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ORIGINAL ARTICLE

Clinical and laboratory characteristics of human immunodeficiency virus-infected adolescents: Experience from a single medical center

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KEYWORDS
Adolescents;
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Background: Recently, the proportion of adolescents diagnosed with human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS) has increased. The aim of this study is to evaluate the clinical and laboratory characteristics of HIV-infected adolescents in southern Taiwan.
Methods: From June 1997 to December 2010, a total of 40 HIV-infected adolescents who sought medical care in a university hospital in southern Taiwan were enrolled in the study. They were classified into three HIV at-risk groups, men who have sex with men (MSM), heterosexuals, and intravenous drug users (IDUs). Clinical and laboratory data were obtained from medical records.
Results: The median age of the 40 HIV-infected adolescents was 19 years. The HIV at-risk groups were MSM (22/40, 55%), heterosexuals (7/40, 17.5%), IDUs (5/40, 12.5%), and unknown (6/40, 15%). The initial median CD4 count and log plasma HIV viral load were 318 cells/mm^3 and 4.61, respectively. The seroprevalence of anti-HAV, anti-HBc, anti-HCV antibodies and HBsAg was 5.3%, 26.1%, 13% and 13%, respectively. Among 17 adolescents who had regular follow-ups more than twice, 7 (41.2%) had a concurrent sexually transmitted disease (STD). The most common STD was genital warts (41.2%) followed by syphilis (11.8%). Among 7 patients

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who received highly active antiretroviral agents (HAART) for more than 12 months, 5 (71.4%) had sustained virologic suppression.
Conclusion: MSM are the largest risk group in HIV-infected adolescents in southern Taiwan and are characterized by a high prevalence of anogenital warts and low seroprevalence of anti-HAV.

Introduction

It is estimated that 33.3 million people are living with human immunodeficiency virus (HIV) globally, with nearly 2.6 million new HIV infections and 1.8 million acquired immunodeficiency syndrome (AIDS) deaths in 2009 alone.[1] In the United States, the number of cases of HIV infection is increasing among adolescents. The Centers for Disease Control and Prevention (CDC) reported 579 cases in 1994 and 5400 cases in 2006.[2,3] From 1997 to 2006, AIDS rates doubled in males between 15 and 24 years of age largely due to the dramatic increase in HIV infection among males who have sex with men in this age group.[4]

In Taiwan, reports have indicated that a significant number of teenagers had their first sexual experience without the use of a condom and with multiple partners.[5] A survey of 8541 high school students in Taiwan in 2000 showed that 14% of male and 10% of female students have had a sexual experience.[6] Another study from 2002 and 2003 showed that 27% of high school students in southern Taiwan have had a sexual experience and that 79% had engaged in high-risk sexual behavior. Among sexually active students, 8.8% had chlamydial infection and 1.1% had gonococcal infection.[7] As a result, a high prevalence of risky behavior among teenagers has created a potential epidemic of sexually transmitted disease (STD) and HIV.

The proportion of HIV-infected youth aged 15-24 years is increasing from 14% (272 cases) in 2007 to 20% (351 cases) in 2009, and 28% (413 cases) in 2009 with most (90%) acquiring HIV infection through sexual behavior.[8] However, a study evaluating the clinical profile of adolescents infected with HIV through horizontal transmission was lacking in Taiwan. The objective of this study is to evaluate the clinical and immunologic characteristics, serology of viral hepatitis, concurrent STDs, and therapeutic response to antiretroviral agents among HIV-infected adolescents younger than 20 years old in southern Taiwan.

Materials and methods

Patient enrollment

From Jan. 1, 1997 to Dec. 31, 2010 a total of 40 HIV-infected adolescents were enrolled. These patients were followed in the National Cheng Kung University Hospital, a tertiary care center in southern Taiwan. They were categorized into three at-risk groups according to presumed HIV transmission routes: men who have sex with men (MSM), heterosexuals, and intravenous drug users (IDUs). All of the data was obtained by reviewing medical records.

