FibroScan used in street-based outreach for drug users is useful for hepatitis C virus screening and management: a prospective study

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SUMMARY. Although hepatitis C virus (HCV) infection prevalence is high among drug users, they do not commonly receive regular care in academic centres. The aim of this prospective study was to assess the influence of FibroScan use on HCV screening and management in street-based outreach. From January 2006 to January 2007, all consecutive drug users were offered noninvasive evaluation of liver fibrosis with FibroScan. After FibroScan, parameters were recorded with a structured, face-to-face questionnaire by outreach workers. All 298 subjects accepted FibroScan evaluation drug use was – ever injected heroin (69%), ever snorted or injected cocaine (89%), current chronic alcohol abuse (44%). The median Fibro-Scan score was 5.3 kPa. Before blood sampling, 34% of subjects reported HCV positivity. HCV positivity was found in 83 cases. All these subjects had positive HCV-RNA. Forty-five subjects agreed to meet a hepatologist. By multivariate analysis, never snorted cocaine, consumed alcohol < 21 drinks per week, duration of injected heroin > 7 years, and FibroScan > 7.1 kPa were significantly associated with HCV positivity. Thus in a street-based outreach service for drug users, the acceptance of FibroScan is excellent. FibroScan with a hospital-based physician may facilitate screening and management of drug users for HCV infection.

Keywords: cirrhosis, FibroScan, fibrosis, hepatitis C, injection-drug users, transient elastography.

INTRODUCTION

In France, in spite of harm reduction interventions, the leading cause of hepatitis C virus (HCV) infection is the sharing of contaminated equipment between injection-drug users (IDUs) [1]. The incidence of HCV infection among IDU populations ranges from 4.2 to 22.0 per 100 person-years, and the estimates of prevalence are between 30% and 90% [2–5]. Identification of IDUs with serious HCV-related liver disease is one of the most important challenges for reducing HCV-related morbidity and mortality. The natural history of HCV infection in IDUs must be understood because of emerging data regarding treatment. HCV infection generally progresses slowly in young IDUs during the first 10 years of infection, but its prognosis is usually unfavourable because of poor nutritional status, alcohol use or the absence of treatment [6]. HCV infection can be eradicated in approximately half of all people with currently available medications [7–9]. However, treatment of HCV infection is complex and associated with adverse reactions. Consequently, HCV treatment is most advisable in persons with the highest risk of fibrosis progression, a guideline that is even more important in populations such as IDUs in whom there is a high incidence of other medical problems and substantial barriers to traditional medical care [10]. Despite the importance of understanding the natural history of liver disease in IDUs and of identifying those in need of treatment, remarkably little published information is available on either topic. It appears that few HCV-positive IDUs are offered this treatment [11]. One reason is that IDUs do not commonly receive regular care in academic centres. In addition, histological assessment of chronic hepatitis C has classically been made by using liver biopsy. However, the limitations of this current procedure have gained importance. The need for an expert pathologist to interpret and stage liver fibrosis

Abbreviations: HCV, hepatitis C virus; IDU, injection-drug users; AST, aspartate aminotransferase; ALT, alanine aminotransferase; GGT, γ-glutamyl-transpeptidase; CI, confidence interval.

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adequately, the request for a fragment greater than 15 mm long to be representative, the risks inherent in the procedure (such as pain or bleeding), and the fact that the latter cannot be repeated periodically for obvious reasons, are among the most important caveats of liver biopsy [12–15]. Moreover, IDUs rarely undergo liver biopsy due to the risk of the procedure, and to the fear of the physician, the hospital and the treatment.

Two noninvasive approaches have recently been developed to replace liver biopsy as the unique tool to collect information on liver fibrosis. First, serum fibrosis markers have been analysed and integrated in distinct indexes (i.e. Fibrotest, APRI, Forns, etc.) that have been proven to correlate quite well with liver fibrosis staging as derived from liver biopsies [16–20]. Second, new imaging techniques have been developed and are now used to provide an accurate and reliable estimation of liver fibrosis stage. Transient elastography using FibroScan is the most widely used of the latest tools. It is based on the emission of ultrasound and vibratory waves, and provides information on hepatic stiffness, which ultimately reflects the extent of liver fibrosis [21–26]. Therefore, liver fibrosis assessment is now available for all patients, even for those in whom liver biopsy is not ethical, such as responders after HCV treatment. In France, FibroScan or Fibrotest are now recommended for the initial evaluation of liver fibrosis in HCV-naïve patients without any other disease [27]. However, to our knowledge, FibroScan has never been used in street-based outreach for the evaluation of liver fibrosis and as a factor associated with the acceptance of blood sampling for HCV screening.

The aim of this prospective study was to assess the influence of FibroScan on HCV screening and management in street-based outreach.

