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HCV viremia is associated with drug use in young HIV-1 and HCV coinfecting pregnant and non-pregnant women*

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Abstract

Aims—Vertical transmission of HCV is increased among HIV-1/HCV coinfecting women and is related to HCV viral load. In this study we assessed clinical and demographic factors associated with HCV viremia in a cohort of young pregnant and non-pregnant mothers coinfecting with HIV-1.

Design—A cross-sectional clinic-based study nested within a prospective cohort study.

Methods—From 1988 to 2000, HIV-1 + pregnant and non-pregnant women with children followed in a large maternal, child and adolescent HIV-1 clinic were evaluated for HCV infection using EIA 3.0. HCV RNA levels were determined for HCV antibody + women using polymerase chain reaction. Demographic and clinical characteristics between HCV-RNA(+) and HCV-RNA(−) women and between pregnant and non-pregnant HIV-1/HCV coinfecting women were compared using univariate and multivariate analyses.

Findings—Among 359 HIV-1(+) women, 84 (23%) were HCV-ab + and 49/84 (58%) had detectable HCV-RNA in plasma. Median age was 31. CD4 counts, HIV-1 RNA levels and demographic characteristics were similar for viremic and non-viremic women and pregnant and non-pregnant women. However, viremic women were more likely to report a history of (88% versus 43%; $P < 0.001$) or active injection drug use (AIDU) (83% versus 29%; $P < 0.001$). Logistic regression analysis showed that HCV viremia was associated significantly with AIDU (adjusted OR: 15.17; 95% CI: 3.56, 64.56) after adjusting for age, race, number of sexual partners, pregnancy status, CD4 counts and HIV-1 viral load.

Conclusion—In this cohort of young HIV-1 and HCV coinfecting women, HCV viremia was associated strongly with active injection drug use, perhaps due to reinfection or reactivation of HCV. Thus, careful evaluation for HCV infection and counseling related to drug use may be necessary.

Keywords

HCV; HIV-1 infection; HCV viremia; intravenous drug use; pregnancy

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INTRODUCTION

Hepatitis C virus (HCV) infection represents a major health problem and is common among human immunodeficiency virus-1 (HIV-1) infected patients, hemophiliacs and individuals with a history of injection drug use [1–3]. Prevalence can be as high as 30–100% in these populations. In the pediatric population, perinatal transmission of HCV is the predominant mode of infection with an estimated overall transmission of 5%, and is highly correlated with maternal HCV viremia and exposure to maternal blood at delivery [4–12]. Additionally, an association between injection drug use during pregnancy and perinatal transmission has also been noted [9]. Among HIV+ women, rates of transmission are significantly increased and estimated to be 15–36%, due most probably to the high rates of viremia noted in most HIV+ populations and the higher observed HCV RNA levels that may be related to immunosuppression [5,13].

Infection with HCV results in chronic or intermittent viremia. Although viral clearance is described in only 15% of patients overall [1,14], higher rates of spontaneous clearance of HCV have been reported in selected populations [15,16], especially among women [17]. Recent evidence indicates that HIV-1/HCV coinfecting individuals are less likely to clear HCV infection and have higher HCV-RNA levels [18–20]. However, others have reported that HIV-1 coinfection does not influence the probability of HCV viremia [21]. On the other hand, vertical transmission of HCV, which appears to occur with low efficiency, may be facilitated by HIV-1 coinfection [12,22,23]. Higher HCV viral loads, as has been reported in HIV-1 coinfecting patients, may be responsible for this increased transmissibility.

In order to gain a better understanding of perinatal transmission of HCV and predictors of HCV viremia among HIV-1 coinfecting women we assessed clinical and demographic factors associated with HCV viremia in a cohort of pregnant and non-pregnant mothers, coinfecting with HIV-1.

