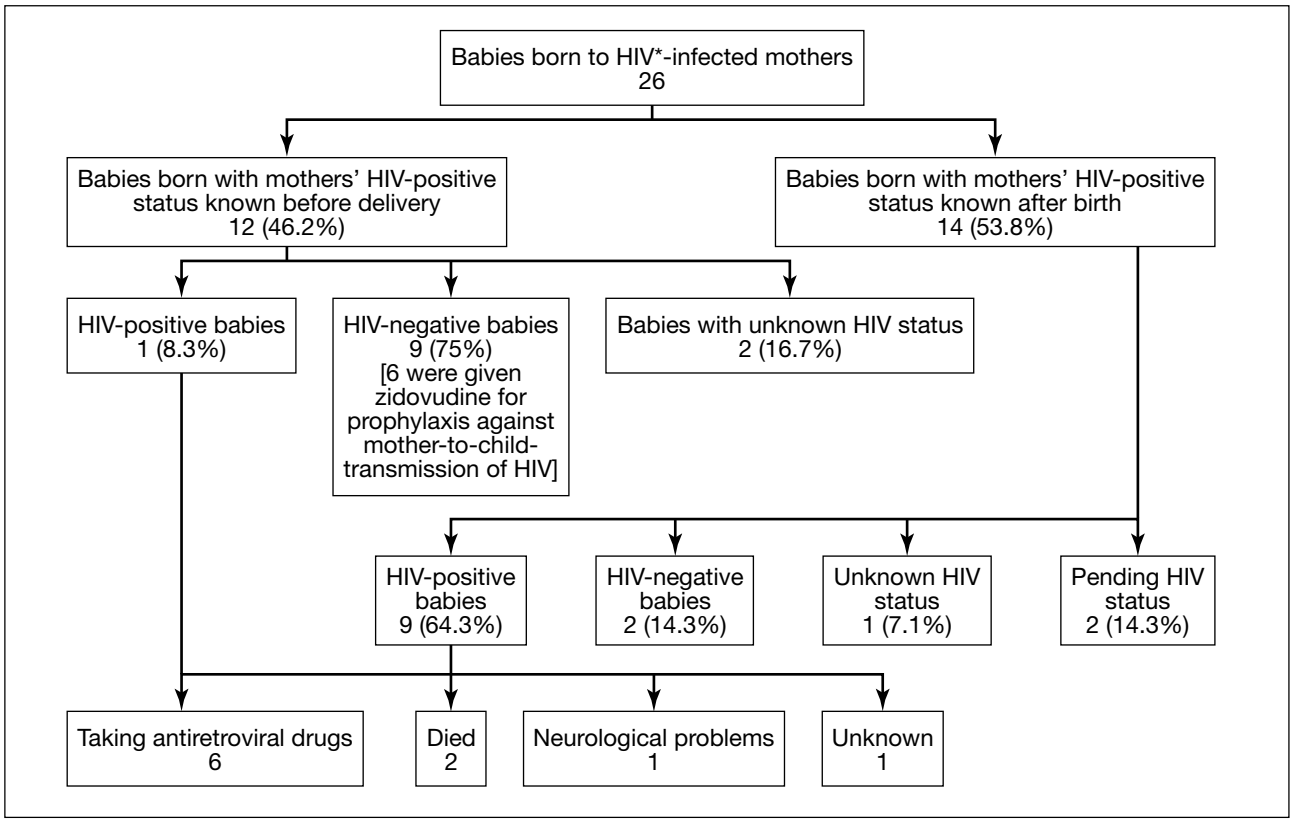


Fig 1. Ethnicity of pregnant women infected with human immunodeficiency virus: retrospective record review

Twelve babies were born to women who knew their HIV status before delivery. Only one baby was confirmed to be HIV-positive. Nine (75%) babies were confirmed to be HIV antibody–negative at the age of 18 months. Two (16.7%) babies were lost to follow-up (one could not be traced and one returned to Thailand). Zidovudine was given to six mothers and/or infants for prophylaxis against vertical transmission and all six babies were confirmed to be HIV antibody–negative at the age of 18 months. After 1994, when the results of the Pediatric AIDS Clinical Trials Group Protocol 076 study were released, there were nine HIV-related pregnancies of whom six women accepted AZT prophylaxis. Assuming all of the women would have been offered AZT prophylaxis, the acceptance rate was 66.7%. An additional baby was given postbirth AZT, although the baby's HIV status is not known as there was no further follow-up for assessment.