PATIENTS AND METHODS

Study population

From January 2006 to January 2007, all consecutive drug users in two street-based outreaches were offered noninvasive evaluation of liver fibrosis with a FibroScan. All participants were over 18 years old.

After FibroScan, patients were administered a standardized face-to-face questionnaire by trained outreach workers in a private area. The questionnaire elicited information regarding socio-demographic and drug risk characteristics, and regarding their knowledge about their HCV status. Continuous variables were elicited with regard to the 6 months before the interview. This included frequency of injection, incarceration, and housing situation (living on the street or in a shelter, hostel, home). Socio-demographic and drug use (alcohol, tobacco, cannabis, heroin, cocaine, etc.) parameters were also recorded in the questionnaire.

The study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki and was approved by the local Ethics Committee. Written informed consent was obtained from all patients.

Assessment of liver fibrosis

All patients had noninvasive assessment of liver fibrosis using liver stiffness measurement (FibroScan) and biochemical markers. Details of the FibroScan technical conditions and examination procedure have been previously described [28]. The tip of the probe transducer was placed on the skin between the rib bones at the level of the right lobe of the liver. Once the measurement area had been located, the operator pressed the probe button to start data acquisition. The measurement depth was between 25 and 65 mm below the skin surface. At least seven successful measurements were performed on each patient, with a ratio of the number of successful measurements over the total number of acquisitions not lower than 30%. The results were expressed in kilopascals. The median value of all acquisitions was kept as representative of the liver elastic modulus in each patient. To evaluate liver fibrosis, published cut-offs for HCV infection were used [21]. Patients with FibroScan ≤ 7.1 kPa had no or mild fibrosis, those with $7.1 <$ FibroScan ≤ 9.5 kPa had moderate fibrosis; those with $9.5 <$ FibroScan ≤ 12.5 kPa had severe fibrosis and patients with FibroScan > 12.5 kPa had cirrhosis.

Study protocol

After FibroScan evaluation, all participants were offered counseling and testing for HIV and hepatitis B and C. Anti-HCV screening was conducted by Abbott Laboratories using the HCV EIA 3.0 and VITROS anti-HCV screening assays. HCV-RNA was considered detectable based on a value of >15 IU/mL (COBAS AmpliPrep-COBAS-Taqman 48 HCV; Roche Molecular Diagnostics, Pleasanton, CA, USA). The following parameters were determined in the same laboratory on blood samples the same day as virological screening: aspartate aminotransferase (AST), alanine aminotransferase (ALT), γ-glutamyl-transpeptidase (GGT), total bilirubin, $\alpha 2$-macroglobulin, apolipoprotein A1 and haptoglobin. The laboratory followed the preanalytical and analytical recommendations required to obtain Fibrotest results [16]. The Fibrotest score was computed on the Biopredictive website (http://www.biopredictive.com).

After FibroScan evaluation and blood sampling, all patients were offered a meeting with a hepatologist in the centre, which is located in a storefront in downtown Bordeaux (France).

Statistical analysis

Age was determined as the age on the date liver stiffness was measured. Unstable housing was defined as living in a shelter, rooming house, or single-occupancy hotel or as

living on the street/being homeless. Descriptive values are expressed as percentages and mean (±SD) or median (interquartile range) values. Comparisons of quantitative data were made using Student's *t*-test or the nonparametric Mann–Whitney rank-sum test when data did not exhibit a normal distribution. Qualitative data were analysed using the chi-square test. The odds ratio, together with its 95% confidence interval (CI) and the corresponding *P* value were calculated to assess relative risks using logistic regression. Kendall's coefficient of correlation (tau-b) and its associated probabilities (*P*) evaluated the relationship between different factors. A *P* value of less than 0.05 was considered statistically significant. All data were recorded and analysed using the SPSS v14.0 software package (SPSS Inc., Chicago, IL, USA).

RESULTS

Study population

The socio-demographic characteristics of the 298 subjects are shown in Table 1. Mean age was 32 years and 76% were males. In this population of drug users, 28% were homeless, 66% had children, only 21% were employed full time, and 35% had a past history of incarceration. Of the 298 subjects, 68% had ever injected heroin, 89% had ever

snorted or injected cocaine, and 94% had ever smoked marijuana (Table 2). Finally, 60% received substitutive treatment. This was buprenorphine in 77/179 cases (43%), methadone in 100/179 cases (55.9%), and morphine in 2/179 cases (1.1%).

FibroScan acceptance and results

Of the 298 patients included in this study, all of them (100%) accepted FibroScan liver stiffness assessment (Fig. 1). Liver stiffness measurement did not fail in any patient. Median IQR/liver stiffness measurement ratio was 0.15. The results are shown in Table 3. Most of the patients had a low FibroScan value (80%) corresponding to no or mild fibrosis according to the published cut-offs [21]. However, 5% had a value >12.5 kPa, i.e. the diagnosis of cirrhosis.