METHODS

From July 1988 to 2000, 359 HIV-1 positive mothers seen at the Maternal–Child and Adolescent (MCA) Center for Infectious Diseases and Virology were enrolled in a natural history and perinatal transmission study of HIV-1 and coinfections following informed consent. Women enrolled either in pregnancy or upon referral to the MCA clinic. Pregnant women were followed once each trimester during pregnancy and at delivery. Visits for non-pregnant and postpartum mothers were at 1–3-month intervals. Demographic and clinical information were collected at the initial and subsequent visits. Additional chart reviews were performed for all anti-HCV positive women to obtain more detailed drug and sexual history. Women were considered to have a history of injection drug use if they reported drug use > 6 months prior to the study visit and to be an active injection drug user (AIDU) if they reported injecting drugs within 6 months of the visit. No patients received treatment for HCV infection during the study period because limited data existed regarding the safety and efficacy of HCV treatment in HIV-1+ patients during the time of study conduct.

Blood was collected for liver enzyme levels, CD4 counts, HIV-1 viral load and for future virological and immunological evaluations at each visit. Serum and plasma were stored at –70°C within 6 hours of collection for future studies. CD4 cell counts were measured using standardized flow cytometric methods. Plasma HIV-1–RNA levels were determined using polymerase chain reaction (PCR) (Amplicor HIV-1 Monitor Test, Roche Diagnostics(r), Branchburg, NJ, USA; lower limit of detection 400 copies/ml or NucliSens, bioMerieux, Inc., Durham, NC, USA; lower limit of detection 176 copies/ml). Alanine aminotransferase

(ALT), and aspartate aminotransferase (AST) levels were also determined in the clinical laboratory.

Presence of anti-HCV antibody was determined by HCV EIA 3.0 (Ortho Diagnostic System(r), Rochester, New York, USA) according to the manufacturer's recommendations, using the most recently available serum sample for all 359 HIV-1+ women enrolled in the study. We used the most recent available sample for all women to assure that we did not miss any seroconversions. As recommended by the manufacturer, positive specimens were retested in duplicate to confirm positivity, if either or both duplicate measurements were positive. Women found to be anti-HCV positive were further evaluated for HCV viremia using another, previously unfrozen stored aliquot from the same date. HCV-RNA was initially detected using a commercially available PCR assay (Amplicor HCV Monitor 2.0, Roche Diagnostics(r); dynamic range: 600–850 000 IU/ml). Samples with HCV-RNA levels exceeding the upper limit of the assay were retested after a 1 : 100 dilution with HCV negative human plasma according to the manufacturer's recommendations. Samples below the linear range of the quantitative assay were retested with a commercially available qualitative PCR (Amplicor HCV, version 2.0 Roche Diagnostics(r) Branchburg, NJ; Lower limit of detection: 50 IU/ml) [24]. If a woman had a positive HCV RNA test result, she was considered to be HCV viremic. HCV-antibody+ but HCV RNA- women who had a signal to cut-off ratio (s/co) of <3.8 had additional testing using Chiron RIBA HCV EIA 3.0 Strip Immunoblot Assay, Emeryville, CA, USA, as suggested by the Centers for Disease Control [25].

Presence (>50 IU/ml) or absence of HCV RNA by demographic and clinical features was assessed using Student's *t*-test for continuous variables and Fisher's exact test for categorical variables. Correlates for HCV-RNA detectability were identified using logistic regression analysis and odds ratios (OR) and 95% confidence intervals (CI) were calculated. A full multivariate model was adopted which included all relevant clinical and demographic variables. However, ALT and AST were analyzed separately as outcomes, because of the high collinearity between HCV viremia and liver enzymes. To assess further the relationship between pregnancy and HCV viremia and elevations in ALT and AST, a full model of repeated-measures multivariate logistic analyses adjusting for relevant variables were performed, utilizing information from all visits.

RESULTS

A cohort of 359 HIV-1 positive women was evaluated for HCV coinfection. The majority of the women were Hispanic (61%) or African American (29%), with a median age of 28 years (range: 17–45). Although overall only 84 (23%) of these women were found to be coinfecting with HCV, women enrolled in our study between 1988 and 1995 were more likely to be coinfecting than those enrolled after 1995 (31% versus 13%, $P < 0.0001$). Coinfecting women tended to be older than women only infected with HIV-1 (median age: 31 versus 28) and were less likely to be Hispanic (54% versus 63%).