Of the other 14 HIV-related pregnancies, the mothers' HIV status was not known before delivery. Their HIV infection was discovered either when their children presented with symptomatic HIV-related diseases, the women developed opportunistic infections, or their partners were found to be seropositive after delivery. Of the 14 births, nine (64.3%) babies were confirmed to be HIV-positive at the age of 18 months following HIV antibody testing, two were confirmed to be HIV-negative, one was lost to follow-up, and the remaining two babies were still younger than 18 months. Eight of the nine babies could be traced, and three were tested because they had symptoms of the disease, four because their mothers were found to be HIV-positive or had died of AIDS-related complications and one because the father was found to be HIV-positive. One child died of lymphoma and one had disease that was complicated by neurological problems. The clinical course and outcome of eight of the children were earlier reported by Chiu and Lau.[10] The results are summarised in Fig 2.

Assuming that the children who were lost to follow-up or were undergoing evaluation were all negative for HIV infection, the rate ratio of having an HIV-positive baby was 7.71 (9/14÷1/12) for the group of women who did not know their HIV status before delivery (P=0.005). However, if the babies lost to follow-up or undergoing evaluation were excluded for analysis, the rate ratio would be 8.18 (9/11÷1/10) [P=0.002]. If it was assumed that all children with an undetermined HIV status were positive, then the rate ratio would be 3.43 (12/14÷3/12) [P=0.006]. The results are shown in Table 1.



* HIV human immunodeficiency virus

Fig 2. Outcomes of babies born to human immunodeficiency virus–positive mothers

Table 1. Outcomes of babies born to human immunodeficiency virus–positive mothers

Mother's status known or unknown before delivery	No. of known cases (n=12) No. (%)	No. of unknown cases (n=14) No. (%)
Outcome of baby		
Human immunodeficiency virus–positive	1 (8.3)	9 (64.3)
Human immunodeficiency virus–negative	9 (75.0)	2 (14.3)
Unknown/pending	2 (16.7)	3 (21.4)

The HIV status of the partners was known to be positive for 27 pregnant women, negative for nine, and uncertain for five. Twenty-one pregnancies were supervised by the obstetric units in the public sector and no information was available for the remaining 20 pregnancies.

Unlinked data prevalence survey

The number of samples collected and the positivity rate is summarised in Table 2. The prevalence rate was 1 in 3125 (0.032%; confidence interval [CI], 0.0008-0.1837%) in 1999 and 1 in 3031 (0.033%; CI, 0.0008-0.1782%) in 1998. The local total live births were 50 513 in 1999 and 53 356 in 1998.

Discussion

Local analysis

In this retrospective observational survey, most of the vertically acquired HIV infection came from mothers who did not know they were infected when they were pregnant, hence no preventive methods could be adopted.

The lower rate for prophylaxis against MTCT may be explained by the fact that most of the pregnant women known to be HIV-positive would have been

Table 2. Unlinked anonymous screening of human immunodeficiency virus antibody of cord blood samples from 1990 to 1999

Year	No. of neonates screened (No. of HIV-positive case)
1990	933 (0)
1991	5253 (0)
1992	5796 (0)
1993	4532 (0)
1994	4762 (0)
1995	4648 (1)
1996	3968 (1)
1997	3331 (0)
1998	3031 (1)
1999	3125 (1)

advised to terminate the pregnancy. Before the use of AZT[3] (and later combined antiretroviral treatments for maximum viral suppression[4]), improved obstetric care, use of caesarean section, and replacement feeding to reduce the risk of MTCT of HIV to ≤5%, termination of pregnancy was likely to be the only option for HIV-positive pregnant women.