Definitions

The age of enrollment was defined as the age of HIV infection confirmed by Western blot method. Adolescence is defined as the age between 10-19 years of age according to the World Health Organization (WHO). AIDS was diagnosed by a confirmed HIV-1 infection with either a CD4 cell count less than 200 cells/mm^3 or a suspected or confirmed opportunistic infection or AIDS-defining malignancy. Acute HIV infection, or primary HIV infection, was defined as the period from the initial infection with HIV to complete seroconversion. The categories of HIV surveillance such as mandatory or active HIV testing (i.e. voluntary, anonymous HIV testing) were defined by the policy for HIV surveillance of CDC Taiwan.[9] The clinical staging of HIV/AIDS was determined using the revised World Health Organization (WHO) clinical staging based on HIV-associated symptoms; asymptomatic for stage 1, mild symptoms for stage 2, advanced symptoms for stage 3, and severe symptoms for stage 4.[10] Highly active anti-retroviral therapy (HAART) was defined as an anti-retroviral regimen consisting of two nucleoside reverse transcriptase inhibitors (NRTI) combined with another NRTI or one to two protease inhibitors. Undetectable HIV-1 plasma viral load was defined as plasma HIV-1 RNA $<$ 400 copies/mm^3. An adequate CD4 response is defined as an increase in CD4 count in the range of 50-150 cells/mm^3 per year. Rebound of plasma HIV viral load (HIV PVL) was defined as detectable HIV PVL above 400 copies of HIV-1 RNA/mm^3 from previous virologic suppression.

Study design

Algorithm of the study design is illustrated in Fig. 1 where demographics and data regarding HIV surveillance are described for all enrolled patients. Immunologic, clinical characteristics, and seroprevalence of hepatitis A, B, and C viruses were obtained from 24 (60%) patients who had CD4 count data soon after diagnosis. Concurrent STDs were evaluated for 17 adolescents who attended follow-ups 2 or more times in outpatient clinics. Immunologic and virologic responses to HAART were analyzed among 5 chronic HIV infection patients who received HAART strictly for more than 12 months with sustained virologic suppression throughout the study period.

Laboratory monitoring

We monitored complete blood cells (CBC), lymphocyte subsets, plasma HIV RNA quantification, and serologic testing for viral hepatitis and syphilis. Lymphocyte subsets

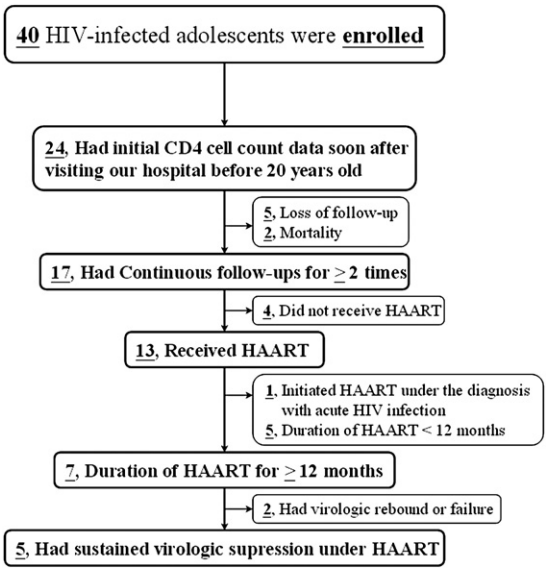

Figure 1. Flow chart of study design.