This study included the 84 women found to be anti-HCV + by EIA, of whom 35 were pregnant, 37 were non-pregnant and 12 were postpartum at the time of the antibody screening for this study. A subset of 57 women was evaluated longitudinally over two study visits (median time between visits 9.2 months) to assess for persistence of HCV viremia; 31 of these women were pregnant. Overall, 47 of the 84 women were pregnant at one of their visits and 37 were not pregnant. A total of 141 HCV RNA levels and antibody determinations were performed for these women. For non-pregnant women evaluations were performed at a median of 9 months from delivery (range: 0–100 months). A group of 15 women with s/co ratios < 3.8 were assessed by RIBA, the majority were either RIBA+ or

indeterminate. However, in view of decreasing levels of antibody following seroconversion and potential for low levels and difficulty in interpreting RIBA in HIV+ women, this study included all EIA+ women [26–28].

Among the 84 HIV-1/HCV coinfecting women evaluated using their most recent available sample, 49 (58%) had detectable HCV-RNA in plasma (median HCV RNA: 0.77 million IU/ml; range: 600–23.8 million IU/ml) with no difference noted in the geometric mean level of RNA between pregnant and non-pregnant women (0.54 versus 1.27 million IU/ml; $P = 0.19$). The majority of women had HCV RNA levels that were $>500\,000$ IU/ml. Characteristics of women were examined by presence or absence of plasma RNA and level of RNA in Table 1 (detectable versus not detectable; low: $<500\,000$ IU/ml, medium: $500\,000$ – $5000\,000$ IU/ml and high $>5000\,000$ IU/ml). As expected, drug use was seen often among study patients with 60% (50/83) being active injection drug users (AIDU) and another 9% (7/83) reporting a history of injection drug use. Among HCV viremic women, 88% (42/48) reported injection drug use (history or active), compared to only 43% (15/35) of HCV non-viremic women ($P < 0.001$). Women with detectable HCV RNA were also more likely to be AIDU ($P < 0.001$) and to have AST and ALT levels > 40 IU/ml ($P = 0.02$ and $P < 0.001$, respectively; Table 1) than women who did not have detectable HCV RNA. Among women with detectable HCV RNA, characteristics were not significantly different by level of HCV RNA.

Unadjusted logistic regression analysis revealed that HCV-RNA detectability was significantly associated with injection drug use and, as expected, elevated levels of ALT and AST (>40 IU/ml; Table 2). In multivariate analysis, which included age, race, number of sexual partners, pregnancy status, AIDU, CD4 counts and HIV-1 viral load, we found that women who were AIDU were still more likely to have detectable HCV RNA (adjusted OR: 15.17; 95% CI: 3.56, 64.56) than non-AIDU. Pregnancy status was not associated with detectability of HCV-RNA ($P = 0.95$, Table 2). However, in separate multivariate models assessing for predictors of elevated AST and ALT levels, adjusting for age, race, number of sexual partners, AIDU, CD4 counts, HIV-1 viral load and HCV RNA detectability, pregnant women were less likely to have high AST and ALT levels (AST: adjusted OR: 0.26; 95% CI: 0.07, 0.94; $P = 0.04$; ALT: adjusted OR: 0.27; 95% CI: 0.06, 1.20; $P = 0.08$) than non-pregnant women.

In univariate analyses we further assessed the relationship between pregnancy and HCV viremia (Table 3). Pregnant and non-pregnant were similar ($P > 0.05$) in their ethnicity, age, injection drug use history, CD4 counts, plasma HIV-1 RNA levels, HIV-1 treatment and number of life-time sexual partners (Table 3). However, pregnant women were found to have significantly lower ALT and AST levels than non-pregnant women (pregnant versus non-pregnant: geometric mean of AST: 33 IU/ml versus 46 IU/ml, $P = 0.03$; ALT: 27 IU/ml versus 40 IU/ml, $P = 0.03$). Postpartum women (6 months after delivery) were excluded in this set of analyses because of potential physiological changes during this period.