The foetal outcomes for the women who knew their HIV status when they were pregnant were better than for those who did not know their HIV status. The reasons were due to AZT prophylaxis, cautious perinatal management with or without caesarean section, and advice against breast-feeding. The transmission rate was >50% for the women who did not know their HIV status, which was higher than expected for developed countries (15%-20% transmission rate is expected without intervention[11]). This could be explained by the fact that the women in this study were a highly selected group because they had an already infected baby.

Detailed information of the personal characteristics of individual women was not complete in this study so risk correlation was not possible. Apart from the fact that more women of non-Chinese origin than of Chinese origin were affected, no particular risk factors associated with a higher risk of being an HIV-positive mother were identified. Most of the mothers were not identified as being at risk for HIV infection during the antenatal visits. Similar results were found by Tse et al[12] in a prospective study of universal antenatal screening by opt-out mechanism at a local regional hospital in 1999.

There are several limitations to this survey. It was a retrospective survey involving two centres and was not territory-wide. The completeness of the case reporting and the total number of woman involved could not be ascertained. Some important information, such as the stage of HIV infection, the exact number of pregnancies after contracting the virus, the proportion of women being taken care of in the private sector, and the disease course of the infected babies was not always available. Some of the missing information was supplemented by UAS and prospective studies, such as that conducted by Tse et al.[12]

Results of the UAS of cord blood for neonates showed a steady trend during the past 5 years. Although the results were subject to some degree of error because of the low local prevalence rate, they reflected the true scenario, since results from the prospective study[12] and the voluntary reporting system (four reported vertical transmissions occurred in 1999[2]) were consistent with one another. We cannot be complacent, however, as heterosexual transmission has now emerged as the most important route of transmission (69.3% in 1998 and 59.2% in 1999) and women of reproductive age accounted for more than one sixth of the total reported HIV infections (2.9% in 1990, 19.0% in 1998, and 17.8% in 1999[2]). The summaries of trends are shown in Fig 3.[2]

Lessons to be learned from the United Kingdom

In December 1992, The Department of Health in the UK issued guidelines that recommended offering every pregnant woman voluntary confidential antenatal HIV testing in areas of high prevalence, such as London, and to women at increased risk, such as injecting drug users and certain ethnic groups (notably Africans). In 1994, Holland et al[13] reported the findings of anonymous newborn serosurveys in three Thames regions from June 1988 to December 1993, in which 729 105