of $CD4^+$ T cells, and $CD8^+$ T cells were enumerated using direct immunofluorescence with fluorescein isothiocyanate. Samples were analyzed by flow cytometry (Beck-Dickinson Immunocytometry Systems or EPICS-XL; Beckman Coulter, CA, USA). Anti-HIV antibody was detected using an enzyme-linked immunosorbent assay. Plasma HIV-1 RNA quantification was assessed every three to six months in patients receiving antiretroviral therapy. HIV-PCR was analyzed using primers detecting LTR-*gag*, *pol*, and *env*. Plasma HIV-1 RNA quantification was performed using quantitative reverse transcriptase-PCR assay (Roche Amplicor, Version 1.5; Roche, Branchburg, NJ, USA or Cobas AmpliPrep/Cobas TaqMan [CAP/CTM] assay). Serologic specimens were tested for IgG antibodies to Hepatitis A Virus (HAV) (HAV-IgG) (Axesbaden-Delkenheim, Germany), hepatitis B surface antigen (HBsAg), antibody to HBsAg (HBsAb) (AxSYM HAVAB 2.0; Abbott GmbH Diagnostika,Wiesbaden-Delkenheim, German), and antibodies to Hepatitis C Virus (HCV) (HCV Ab) (AxSYM HCV version 3.0; Abbott Laboratories, Abbot Park, IL, USA). Nontreponemal antibodies against *Treponema pallidum* were measured using the RPR Card Test (Becton-Dickinson, Maryland, USA), and treponemal-specific antibodies were measured using the *T pallidum* hemagglutination (TPHA) assay (SERODIA-TPPA; Fujirebio, Taoyuan, Taiwan). The RPR and TPHA tests were performed according to the manufacture's instructions. Participant with a TPHA titer $\geq$ 1:160 were considered *T pallidum*-seroreactive.

Statistical analysis

All statistical analyses were conducted using the Statistical Package for the Social Sciences (SPSS) version 10.0 for Windows (SPSS Inc, Chicago IL, USA). Data were analyzed to determine the statistical significance of differences between the types of HIV surveyed, the seroprevalence of viral hepatitis and concurrent STDs among the three at-risk groups. A p value <0.05 was considered statistically significant.

Table 1 Demographic features and human immunodeficiency virus (HIV) surveillance among 40 HIV-infected adolescents

Demographic data	Total (n = 40) no. (%)	MSM (n = 22) no. (%)	Heterosexuals (n = 7) no. (%)	IDUs (n = 5) no. (%)	Unknown risk (n = 6) no. (%)
Age (y)					
16	2 (5)	1 (4.5)	1 (14.3)	0	0
17	9 (22.5)	4 (18.2)	3 (42.9)	1 (20)	1 (16.7)
18	9 (22.5)	6 (27.3)	1 (14.3)	0	2 (33.3)
19	20 (50)	11 (50)	2 (28.6)	4 (80)	3 (50)
Men	36 (90)	22 (100)	5 (71.4)	4 (80)	5 (83.3)
Married	2 (5)	1 (4.5)	0	0	1 (16.7)
HIV surveillance & screening					
Detected by clinician	5 (12.5)	5 (22.7)[a]	0	0	0
Mandatory HIV testing	20 (50)	7 (31.8)[b]*	4 (57.1)[c]	5 (100)[d]*	4 (66.7)
Voluntary or anonymous HIV testing	10 (25)	7 (31.8)[e]	3 (42.9)	0	0
Unknown	5 (12.5)	3 (13.6)	0	0	2 (33.3)

[a] All five cases had symptomatic HIV infection, including; one with recurrent oral thrush, one with mononucleosis-like symptoms, one with genital/oral ulcers and significant body weight loss, one with wasting syndrome, and one with bilateral pneumonia.
[b] Three cases were detected by blood donation, three by military HIV testing, and one in a juvenile detection house.
[c] Two cases were detected by blood donation, one was detected by military HIV testing, and one was detected in juvenile detection house.
[d] Three cases were detected in a drug rehab/detection center and two cases were detected by military HIV testing.
[e] One case received HIV testing because his partner was HIV positive, one case received HIV testing because his partner had syphilis, and two cases had a positive syphilis screening result.
* P value <0.05.
HIV = human immunodeficiency virus; IDUs = intravenous drug users; MSM = men who have sex with men.