Hepatitis C virus infection screening

After liver stiffness assessment, patients were administered a standardized face-to-face questionnaire about their HCV status. Of the 298 subjects enrolled in the study who had a FibroScan (100%), 245 (82.2%) reported a past blood

Table 1 Main socio-demographic features of the study population

Characteristics	*n* = 298 (%)
Mean age (years)	31.6 ± 8.3
Male gender	226 (75.8)
BMI (kg/m^2)	22.1 ± 3.2
Marital status (self-report)	
Single, divorced, separated, widowed	109 (36.6)
Married or cohabitation	189 (63.4)
Children	198 (66.4)
Employed full time	62 (20.8)
Income	
Salary	54 (18.1)
Social welfare	170 (57.1)
No income	74 (24.8)
Residence pattern	
Permanent residence/housing	158 (53.0)
Transient (living temporally with friends or family)	55 (18.5)
Unstable housing (homeless, living in street, car, or shelter)	85 (28.5)
Social welfare for health	156 (52.3)
Incarceration	104 (34.9)

BMI, body mass index.

Table 2 Main drug use of the study population

Characteristics	*n* = 298 (%)
Drug use history/median duration (years) (interquartile range)	
Ever injected heroin	204 (68.5)/7.0 (2.3–14.4)
Ever snorted or injected cocaine	265 (88.9)/7.6 (3.6–14.2)
Ever smoked marijuana	279 (93.6)/14.0 (9.4–21.2)
Current drug use (used in the past week)	
Injected heroin	78 (26.2)
Snorted or injected cocaine	139 (46.6)
Smoked marijuana	243 (81.5)
Consumed hallucinogen	79 (26.5)
Consumed amphetamine	82 (27.5)
Consumed alcohol (>21 drinks/week)	115 (44.2)
Smoked cigarettes	276 (92.6)
Age at first injected heroin (years)	20.3 ± 5.1
Age at first snorted cocaine (years)	18.3 ± 4.8
Age at first smoked marijuana (years)	15.2 ± 4.5
Currently in drug treatment	179 (60.1)

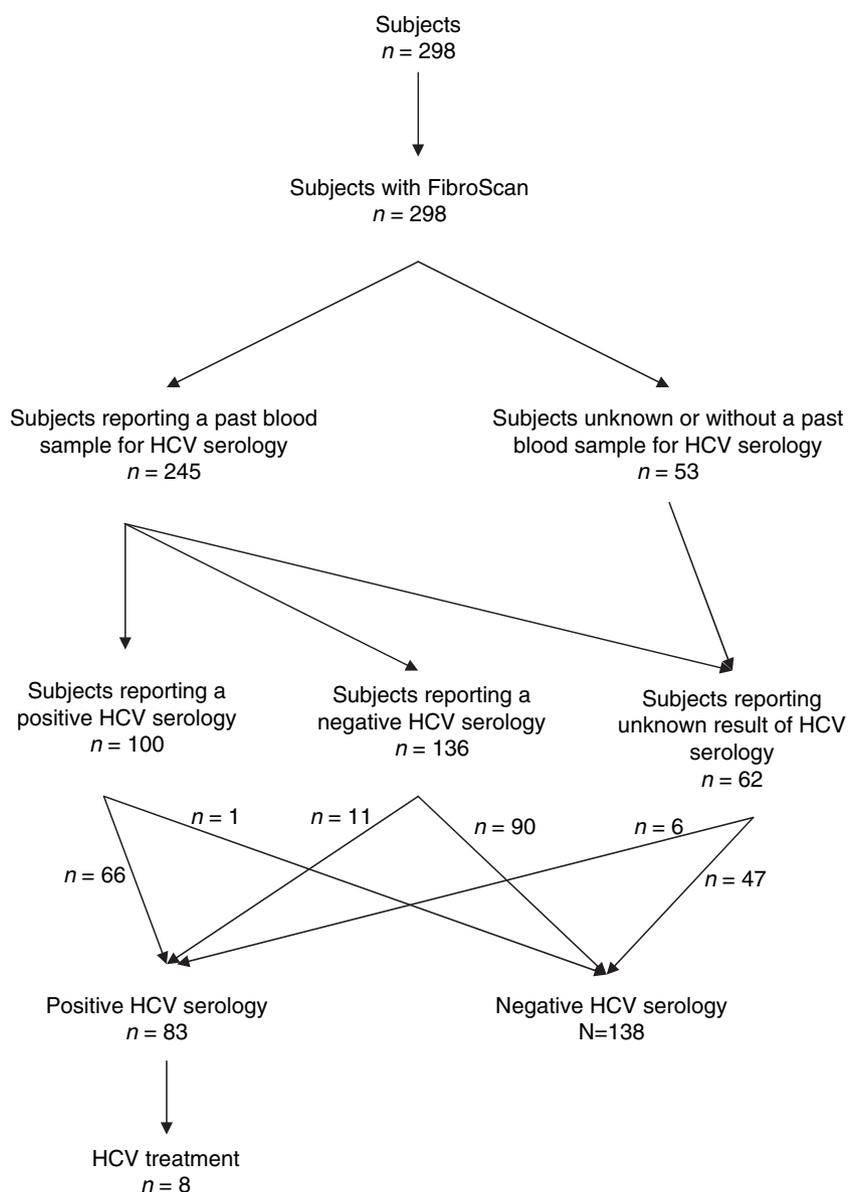Duration of drug use is indicated in years. Alcohol use was missing for 38 patients.