To assess further the relationship between pregnancy and HCV viremia and elevations in ALT and AST, repeated-measures multivariate logistic analyses adjusting for relevant variables was performed. These analyses included measurements from two visits for the subset of 57 women, and (Table 4) confirmed the lack of association between HCV viremia and pregnancy, but did confirm that pregnancy was associated with lower ALT and AST levels.

Among the 57 women evaluated on two occasions, five were determined to be seroconvertors (three of five had multiple tests) due most probably to sexual transmission, as only one was an injection drug user. Three of their infants were HCV infected. Among the

remaining 52 women, 26 (50%) were persistently viremic, 20 (38%) were persistently non-viremic and six (12%) had discordant results or intermittent HCV viremia. Interestingly, four of six women (three were pregnant) with discordant RNA results were RNA negative at the first RNA evaluation and two were positive. These six women were all anti-HCV+ and five were AIDU. Women who were AIDU were more likely to be persistently RNA positive (21/28 versus 5/18; OR: 7.80, $P = 0.0027$).

DISCUSSION

In this study of young HIV-1 positive pregnant women and non-pregnant or postpartum mothers coinfecting with HCV, we found a lower rate of HCV viremia than has been reported previously for HIV-1 and HCV coinfecting populations [1,14]. As reported for other populations of women and recent seroconverters, viremia was present in only 58% of women in our study [16,17]. The most striking finding in our study was the strong association between HCV viremia and a history of injection drug use, suggesting that reinfection may be one reason for the high rates of viremia noted among injection drug users compared to populations who have had single exposures.

Surprisingly, the prevalence of HCV among the mothers enrolled in our study after 1995 was significantly lower than those enrolled prior to 1995. Earlier in the HIV-1 epidemic, intravenous drug use was more commonly a risk factor for HIV infection among women, while more recently heterosexual contact has been an important transmission risk. Our cohort included relatively young HIV-1/HCV-positive women, many of whom did not report a history of injection drug use or active injection drug use. This is in contrast to other studies that included active injection drug users who were older. These differences may explain the higher rates of viremia noted in these studies [19,29]. Other studies indicate that in some population groups, such as young women and children, HCV RNA resolution can approach 50% [15,17,30,31], a rate similar to our study. Recently, Jauncey *et al.* found that 26–42% of newly infected injection drug users cleared HCV when followed for 2 years, suggesting that perhaps higher rates of HCV infection noted in cross-sectional analyses of injection drug users may be related to reinfection [16].

Because women with undetectable RNA were retested with a more sensitive qualitative assay, we are confident that viral load below the limit of detection indicates that a large proportion of women in our cohort controlled HCV replication at the time of testing or completely cleared the virus. One limitation of our study is that some of the women who were EIA+ may have false positive HCV antibody results. The EIA 3.0 assay has >99% specificity in populations with prevalence > 10% and the prevalence in our cohort of high-risk women was 23%. Therefore, we expect the rate of false positivity to be low based on the 2003 CDC guidelines for laboratory testing of HCV [25]. Additionally, the signal to cut-off ratio was >3.8 in the majority of women (69/84), a value associated with >95% RIBA positivity. Because HIV+ women have been found to have low or undetectable antibody levels, it is also difficult to interpret the RIBA test [26–28]. For this reason, we included all EIA+ women and thus we may have slightly overestimated the true rate of viral clearance. On the other hand, we also did not perform HCV RNA testing of all HIV+ women, leading potentially to false negative results. This may have led to a lower estimated rate of HCV infection in our cohort of women, as HCV RNA positivity with negative antibody is seen among HIV+ populations [32–34] either because of a lack of seroconversion due to immunodeficiency or loss of antibody.

Coinfected women in our study also had tremendous variability in the levels of HCV RNA and some women had levels as high as 23 million IU/ml. Lower HCV-RNA levels have been reported among HIV-1-negative people avoiding needle-sharing during injection drug

use [13]. Patients with HCV and HIV-1 coinfection tend to have higher plasma HCV-RNA levels [19,20,29,35] compared with those infected with HCV alone, and are at increased risk of cirrhosis, liver failure and death [36–38]. HCV-RNA levels have been shown to correlate with CD4 counts and to increase with decline in CD4 lymphocytes counts in some, but not all, studies [13,19,20,39–41]. These findings have led to the conjecture that HIV-1 affects HCV-RNA levels by immune suppression. We did not find a significant association between HCV RNA detectability and level of CD4.