Results

HIV surveillance and demographic data

During the 14 year study period, 1127 HIV-infected patients sought HIV care at this hospital and 40 (3.6%) were HIV-infected adolescents. The HIV at-risk groups included MSM (22/40, 55%), heterosexuals (7/40, 17.5%), IDUs (5/40, 12.5%), and unknown risk (6/40, 15%). There were 5 (12.5%) patients with HIV detected by their clinician due to presentation of symptoms, 20 (50%) that were screened by mandatory HIV testing, 10 (25%) that received voluntary or anonymous HIV testing, and 5 (12.5%) that were unknown. The HIV surveillance and demographic data of HIV-infected adolescents is summarized in Table 1. The median age at enrollment was 19.0 years (range, 16.1 to 19.9 years) with a male-to-female ratio of 9. Two patients (5%) were married before enrollment. All of the IDUs were screened positive through mandatory HIV testing ($p < 0.05$). Data for high-risk behaviors were available for 10 MSM and 2 heterosexual patients. The median period of high risk behavior before HIV diagnosis was 1.4 years (range, 0.1-3.0 years) among HIV-infected adolescents.

Clinical and immunologic status

A total of 24 adolescents had recorded CD4 cell counts on their first visit. The median CD4 count was 318 cells/mm^3 (range, 11-993 cells/mm^3), CD8 count was 1262 cells/mm^3 (range, 177-3516 cells/mm3), and log HIV-1 viral load was 4.61 (range, 3.11-7.00). The data are summarized in Table 2. Among 22 patients with chronic HIV infection with/without AIDS, 19 (86.4%) were stage 1 and they were either asymptomatic or had generalized lymphadenopathy. One 19-year-old MSM (4.5%) with recurrent oral candidiasis and ulceration was stage 2 and he was referred to the infectious outpatient department by his dentist where 3 concurrent STDs (Syphilis, genital wart and gonorrhea) were detected on his first visit. One 19.5-year-old MSM (4.5%) with significant weight loss (>10%), genital ulcers and oral candidiasis was stage 3 and concurrent genital warts were detected during his first visit. One 17.5-year-old MSM (4.5%) who presented with HIV wasting syndrome and *Cryptococcus* sepsis was stage 4, he had significant cachexia on his first visit to the emergency room and followed a rapid fatal course in the second day after visiting the hospital.

Seroprevalence of viral hepatitis

Among the 24 patients who had CD4 count data soon after enrollment and before reaching 20 years old, the seropositive rate of HAV-IgG was 5.3%, HBsAg 13.0%, anti-HBc 26.1% and HCV Ab 13.0% (Table 3). For patients born after Jul 1984 (n = 18), two patients (11.1%) were seropositive for HBsAg and five (27.8%) were seropositive for anti-HBc antibody.

Concurrent STDs

Among the17 patients (13 MSMs and 4 heterosexuals) who received continuous follow-up ≥2 times in the cohort, none of heterosexuals had concurrent STD. The rates of concurrent STDs among MSM group were 53.8% (Table 4).

Table 2 Comparison of initial diagnosis, immunologic and HIV-1 viral load data among human immunodeficiency virus (HIV)-infected adolescents

Categories	Total	MSM	Heterosexuals	IDUs
	(n = 24)	(n = 17)	(n = 6)	(n = 1)
	no. (%)	no. (%)	no. (%)	no. (%)
Initial diagnosis in our hospital				
Acute HIV infection	2 (8.3)	2 (11.8)	0	0
Non-AIDS[a]	17 (70.8)	11 (64.7)	5 (83.3)	1 (100)
AIDS[b]	5 (20.8)	4 (23.5)	1 (16.7)	0
Immunologic data				
Median CD8 cells/mm^3 (range)	1262 (177—3516)	1245 (177—3516)	1280 (716—1402)	915
Median CD4 cells/mm^3 (range)	318 (11-—993)	288 (11—941)	549 (151—993)	586
Range of CD4 count cells/mm^3				
>350	10 (41.7)	5 (29.4)	4 (66.7)	1 (100)
200—350	8 (33.3)	7 (41.2)	1 (16.7)	0
100—199	3 (12.5)	2 (11.8)	1 (16.7)	0
<100	3 (12.5)	3 (17.6)	0	0
Median plasma HIV RNA log 10 copies/mm^3 (range)	4.61 (3.11—7.00)	4.64 (3.11—7.00)	3.88 (3.57—5.30)	3.68

[a] Non-AIDS was defined as chronic HIV infection with CD4 count >200 without AIDS defined illness. All 17 of the non-AIDS adolescents were in clinical stage 1 according to revised WHO clinical staging of HIV/AIDS for adults and adolescents.[10]

[b] Of the five adolescents diagnosed with AIDS, two were in clinical stage 1, one was in clinical stage 2 with an initial CD4 count of 152 cells/mm^3, one was in clinical stage 3 with and initial CD4 count of 46 cells/mm^3, and one was in clinical stage 4 with an initial CD4 count of cells/mm^3.