Subjects
n = 298

↓

Subjects with FibroScan
n = 298

Subjects reporting a past blood
sample for HCV serology
n = 245

Subjects unknown or without a past
blood sample for HCV serology
n = 53

Subjects reporting a
positive HCV serology
n = 100

Subjects reporting a
negative HCV serology
n = 136

Subjects reporting
unknown result of HCV
serology
n = 62

n = 1   *n* = 11   *n* = 90   *n* = 6

n = 66   *n* = 47

Positive HCV serology
n = 83

Negative HCV serology
N=138

↓

HCV treatment
n = 8

Fig. 1 Summary of outcome of 298 patients recruited.

Table 3 Results of liver stiffness measurements

	n = 298 (%)
Median FibroScan (interquartile range) (kPa)	5.3 (4.3–6.8)
Median interquartile range (kPa)	0.8
Median success rate	100
Number of measurements	10
FibroScan ≤ 7.1 kPa	238 (79.9)
7.1 < FibroScan ≤ 9.5 kPa	33 (11.1)
9.5 < FibroScan ≤ 12.5 kPa	13 (4.4)
FibroScan > 12.5 kPa	14 (4.7)

sample for HCV serology (Fig. 1). Of these 245 patients, 100 (40.7%) reported being HCV-positive, 136 (55.3%) claimed they were HCV-negative and 10 (4.1%) were unaware of their HCV serology. Then, all participants were offered testing for hepatitis C, B, and HIV.

When the nurse requested a blood sample after the questionnaire, 290 (97.3%) agreed to the principle. However, only 221 (76.2%) really had a blood sample. The others said that they would return for it another day but never came again. By univariate analysis, no factor was associated with the acceptance of a blood sample (data not shown). Of these 221 patients, the overall prevalence of HCV infection was 37.6% (83/221), with a majority of HCV genotype 1 (53.4%). Of the 198 patients with a past history of negative or unknown HCV serology, 17 (8.6%) were HCV-positive (Fig. 1). Therefore, the FibroScan led indirectly to

Table 4 Characteristics of the 8 patients who started HCV treatment

Patients No.	Age (years)	Gender	Current heroine use	Current cocaine use	Current marijuana use	Alcohol use (drinks /week)	Substitutive treatment	FibroScan (kPa)	HCV genotype
1	39	Male	No	No	Yes	0	Yes	7.8	1
2	35	Male	No	Yes	No	21	Yes	5.5	3a
3	50	Male	No	No	Yes	7	No	7.5	1
4	38	Male	Yes	No	Yes	0	Yes	8.4	1b
5	38	Male	No	No	Yes	21	Yes	10.6	1a/1b
6	28	Male	No	No	Yes	0	Yes	7.8	1a
7	42	Male	Yes	No	Yes	6	Yes	11.8	1b
8	47	Male	Yes	Yes	Yes	30	No	8	1b

discovering nearly 9% of subjects with chronic HCV infection.

Hepatitis C virus genotypes were: genotype 1 in 11 cases, 1a in 12 cases, 1a/1b in one case, 1b in seven cases, 2 in two cases, 3 in two cases, 3a in 17 cases, and 4 in six cases. HCV genotype was not obtained in 25 cases (patients did not accept another blood sample for HCV genotype after a positive HCV serology). Of the 83 HCV-positive patients, 36 (43.4%) met a hepatologist. Of these 36 patients, eight patients (22.2%) had already started treatment for HCV infection at the end of this study (Table 4).

No patient had positive HBs antigen. Only eight patients (2.7%) were HIV-positive.

Fibrotest was available for 212 patients. Fibrotest was <0.30 (no or mild fibrosis) in 180 cases (84.9%), >0.50 (significant fibrosis) in 18 cases (8.5%), and >0.75 (cirrhosis) in five cases (2.3%). A strong correlation was found between Fibrotest and FibroScan ($r = 0.272$, $P < 0.0001$).