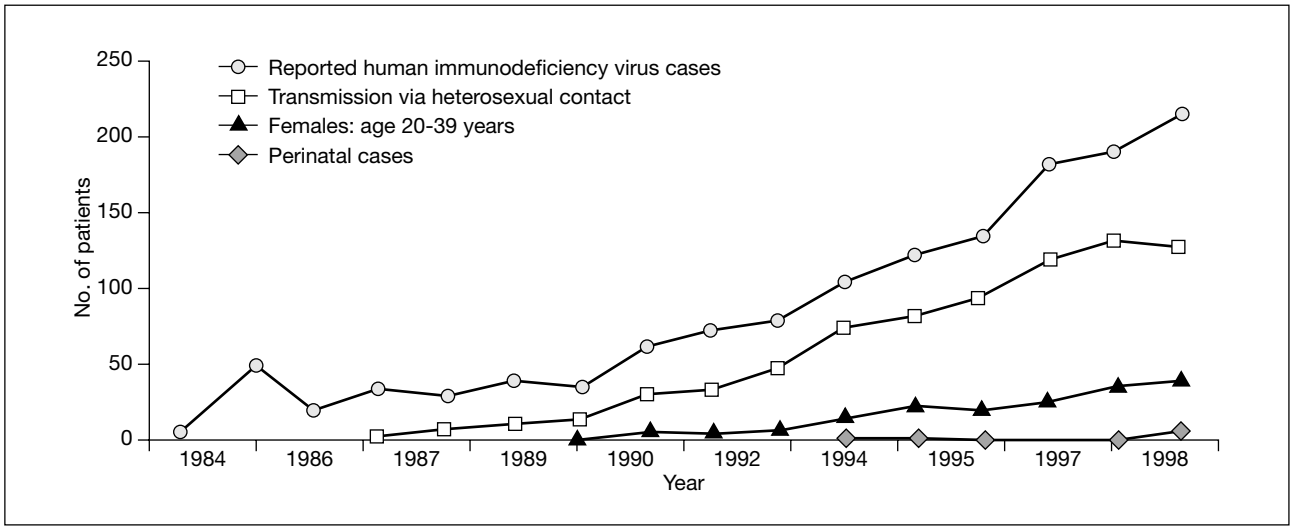


Fig 3. Trends in reported human immunodeficiency virus transmission in Hong Kong

neonatal blood samples were tested. The proportion of HIV-infected women who were identified before delivery was 16.9%, but less than half of these women were diagnosed during pregnancy. Indeed, there had been a continual decrease in the percentage of women identified during pregnancy from 10.5% in 1990, 15.2% in 1991, and 5.7% in 1992, to 3.9% in 1993. The author concluded that despite increased emphasis on antenatal testing for HIV in areas of high prevalence, the number of undiagnosed women delivering babies continued to rise and alternative strategies for offering antenatal HIV testing had to be considered.[13]

A national survey on the epidemiology and detection of HIV among pregnant women in the UK from 1988 to 1996 was conducted by Nicoll et al.[14] The number of births to HIV-positive mothers was determined by UAS using residual dried blood spot samples remaining after metabolic screening of newborn infants. The results are summarised in Fig 4.

There were 1459 HIV-positive births, of which only 122 (8.4%) were detected by the screening policy—77% of births were to HIV-positive mothers who were not diagnosed with antenatal screening. The situation was similar for London and the rest of the UK (except Scotland) with respect to the percentage of HIV diagnosed before or during pregnancy. Data from voluntary confidential reporting by obstetricians, paediatricians, other clinicians, and microbiologists showed that 128 children with AIDS were thought to have acquired HIV via vertical transmission from their mothers. The authors concluded that the level of diagnosis among pregnant women had not improved since the recommendation made by the Department of Health in 1992.[14]

In August 1999, the Department of Health in the UK revised the recommendations and targets aiming

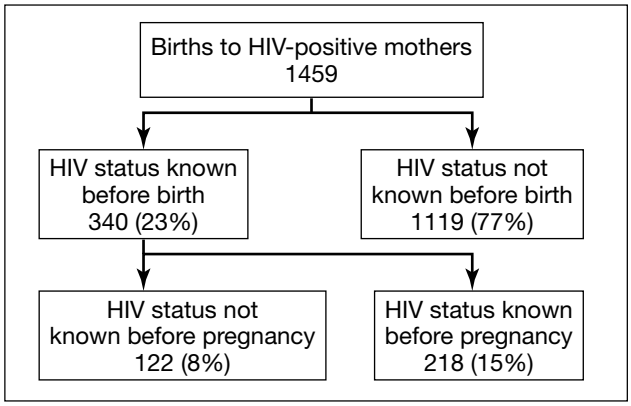


Fig 4. Epidemiology and detection of human immunodeficiency virus among pregnant women: UK national survey, 1988-1996

to reduce MTCT of HIV were set up to achieve a national objective of reducing the number of babies with HIV acquired from an infected mother during pregnancy. The recommendations and targets are summarised as follows.[15] All health authorities were to attain the following targets by 31 December 2000: (1) all pregnant women are to be offered an HIV test as an integral part of their antenatal care; (2) an increased uptake of antenatal HIV testing to a minimum of 50%; and (3) to increase uptake by a further 15% in those health authorities with effective monitoring systems in place and already achieving 50% or more HIV screening. By 31 December 2002, all health authorities should achieve an increase in uptake of antenatal HIV testing to 90%, so that 80% of HIV infected pregnant women are identified during antenatal care.