AIDS = acquired immunodeficiency syndrome; HIV = human immunodeficiency virus; MSM = men have sex with men.

Table 3 Seroprevalence of viral hepatitis among human immunodeficiency virus (HIV)-infected adolescents

Serologic test	All tested	MSM	Heterosexual	IDUs
	Case no. with positive result/case no. tested (%)			
HAV-IgG	1/19 (5.3)	0/14 (0)	1/4 (25)	0/1 (0)
HBsAg	3/23 (13.0)[a]	1/16 (6.3)	2/6 (33.3)	0/1 (0)
HBc Ab	6/23 (26.1)[b]	2/16 (12.5)	4/6 (66.7)	0/1 (0)
HCV Ab	3/23 (13.0)	1/16 (6.3)	1/6 (16.7)	1/1 (100)

[a] Of the three patients who were seropositive for HBsAg, one was born in July 1981, one in May 1985, one in November 1990. The HBsAg seropositive rate among those born after July 1984 was 11.1%.
[b] The HBc Ab seropositive rate among those born after July 1984 was 27.8%.
HAV = hepatitis A virus; HBc Ab = anti-hepatitis B core protein antibody; HBsAg = hepatitis B surface antigen; HCV Ab = anti-hepatitis C virus antibody; HIV = human immunodeficiency virus; IDUs = intravenous drug users; IgG= immunoglobin G; MSM = men who have sex with men.

Antiretroviral therapy

There were 13 patients that received HAART therapy during the study period in our cohort. Of them, 7 cases were treated for more than 12 months, two (28.6%) of which experienced virologic failure. One patient was tracked beginning in the 8th month of HAART for 26 months. Another patient had a temporary rebound of HIV PVL in the 20th, 36th, and 46th month with 5750, 2240, and 440 copies of HIV RNA/mm^3 during 112 months, respectively. Of the 5 (71.4%) patients that had sustained virologic suppression throughout the study period, the median duration of HAART treatment was 20 months (range, 14-70 months). The immunologic and virologic responses were summarized in Table 5.

Outcome

Among 24 patients with available CD4 counts, 2 (8.3%) died soon after visiting the hospital. One AIDS patient died of AIDS wasting syndrome and *Cryptococcus* sepsis with an initial CD4 count of 38 cells/mm^3 during the 2nd day of hospitalization. Another patient with acute HIV infection died of severe influenza pneumonia with an initial CD4 count of 11 cell/mm^3 in the 10th day of hospitalization. Of the 17 patients with regular follow-ups, 1 (5.9%) MSM had newly acquired syphilis 20 months after enrollment. Of the 13 patients who received HAART, all survived with a median of 14 months for HAART therapy (range 1-112 months) without new opportunistic infections or HIV associated end organ damage.

Table 4 Sexually transmitted diseases among human immunodeficiency virus (HIV)-infected adolescents who received continuous follow-ups ≥2 times at a tertiary care hospital

Reported sexually transmitted diseases (STDs)	Total	MSM	Heterosexuals
	(n = 17)	(n = 13)	(n = 4)
	no. (%)	no. (%)	no. (%)
Syphilis[a]	2 (11.8)	2 (15.4)	0
Genital warts	7 (41.2)	7 (53.8)	0
Genital herpes	1 (5.9)	1 (7.7)	0
Gonorrhea	1 (5.9)	1 (7.7)	0
Any concurrent STDs	7 (41.2)	7 (53.8)	0
Concurrent STDs, no.			
1 STD	2 (11.8)	3 (23.1)	0
2 STDs	5 (29.4)	4 (30.8)	0

[a] Serum rapid plasma regain (RPR) titers ≥1:4 among patients with *Treponema pallidum* hemagglutination (TPHA) titer ≥1:160.
HIV = human immunodeficiency virus; MSM = men have sex with men; RPR = rapid plasma regain; STDs = sexually transmitted diseases; TPHA = *Treponema pallidum* hemagglutination.