We found that five of the 57 women whom we tested on multiple occasions were seroconvertors and three of their newborns became infected. Our overall rate of perinatal transmission was 15% (data not shown). Thus, this rate of transmission is high for this small group of seroconvertors, most probably because their mothers may have had primary viremia during pregnancy. Only one of these women was an active injection drug user, and sexual contact was the only risk for infection for the other women. Transmission by sexual contact is thought to be a mode of transmission among HCV+ patients with no history of injection drug use [3,42–44]. We also found that four of 57 women who were tested on multiple occasions may have been reinfected because they went from undetectable RNA levels to detectable levels over the study period, although intermittent viremia may also be a possibility. All were active injection drug users. Reinfection has been reported in many studies and estimated to occur at a rate of 12% [45]. HCV infection, even when it is cleared spontaneously or with antiviral treatment, does not confer protective immunity [46,47]. In some studies it was demonstrated that over 50% of active drug users were found to be reinfected after successful treatment [48]. Among those who cannot stop injecting drug use, reinfection could be avoided by using a new sterile syringe for each injection and avoidance of equipment sharing with other users [48]. Those who share needles are at great risk of becoming reinfected with hepatitis C virus, with rapid acquisition being the norm and with increased risk with every use.

The findings of our study may also explain the higher mother-to-infant transmission rates of HCV in women with a high prevalence of active injection drug use behavior, as vertical transmission is higher in the presence of high maternal HCV viremia [5,11,49,50]. Our findings suggest that every effort should be made to enroll drug-using HCV+/HIV+ pregnant women into drug treatment programs to prevent reinfection, seroconversion and maternal-to-child transmission of HCV. All women in our study were caring for children and were in close follow-up with referral for drug use. Services offered including discussions about safe sex and drug use might have impacted the overall exposure for repeated HCV infection. Also, women who continued to use drugs were at risk for losing their children to the foster care system and this, too, may have been a deterrent for changes in drug use behavior.

Our findings suggest that even among HIV-1 positive women, especially those who most probably become infected at a young age, a greater portion of patients may clear HCV than has been reported in other populations such as active drug users or hemophiliacs [1,13,14]. Higher rates of viremia in these populations may be due to frequent exposures, which may result in reinfection. Reasons for higher rates of clearance include gender and their young age at time of HCV infection. Alternatively, as with HIV-1, female sex may be protective and modify HCV disease expression due perhaps to hormonal differences. To differentiate viral clearance from low-level or intermittent viremia, long-term follow-up and additional serial HCV-RNA testing using more sensitive assays would be needed because HCV-RNA serum levels may vary from person to person or in the same person over time.

As expected, we observed statistically significant elevation of AST and ALT levels in the patients with detectable HCV-RNA. Additionally, we noted lower liver enzyme levels

among pregnant women compared to non-pregnant women, as has been reported previously [51–53]. This may be due to hormonal or immunosuppressive affects of pregnancy or alternatively a dilutional affect of pregnancy. Unfortunately, liver biopsies were not available to verify the severity of liver disease among women in our study. Pregnancy has been associated with a decrease in liver abnormalities and perhaps milder liver disease [31,53]. In contrast with other studies, in our cohort we found that pregnancy is not associated with decrease in HCV replication.

Injection drug use may have physiological affects on the immune system that may be immunosuppressive, although this has not always been found among HIV-1 infected patients [54,55]. There is an increasing body of evidence showing that drug use has a variety of effects on cells of the immune system. Total numbers of T lymphocytes (CD3), cytotoxic T cells, B cells and natural killer cells were detected or were altered in heroin addicts [55]. Data obtained both *in vitro* and *in vivo* models show that opioids increase susceptibility to bacterial and viral infections, the latter effect possibly being related to a suppressive effect on gamma-interferon levels [54]. It is important to note that upon heroin withdrawal sustained for 2 years, immune parameters gradually reversed to normal [55]. Further research is needed to understand the mechanism through which these factors affect HCV RNA blood levels.