In short, universal screening is to be offered in an opt-out manner to all pregnant women and to be implemented in areas with low prevalence (the 1996 HIV figures among mothers were 0.19% in London, 0.025% in Scotland, and 0.016 in the rest of the UK).

Strategies in countries other than the United Kingdom

Since August 1994, the US Public Health Service recommended AZT to reduce perinatal HIV transmission and, in July 1995, routine HIV counselling and voluntary prenatal testing was recommended. Some states (for example, Arkansas and New York State) have even passed legislation stating that health care providers should test all pregnant women for HIV.[16,17] Many other European countries have adopted universal antenatal screening. For instance, France, where by law all pregnant women are offered HIV testing, has been especially successful at reducing the rate of paediatric AIDS. It is interesting to know that the European Study Group on Antenatal Testing, under the aegis of the European Union, has produced a consensus document and recommendation, re-emphasising the point that such testing was not only in the interests of the babies but also of the asymptomatic women.[18]

Some Asian countries/cities, including Malaysia and Shen Zhen, have adopted routine antenatal screening for prevention of MTCT of HIV.[19] Taiwan has also been working towards a similar strategy.

Comparison between Hong Kong and other countries

In Hong Kong, a selective approach, by which women with identifiable high-risk behaviour attending an antenatal clinic would be advised to have HIV antibody testing, has been adopted during the past few years. As in the UK, however, only a small number of

Table 3. Comparison of human immunodeficiency virus prevalence among pregnant women in Hong Kong, the UK, and Malaysia

Screening type (year)	Hong Kong	UK	Malaysia
Unlinked anonymous screening			
1996		London 0.191% Scotland 0.025% Rest of UK 0.016% Total 0.053%	-
1998	0.033%		
1999	0.032%		
Voluntary antenatal testing			
1998		-	0.035%
1999	0.055%		0.026%

pregnant women were tested and only a few of the HIV-positive women were identified by this approach. This observation has been verified by a prospective study conducted at the Kwong Wah Hospital, in which 5597 women attending the antenatal clinic were recruited for HIV testing by an opt-out approach.[12] Ninety-seven percent of the women accepted HIV antibody testing after routine antenatal advice (including HIV testing). Three women were found to be HIV-positive, none of whom could have been identified by the selective approach since they did not practice high-risk behaviour.

The prevalence of HIV in Hong Kong is comparable to that in Scotland and higher than in areas other than London in the UK. The UK Department of Health has already adopted a universal testing strategy. This approach has been shown to be cost-effective even in the low prevalence area of the Midlands, provided there is a high uptake. No more than 3.5 extra minutes were spent counselling each individual woman.[20] Learning from this experience, we strongly advocate adopting universal antenatal screening (by an opt-out mechanism) in Hong Kong to prevent MTCT of HIV.

The local figures are also comparable to those of Malaysia (Table 3), which has implemented universal antenatal HIV testing by stages since 1998.[19]

Assuming there are approximately 60 000 deliveries in Hong Kong every year, there will be 18 to 20 (60 000 x 0.032) deliveries to women affected by HIV. If 30% is taken as the percentage of vertical transmissions, there will be five to six babies born infected by HIV each year. Alternatively, if 15% to 20% is taken as the true transmission rate, the number of infected babies born will be three to four each year. This figure is close to the total number of reported cases of vertical transmission in 1999. Pooling the data collected by different methods, the estimated number of babies infected by HIV will be between three and ten per year (60 000 x 0.03 x 0.15; 60 000 x 0.055 x 0.3). Based on the results of this survey and the estimations made, we urge adoption of universal antenatal screening in the local setting to face the challenge ahead.

Conclusions

Human immunodeficiency virus–related pregnancy is not rare in Hong Kong. The majority of these pregnancies escape identification and treatment under the current health care programme. Effective prophylactic measures are available to prevent vertical transmission of HIV. Detection of HIV-related pregnancies will prove to be invaluable for the prevention of MTCT of HIV. Universal antenatal screening for HIV infection is therefore proposed as an effective and feasible strategy.