Factors associated with hepatitis C virus positivity

The prevalence of HCV infection among ever-injectors and never-injectors of heroin was 85.5% and 53.6% ($P < 0.0001$), respectively (Table 5). The prevalence of HCV infection was lower in patients who had ever used cocaine or currently were using cocaine, in patients who consumed hallucinogen or amphetamine, and in patients who consumed more than 21 drinks per week. However, more HCV-positive patients were following drug treatment (Table 5). The FibroScan value was higher in HCV-positive patients than in HCV-negative ones: 7.7 kPa *vs* 5.7 kPa, $P = 0.01$, respectively (Fig. 2).

By univariate analysis, factors associated with HCV positivity were age ≤ 30 years, ever injection of heroin or never snorted cocaine, no currently snorted cocaine or consumed hallucinogen and amphetamine, consumed alcohol less than 21 drinks per week, duration of injected heroin > 7 years, and FibroScan > 7.1 kPa (Table 6). By multivariate analysis, never snorted cocaine, consumed alcohol < 21 drinks per week, duration of injected heroin > 7 years, and Fibro-

Scan > 7.1 kPa were significantly associated with HCV positivity (Table 6).

Factors associated with high FibroScan values

As mentioned above, significant fibrosis was defined as FibroScan > 7.1 kPa [21]. In patients with Fibro-Scan > 7.1 kPa, the prevalence of patients who ever used cocaine and consumed hallucinogen was lower (Table 7). However, the prevalence of HCV positivity was higher in patients with FibroScan > 7.1 kPa.

By univariate analysis, factors associated with FibroScan > 7.1 kPa were never used cocaine, no currently consumed hallucinogen, and positive HCV serology (Table 8). By multivariate analysis, only HCV positivity and no currently consumed hallucinogen were significantly associated with FibroScan > 7.1 kPa (Table 8).

DISCUSSION

To our knowledge, this is the first study to evaluate the usefulness of FibroScan in association with multi-faceted interventions for HCV screening in a difficult-to-manage population. Performing a FibroScan in a street-based outreach led to screening most subjects for HCV infection, especially 53 subjects (18%) who had never or did not remember having a blood sample for HCV screening.

Identification of IDUs with HCV-related liver disease is one of the most important challenges for reducing HCV-related morbidity and mortality in Western countries. This is true not only because IDUs constitute the majority of infected persons, but also because treatment involves substantial public health resources, which are rarely received by IDUs. Therefore, any form of innovation should be evaluated, especially in IDUs. In France, the FibroScan is now recommended for the initial evaluation of liver fibrosis in HCV-naïve patients [27]. Owing to the rapid acquisition of HCV infection following initiation into use of intravenous drugs, IDUs represent an important target group for HCV prevention. This could particularly important in urban areas

	HCV-negative *n* = 138 (%)	HCV-positive *n* = 83 (%)	*P*
Mean age (years)	32.6 ± 8.0	31.1 ± 8.6	NS
Male gender	108 (78.3)	64 (77.1)	NS
BMI (kg/m^2)	22.1 ± 3.1	21.9 ± 3.1	NS
Married or cohabitation	49 (35.5)	31 (37.3)	NS
Children	76 (55.3)	63 (75.9)	0.002
Employed full time	31 (22.5)	14 (16.9)	NS
Income: salary	25 (18.1)	13 (15.7)	NS
No income	30 (21.7)	23 (27.7)	NS
Residence pattern			
Permanent residence/housing	82 (59.4)	43 (51.8)	NS
Transient (living temporally with friends or family)	22 (15.9)	14 (16.9)	NS
Unstable housing (homeless, living in street, car, or shelter)	34 (24.6)	26 (31.3)	NS
Social welfare for health	60 (43.5)	54 (65.1)	0.002
Incarceration	55 (39.8)	21 (25.3)	0.03
Drug use history			
Ever injected heroin	74 (53.6)	71 (85.5)	<0.0001
Ever snorted or injected cocaine	127 (92.0)	67 (80.7)	0.01
Ever smoked marijuana	129 (93.5)	77 (92.8)	NS
Current drug use (used in the past week)			
Injected heroin	31 (22.5)	27 (32.5)	NS
Snorted or injected cocaine	72 (52.2)	32 (38.5)	0.05
Smoked marijuana	112 (81.2)	68 (81.9)	NS
Consumed hallucinogen	48 (34.8)	15 (18.1)	0.008
Consumed amphetamine	49 (35.5)	14 (16.9)	0.003
Consumed alcohol (>21 drinks/week)	60 (43.5)	22 (26.5)	0.002
Smoked cigarettes	128 (92.7)	77 (92.8)	NS
Age at first injected heroin (years)	72 (52.2)	19.7 ± 5.2	NS
Age at first snorted cocaine (years)	18.1 ± 5.5	18.6 ± 4.5	NS
Age at first smoked marijuana (years)	14.7 ± 4.1	16.0 ± 5.2	0.05
Currently in drug treatment (%)	68 (49.3)	55 (66.3)	0.01
ALT (IU/L)	29.8 ± 25.0	78.7 ± 63.6	<0.0001
AST (IU/L)	27.5 ± 26.7	53.1 ± 40.9	<0.0001
GGT (IU/L)	49.3 ± 83.1	110.3 ± 162.9	0.001
Platelets (G/L)	275.0 ± 78.8	241.3 ± 64.0	0.001
FibroScan (kPa)	5.7 ± 6.2	7.7 ± 5.2	0.01
Fibrotest	0.12 ± 0.12	0.28 ± 0.23	<0.0001