Discussion

HIV-1 infection in pediatric patients causes a broad spectrum of disease by various transmitted routes. Most pediatric HIV infections are acquired through mother-to-child transmission, although infection via contaminated blood products or tissue, unsafe injection or incision practices, and sexual abuse also takes place.[11] In adolescents, horizontal spread of transmission through sexual contact and intravenous drug use are substantial methods of transmission. Adolescents must be an important focus for HIV prevention programming and research. In Taiwan, adolescents aged 10-19 years old make up a small percentage (1.8%, 338/19105) of HIV-infected patients during our study period (1997-2010) according to statistics from CDC Taiwan.[12] Most of our 40 cases have behavioral acquisition of HIV-1 infection and half of them were screened by mandatory HIV testing.

The rate of HIV progression varies widely among individuals, the median time of progression from HIV infection to AIDS is nine to ten years.[13] In the current study, about one-fifth (20.8%) of adolescents diagnosed with AIDS experience a median 2 year period of engaging in high risk behavior at enrollment. Rapid HIV progression may be related to immunologic variation of susceptible host and genetic variation of infective virus.[14] However, studies of rapid HIV progression among sexually active youth is lacking.

In Taiwan, HIV-positive MSM, heterosexuals, and IDUs all had significant higher prevalence of anti-HAV antibodies compared with HIV-negative persons. Increasing age was also associated with increased anti-HAV antibody prevalence.[15] Young age may account for the low HAV seropositivity because only one patient (5.3%) was positive for

Table 5 Treatment response among five human immunodeficiency virus (HIV)-infected adolescents who received highly active antiretroviral agents (HAART) strictly for ≥12 months with sustained virologic suppression throughout the study period

	Case 1	Case 2	Case 3	Case 4	Case 5
Enrollment year	2005	2005	2006	2009	2009
Gender	Male	Male	Male	Male	Male
Age (y)	19.9	19.3	19.2	17.9	19.5
Period from enrollment to HAART (mo)	0.4	37	35	0.4	0.2
$CD4^+$ cell count prior to HAART (cells/mm^3)	205	305	365	151	46
PVL prior to HAART (log10 copies/mm^3)	5.95	4.87	4.35	3.7	5.12
Duration of HAART treatment (mo)	70	25	14	15	20
Treatment response					
Time to undetectable HIV PVL (mo)	1.4	3.3	1.2	0.9	4
Increased CD4 count after 6 months of therapy (cells/mm^3)	403	165	316	188	110
Increased CD4 count after 12 months of therapy (cells/mm^3)	565	74	287	461	201
Increased CD4 count per year (cells/mm^3/y)	121	51	239	192	189
CD4 count at the end of follow-up(cells/mm^3)	920	413	652	400	367

HAART = highly active antiretroviral therapy; HIV = human immunodeficiency virus; PVL = plasma viral load.

anti-HAV in our study. This low prevalence of HAV infection also makes HIV-infected adolescents optimal candidates for HAV vaccination. Current guidelines also recommend HAV vaccination as an important preventive strategy for HIV-infected MSMs, IDUs and persons with chronic liver disease or co-infected with hepatitis B and/or C.[16] Studies also reveal that HAV vaccination could induce durable seropositive responses up to 6-10 years among HIV-infected adults and could induce high immune response in HIV-infected children aged 2-16 years.[17,18]