References

1. Joint United Nations Programme on HIV/AIDS (UNAIDS). Report on the global HIV/AIDS epidemic; June 2000.
2. Virtual AIDS office of Hong Kong. Department of Health, Hong Kong website: http://www.info.gov.hk/aids
3. Connor EM, Sperling RS, Gelber R, et al. Reduction of maternal-infant transmission of human immunodeficiency virus type 1 with zidovudine treatment. Pediatric AIDS Clinical Trials Group Protocol 076 Study. N Engl J Med 1994;331: 1173-80.
4. Sperling RS, Shapiro DE, Coombs RW, et al. Maternal viral load, zidovudine treatment, and the risk of transmission of human immunodeficiency virus type 1 from mother to infant. Pediatric AIDS Clinical Trials Group Protocol 076 Study Group. N Engl J Med 1996;335:1621-9.
5. Mofenson LM, Lambert JS, Stiehm ER, et al. Risk factors for perinatal transmission of human immunodeficiency virus type 1 in women treated with zidovudine. N Engl J Med 1999;341: 385-93.
6. Shaffer N, Roongpisuthipong A, Siriwasin W, et al. Maternal virus load and perinatal human immunodeficiency virus type 1 subtype E transmission, Thailand. J Infect Dis 1999;179: 590-9.
7. Wade NA, Birkhead GS, Warren BL, et al. Abbreviated regimens of zidovudine prophylaxis and perinatal transmission of the human immunodeficiency virus. N Engl J Med 1998;

339:1409-14.
8. Saba J, and the PETRA Trial Study Team. Interim analysis of early efficacy of three short courses of ZDV/3TC combination regimens to prevent mother-to-child transmission of HIV. The PETRA Trial. 6th Conference on Retroviruses and Opportunistic Infections, Chicago. Jan/Feb 1999 (Seminar-8). Conference on Retroviruses and Opportunistic Infections website: http://www.retroconference.org/2002/past_conf.htm
9. Guay LA, Musoke P, Fleming T, et al. Intrapartum and neonatal single-dose nevirapine compared with zidovudine for prevention of mother-to-child transmission of HIV-1 in Kampala, Uganda: HIVNET 012 randomised trial. Lancet 1999;354:795-802.
10. Chiu SS, Lau YL. Perinatal acquired human immunodeficiency virus infection in children in Hong Kong: the experience of one centre. HK J Paediatr 2000;5:132-8.
11. European Collaborative Study. Risk factors for mother-to-child transmission of HIV-1. Lancet 1992;339:1007-12.
12. Tse HY, Lai FK, Wong J, Chan AS, Tang LC. Universal screening of human immunodeficiency virus infection in pregnant women in Hong Kong: prospective study. HKMJ 2001;7:246-50.
13. Holland FJ, Ades AE, Davison CF, et al. Use of anonymous newborn serosurveys to evaluate HIV screening programmes. J Med Screen 1994;1:176-9.
14. Nicoll A, McGarrigle C, Brady AR, et al. Epidemiology and detection of HIV-1 among pregnant women in the United Kingdom: results from national surveillance 1988-96. BMJ 1998;316:253-8.
15. UK Department of Health. Reducing mother to child transmission of HIV. Health Service Circular August 1999; 1999/83.
16. Prenatal discussion of HIV testing and maternal HIV testing—14 states, 1996-1997. MMWR Morb Mortal Wkly Rep 1999; 48;401-4.
17. Lindegren ML, Byers RH Jr, Thomas P, et al. Trends in perinatal transmission of HIV/AIDS in the United States. JAMA 1999;282:531-8.
18. Hudson CN, Sherr L. Antenatal HIV testing in Europe. Lancet 1997;350:1783.
19. Antenatal Screening. Ministry of Health, Malaysia. AIDS/STD Section, Division of Disease Control, Department of Public Health. October 1999.
20. Ades AE, Sculpher MJ, Gibb DM, Gupta R, Ratcliffe J. Cost effectiveness analysis of antenatal HIV screening in United Kingdom. BMJ 1999;319:1230-4.