CONCLUSION

In this study of relatively young women, HCV viremia was lower than previously reported for coinfecting populations. This may be due to age at the time of exposure or gender-associated factors. However, active injection drug use appeared to be closely associated with HCV viremia. Active injection drug use may result in seroconversions resulting in persistent HCV viremia in HCV and HIV-1 coinfecting people or reinfection. Thus, efforts should be made to screen and counsel pregnant women against active drug use and potential exposure through sexual activity with drug using or HCV+ infected partners. This is especially important during pregnancy, where primary viremia is most likely to result in perinatal transmission.

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Table 1

Characteristics of women with detectable and undetectable HCV RNA ($n=84$).

Parameter	HCV RNA not detectable % (n/total) (n = 35)	HCV RNA detectable ^a (n = 49) % (n/total)				P-value ^c
		All (n = 49)	<500 000 IU/ml (n = 14)	500 000–5 000 000 IU/ml (n = 23)	>5 000 000 IU/ml (n = 12)	
Age (years)						
Mean ± SD	31 ± 6	32 ± 5	31 ± 5	32 ± 4	32 ± 6	0.91
<30	43% (15/35)	31% (15/49)	36% (5/14)	30% (7/23)	25% (3/12)	
Race						
Hispanic	63% (22/35)	47% (23/49)	43% (6/14)	52% (12/23)	42% (5/12)	0.15
Ever IDU (history and AIDU)						
Yes	43% (15/35)	88% (42/48)	93% (13/14)	82% (18/22)	92% (11/12)	<0.001
Missing		1				
Active IDU (AIDU)						
Yes	29% (10/35)	83% (40/48)	86% (12/14)	77% (17/22)	92% (11/12)	<0.001
Missing		1				
≥5 sexual partners						
Yes	74% (25/34)	86% (38/44)	93% (13/14)	79% (15/19)	91% (10/11)	0.15
Missing	1	5				
Pregnancy						
Yes	50% (15/30)	48% (20/42)	64% (7/11)	48% (10/21)	30% (3/10)	0.84
Not applicable	5	7				
CD4 (cells/mm ³)						
<200	29% (10/35)	23% (11/47)	23% (3/13)	32% (7/22)	8% (1/12)	0.60
Missing		2				
HIV-RNA						
Detectable ^b	79% (27/34)	79% (38/48)	64% (9/14)	83% (19/23)	91% (10/11)	0.98
Missing	1	1				
AST (IU/ml)						
>40	23% (8/35)	49% (24/49)	29% (4/14)	61% (14/23)	50% (6/12)	0.02

Parameter	HCV RNA detectable ^a (n = 49) % (n/total)					P-value ^c
	HCV RNA not detectable % (n/total) (n = 35)	HCV RNA detectable				
		All (n = 49)	<500 000 IU/ml (n = 14)	500 000– 5 000 000 IU/ml (n = 23)	>5 000 000 IU/ml (n = 12)	
ALT (IU/ml)						
>40	15% (5/34)	53% (26/49)	43% (6/14)	65% (15/23)	42% (5/12)	<0.001
Missing	1					

^a HCV-RNA ≥ 50 IU/ml;

^b HIV-RNA ≥ 400 copies/ml;

^c comparison between HCV RNA Not Detectable and Detectable;

n = number of patients in the characteristic group; SD = standard deviation.

Table 2

Association of HCV viremia with patients' demographic and clinical characteristics.