Table 5 Characteristics of patients according to HCV positivity

ALT, alanine aminotransferase; AST, aspartate aminotransferase; GGT, gamma-glutamyl transpeptidase; NS, not significant.

experiencing a high prevalence of blood-borne infections among IDU populations. This is why a FibroScan was installed in a street-based outreach were the prevalence of HCV infection should be elevated.

Previous investigations have shown the prevalence of HCV infection in IDUs to be 60–90%. However, none of these studies is very recent and the prevalence could have been lower in 2006 due to information and needle exchange programmes. In a recent study performed from 2000 to 2004, a drop in HCV positivity was reported among young drug users in Amsterdam (14%) [29]. However, others still report a high and stable HCV incidence among young IDUs who have recently started injecting [30–32]. Mathematical modelling showed that the level of risk behaviour determines whether HCV incidence decreases [33]. In our study, the prevalence of HCV positivity was 38%.

By demonstrating a significant number of screenings for HCV infection, this study was successful. Consistent with previous studies, this indicates a need for interventions that improve access to and acceptance of HCV screening and

Fig. 2 Distribution of FibroScan values among 221 patients with negative and positive HCV serology (box plots). Median FibroScan values in each category are depicted by the clear central lines. The top and bottom of the boxes are the first and third quartiles, respectively. The length of the box thus represents the interquartile range within which 50% of the values were located. The error bars show the minimum and maximum values (range).
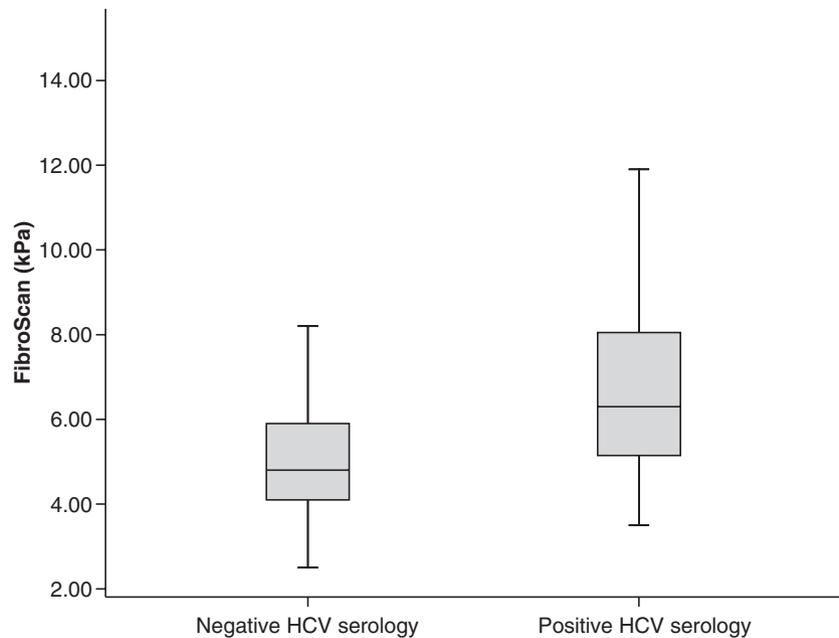
Table 6 Factors associated with HCV positivity