Hepatitis B virus is one of the major causes of chronic liver disease in Taiwan. 18 of 23 (78.3%) tested adolescents in our study were born after July 1984 when the nationwide Hepatitis B Vaccine (HBV) vaccination program was launched. This mass vaccination program for infants provides not only long-term protection from Hepatitis B for up to 20 years but also a reduction of HBV infection in Taiwan.[19] Recent studies have shown significant decline in the seroprevalence of HBV infection among both HIV-negative and HIV-positive persons who were born in the era of nationwide HBV vaccination in Taiwan and the seroprevalence of HBsAg and anti-HBc among HIV-infected patients born after Jul 1984 was 3.3% and 30.0% respectively.[20] Among our patients born after July 1984, a similar seropositive rate of anti-HBc (27.8%, 5/18) and higher seropositive rate of HBsAg (11.1%, 2/18) are observed. In the general population, the seroprevalence of HBsAg and anti-HBc antibody was 1.6% and 4.1% in those born after July 1986 in adolescents aged 15-17 years in Taiwan.[21] Because high risk behaviors increase the exposure to HBV and because subclinical infection could happen, it is reasonable that seroprevalence of anti-HBc antibody is high among HIV-infected patients born after July 1984. As for the 2 cases born after July 1984 with positive HBsAg, HBV breakthrough infection or natural HBV infection is hard to conclude due to a lack of HBV vaccination information. However, HBV infection was truly a concern among sexually active HIV-infected adolescents because 10.1% of the general population may have lost immune memory to hepatitis B antigen when they were 15-18 years old.[21] Booster of hepatitis B vaccine should be considered in those high risk groups with negative HBs antibody.

Concurrent STDs in HIV infected persons are common. In southern Taiwan, reports have shown that the prevalence of STDs before and at the diagnosis of HIV to be approximately 40% (syphilis 38% and genital warts 14%).[22] Our study reports a similar prevalence of concurrent STDs (41.2%) and the most common STD being genital warts (53.8%) instead of syphilis (15.4%) among MSM. For Human Papilloma Virus (HPV) infection, recent studies demonstrated that younger age was independently associated with detection of anal HPV in HIV-negative MSM. The prevalence of HPV infection among MSM aged 18-24 years is high (60%) and decreases gradually with increasing age.[23,24] Persons who are HIV-infected are more likely to develop genital warts than persons who are not HIV-infected.[25] As a result, HPV infection may become an important issue among HIV-infected young homosexuals.

Virologic response to HAART treatment of HIV infection depends on viral sensitivity to antiretrovirals and medication adherence. As previous studies indicate, medicine adherence rates among HIV-infected youth are poor with the rate of adherence ranging from 28.3% to 69.8%.[26,27] Among our patients who received an antiretroviral agent for more than 12 months (n = 7), most (71.4%) had sustained virologic suppression, suggesting that the majority of our patients have good adherence to medication but further investigation is needed to elucidate the phenomena. Because adolescence is a period that is characterized by rapid changes in physical maturation, cognitive processes, and life style, predicting long-term adherence in an adolescent can be very challenging.

In response to the increasing proportion of youth people infected with HIV in Taiwan, risk-reduction strategies for preventing sexually transmitted acquisition of HIV among adolescents should be developed by social, behavioral and public health experts. A recent study concluded that behavioral interventions reduced adolescent risk for STDs more broadly, increase condom use, reduce or delay frequency of penetrative sex, and increase skills to

negotiate safer sex and to acquire condoms.[28] More accessible HIV testing, HIV counseling, and behavior interventions are important for awareness of HIV-infected status and for decreasing HIV transmission among HIV-infected people.[29]

Our study has several limitations. First, it is a retrospective observational study; we were not able to assess the data regarding psychosocial issues like mental illness, substance abuse, family and financial support, and developmental problems among our patients because of limited data on medical records. Second, statistical analysis of STDs among at-risk groups could not be performed because of a limited number of patients. Third, evaluation of long-term immunologic response to HAART and HIV-associated morbidity among these adolescents is incomplete due to a lack of long term follow-up. This study, though the case number is small, is the first study focused on the clinical and laboratory characteristics among HIV-infected adolescents in Taiwan.

In conclusion, adolescent-oriented HIV health care could be developed owing to the unique clinical characteristics of HIV infection in this group. A high prevalence of sexually transmitted diseases such as anogenital warts among men who have sex with men are similar to reports in Western countries. Considering the global trend of increasing numbers of youth infected with HIV, more effort should be taken for prevention and harm-reduction policy among adolescents with HIV infection in Taiwan.

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