Subgroup	% with detectable HCV-RNA ^a (x/n)	Unadjusted		Adjusted	
		OR ^c (95% CI)	P-value	OR (95% CI)	P-value
Age (years)					
<30	50% (15/30)	0.59 (0.24–1.45)	0.25	0.84 (0.18–3.57)	0.77
≥30	63% (34/54)	1.00		1.00	
Hispanic	51% (23/45)	0.52 (0.22, 1.27)	0.15	0.87 (0.24–3.19)	0.83
Non-Hispanic	67% (26/39)	1.00		1.00	
Active injection drug use (AIDU)	80% (40/50)	9.33 (3.15, 27.66)	<0.001	15.17 (3.56–64.56)	0.0002
Non-AIDU	24% (8/33)	1.00		1.00	
≥5 sexual partners	60% (38/63)	2.28 (0.72, 7.20)	0.15	1.53 (0.27–8.58)	0.63
<5 sexual partners	40% (6/15)	1.00		1.00	
Pregnant	57% (20/35)	0.91 (0.36, 2.32)	0.84	0.96 (0.26–3.58)	0.95
Not pregnant	59% (22/37)	1.00		1.00	
CD4 <200 (cells/mm ³)	52% (11/21)	0.76 (0.28, 2.07)	0.60	0.55 (0.14–2.18)	0.39
CD4 ≥200 (cells/mm ³)	59% (36/61)	1.00		1.00	
HIV-RNA detectable ^b	58% (38/65)	0.99 (0.33, 2.91)	0.98	1.37 (0.25–7.38)	0.71
HIV-RNA not detectable	59% (10/17)	1.00		1.00	
AST ≥40 (IU/ml)	75% (24/32)	3.24 (1.23, 8.53)	0.017	N/A	N/A
AST < 40 (IU/ml)	48% (25/52)	1.00			
AST ≥1.5 upper limit	71% (12/17)	1.95 (0.62, 6.14)	0.26	N/A	N/A
AST < 1.5 upper limit	55% (37/67)	1.00			
ALT ≥ 40 (IU/ml)	84% (26/31)	6.56 (2.18, 19.74)	<0.001	N/A	N/A
ALT < 40 (IU/ml)	44% (23/52)	1.00			
ALT ≥ 1.5 upper limit	81% (13/ 16)	3.73 (0.97, 14.31)	0.05	N/A	N/A
ALT < 1.5 upper limit	54% (36/67)	1.00			

^a HCV-RNA ≥ 50 IU/ml;^b HIV-RNA ≥ 400 copies/ml;

n = sample size in group; x = number of cases; CI = confidence interval; N/A: Not applicable;

c
odds ratio.

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Table 3Characteristics of pregnant and non-pregnant HIV-1/HCV coinfecting women ($n = 74$).

Parameter	Pregnant women (n = 35) % (n/total)	Non-pregnant women (n = 37) % (n/total)	P-value
Age (years)			
Mean $\pm$ SD	31 $\pm$ 5	32 $\pm$ 5	0.90
< 30	37% (13/35)	27 (10/37)	0.36
Race			
Hispanic	49% (17/35)	62% (23/37)	0.34
Ever IDU (history and AIDU)			
Yes	62% (21/34)	68% (25/37)	0.63
Missing	1		
≥ 5 sexual partners			
Yes	88% (28/32)	71% (25/35)	0.14
Missing	3	2	
CD4 (cells/mm ³)			
<200	26% (9/34)	32% (12/37)	0.61
Missing	1		
HIV-RNA			
Detectable ^a	71% (25/35)	91% (32/35)	0.06
Missing		2	
HCV RNA			
Detectable ^b	57% (20/35)	59% (22/37)	1.00
AST (IU/ml)			
>40	29% (10/35)	57% (21/37)	0.02
ALT (IU/ml)			
>40	26% (9/35)	49% (18/37)	0.05

Twelve women were excluded from analyses since they were immediately post-partum.

^a HIV-RNA ≥ 400 copies/ml;^b HCV-RNA ≥ 50 IU/ml; n = number of patients in the characteristic group. SD = standard deviation.

Table 4

Association of pregnancy and HCV, AST or ALT.

	HCV viremia		AST > 40 IU/ml		ALT > 40 IU/ml	
	OR (95% CI) ^a	P-value	OR (95% CI) ^b	P-value	OR (95% CI) ^b	P-value
Pregnancy						
Yes	0.78 (0.34–1.79)	0.5618	0.39 (0.17–0.85)	0.0184	0.31 (0.12–0.80)	0.0153
No	1.00		1.00		1.00	

^a Adjusted for age, race, active injection drug use, CD4 and HIV detectability;
^b adjusted for age, race, active injection drug use, CD4, HIV detectability and HCV viremia.