	Odds ratio	95% Confidence interval	*P*
Univariate analysis			
Age ≤ 30 years	1.79	1.03–3.10	0.039
Male gender	0.94	0.49–1.80	NS
Ever injected heroin	5.12	2.55–10.28	<0.0001
Ever snorted or injected cocaine	0.36	0.16–0.83	0.016
Ever smoked marijuana	0.89	0.71–2.61	NS
Current injected heroin	1.66	0.90–3.06	NS
Current snorted or injected cocaine	0.57	0.33–1.00	0.05
Current smoked marijuana	1.05	0.52–2.13	NS
Current consumed hallucinogen	0.41	0.21–0.80	0.009
Current consumed amphetamine	0.37	0.19–0.72	0.004
Current consumed alcohol (>21 drinks/week)	0.37	0.20–0.69	0.002
Current smoked cigarettes	1.00	0.35–2.87	NS
Age at first injected heroin < 20 years	1.32	0.68–2.57	NS
Duration of injected heroin > 7 years	2.84	1.44–5.58	0.002
Age at first snorted cocaine < 17 years	0.83	0.45–1.50	NS
Duration of snorted cocaine > 7 years	0.69	0.38–1.25	NS
FibroScan > 7.1 kPa	3.82	1.94–7.54	<0.0001
Multivariate analysis			
Age ≤ 30 years	1.95	0.83–4.57	NS
Ever snorted or injected cocaine	0.11	0.01–0.95	0.04
Current consumed hallucinogen	0.70	0.18–2.73	NS
Current consumed amphetamine	0.89	0.22–3.52	NS
Current consumed alcohol (>21 drinks/week)	0.27	0.11–0.66	0.04
Duration of injected heroin > 7 years	2.67	1.13–6.34	0.02
FibroScan > 7.1 kPa	3.57	1.23–10.37	0.02

supports the view that the use of the FibroScan, associated with multi-faceted interventions (nurses and hepatologist in street-based outreach), could improve HCV screening and management. Contrary to some opinions regarding the likely poor compliance with HCV management, the active IDU patients in this study were highly motivated to gain access to

Characteristics	FS ≤ 7.1 kPa $n = 238$ (%)	FS > 7.1 kPa $n = 60$ (%)	P
Mean age (years)	31.7 ± 8.4	31.5 ± 7.9	NS
Male gender	177 (74.4)	49 (81.7)	NS
BMI (kg/m^2)	22.0 ± 3.2	22.3 ± 3.0	NS
Married or cohabitation	88 (37.0)	21 (35.0)	NS
Children	156 (65.5)	42 (70.0)	NS
Employed full time	50 (21.0)	12 (20.0)	NS
Income: salary	43 (18.1)	11 (18.3)	NS
No income	57 (23.9)	17 (28.3)	NS
Residence pattern			
Permanent residence/housing	128 (53.8)	30 (50.0)	NS
Transient (living temporally with friends or family)	44 (18.5)	11 (18.3)	NS
Unstable housing (homeless, living in street, car, or shelter)	66 (27.7)	19 (31.7)	NS
Social welfare for health	123 (51.7)	33 (55)	NS
Incarceration	78 (32.8)	26 (43.3)	NS
Drug use history			
Ever injected heroin	158 (66.4)	46 (76.7)	NS
Ever snorted cocaine	217 (91.2)	48 (80.0)	0.01
Ever smoked marijuana	226 (94.9)	53 (88.3)	NS
Current drug use (used in the past week)			
Injected heroin	57 (23.9)	21 (35.0)	NS
Snorted or injected cocaine	116 (48.7)	23 (38.3)	NS
Smoked marijuana	196 (82.3)	47 (78.3)	NS
Consumed hallucinogen	70 (29.4)	9 (15.0)	0.02
Consumed amphetamine	71 (29.8)	11 (18.3)	NS
Consumed alcohol (>21 drinks/week)	89 (37.4)	26 (43.3)	NS
Smoked cigarettes	221 (92.8)	55 (91.7)	NS
Age at first injected heroin (years)	20.4 ± 5.1	20.3 ± 5.2	NS
Age at first snorted cocaine (years)	18.0 ± 4.6	19.5 ± 5.3	NS
Age at first smoked marijuana (years)	14.9 ± 4.1	16.5 ± 5.7	0.02
Currently in drug treatment	141 (59.2)	38 (63.3)	NS
ALT (IU/L)	37.9 ± 32.6	87.8 ± 76.7	<0.0001
AST (IU/L)	30.8 ± 25.5	58.6 ± 50.5	<0.0001
GGT (IU/L)	51.9 ± 79.3	164.8 ± 212.4	<0.0001
Platelets (G/L)	269.5 ± 73.9	238.4 ± 72.4	0.01
Positive HCV serology	54 (22.7)	29 (48.3)	<0.0001
Fibrotest	0.14 ± 0.12	0.34 ± 0.27	<0.0001

Table 7 Characteristics of patients according to FibroScan values

ALT, alanine aminotransferase; AST, aspartate aminotransferase; GGT, gamma-glutamyl transpeptidase; NS, not significant.

HCV screening after FibroScan evaluation. The excellent compliance rate attests to this with only 26% of patients not going for a blood sample. While it is inappropriate to attempt to identify the most important elements of the intervention, this study highlights the importance of clinical and organizational support for the successful screening and management for HCV infection. In the complex intervention, screening for HCV infection after FibroScan was accompanied by information, advice, consent and support before and after testing, an approach whose importance has been highlighted [34]. While the establishment of a FibroScan in a street-based outreach for drug users should be incorporated

Table 8 Factors associated with Fibro-Scan > 7.1 kPa

	Odds ratio	95% Confidence interval	*P*
Univariate analysis			
Age ≤ 30 years	1.14	0.65–2.02	NS
Male gender	1.53	0.75–3.14	NS
Ever injected heroin	1.66	0.86–3.21	NS
Ever snorted or injected cocaine	0.39	0.18–0.84	0.02
Ever smoked marijuana	0.40	0.15–1.07	NS
Current injected heroin	1.71	0.93–3.14	NS
Current snorted or injected cocaine	0.65	0.37–1.17	NS
Current smoked marijuana	0.77	0.38–1.56	NS
Current consumed hallucinogen	0.42	0.20–0.91	0.03
Current consumed amphetamine	0.53	0.26–1.07	NS
Current consumed alcohol (>21 drinks/week)	1.34	0.73–2.46	NS
Current smoked cigarettes	0.85	0.30–2.39	NS
Age at first injected heroin < 20 years	0.73	0.38–1.40	NS
Duration of injected heroin > 7 years	1.00	0.96–1.05	NS
Age at first snorted cocaine < 17 years	1.06	0.99–1.13	NS
Duration of snorted cocaine > 7 years	1.11	0.59–2.09	NS
Positive HCV serology	3.82	1.94–7.54	<0.0001
Multivariate analysis			
Ever snorted or injected cocaine	0.62	0.25–1.55	NS
Current consumed hallucinogen	0.32	0.12–0.89	0.03
HCV positivity	3.22	1.60–6.47	<0.0001

into any subsequent intervention designed to improve screening for hepatitis C in primary care, it is likely to have considerable resource implications. The resource implications of improving HCV screening associated to performing a FibroScan would appear to justify the provision of such support.

As is already well known, ever injected heroin use was associated with HCV infection. Ever or current cocaine use was inversely associated with HCV positivity. This could be due to the fact that cocaine was mainly snorted and that most of cocaine users did not often inject heroin or cocaine.

Duration of injecting heroin and FibroScan > 7.1 kPa were associated with HCV positivity [29]. Duration of injecting together with frequency of injection is one of the most commonly reported risk factors and reflects the cumulative exposure to infected needles and injection paraphernalia [35,36]. To our knowledge, the association of an elevated FibroScan value with HCV positivity has never previously been reported. Therefore, FibroScan could be used as a screening method for HCV infection in IDUs. After liver

stiffness assessment, blood sampling for HCV screening could be offered to all subjects with a value >7.1 kPa.

Considering the average duration of intravenous heroin consumption was around 7 years among the participants in this study, one might have expected a higher prevalence rate for contact with HCV, HBV, and HIV. The present findings are in line with previous studies, which found an association between the presence of HCV antibodies with age and duration of intravenous heroin consumption [37]. These data emphasize the relevance of the length of an individual's drug use career as a pre-eminent risk factor for HCV acquisition.

In IDUs, the Fibrotest can predict insignificant fibrosis [38]. While a high predictive value (>95%) for detection of insignificant fibrosis is achieved by using the Fibrotest, its inability to detect significant fibrosis reliably is disappointing. Moreover, the Fibrotest needs a blood sample, which most IDUs refuse. The FibroScan has the advantage of not needing a blood sample.

Our study did not address the practices of tattooing and body piercing, which have been shown to be associated with

HCV infection. As in most studies of IDUs, our study was based on self-reported behaviour so caution should be exercised in the interpretation of such data. Other studies of IDUs have found that socially desirable responses had only a negligible effect on responses concerning risk behaviour for infection [39].

Recent advances in the treatment of HCV infection are providing the means for reducing the current and future HCV-related liver disease burden. People with HCV who are current IDUs or on drug dependency treatment have often been excluded from treatment programmes. A way to fight the HCV epidemic is to start treating drug users with chronic HCV infection. This would reduce the large pool of circulating HCV infections and decrease the chance of new subjects getting infected. Interferon and ribavirin may be used successfully and safely in current and recovering IDUs, including within opiate detoxification programmes or opiate dependency maintenance programmes [40,41]. HCV treatment can be successful even for persons who continue to inject illicit drugs, although more frequent use is correlated with less success [42]. Despite this, a small minority of current IDUs receive treatment. The explanation for the low rates of HCV treatment among IDUs is multifactorial. Barriers to HCV treatment access may relate to lack of understanding and low prioritization among patients, lack of treatment consideration or active discrimination by clinicians, and limited HCV treatment infrastructure. In our study, 10% of HCV-positive patients started HCV treatment, a result directly stemming from use of the FibroScan. In fact, these subjects were well known to the clinicians in the centre and until then had never accepted blood sampling for HCV screening.

This prospective study strengthens the existing evidence that HCV screening, management and treatment should be offered to active IDU individuals only after they have had a FibroScan. FibroScan should be implemented widely in street-based outreaches.

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