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Anti-HCV prevalence in the general population of Lithuania

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Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

Summary

Background: The aim of this study was to assess risk factors for HCV acquisition and prevalence of anti-HCV in the general population of Lithuania.

Material/Methods: The study enrolled 1528 randomly selected adults from the 5 biggest cities of Lithuania and its rural regions. Screening for anti-HCV was performed by analysis of peripheral capillary blood with lateral flow immunochromatography and confirmation of positive cases by peripheral venous blood testing with 2-step chemiluminescent microparticle immunoassay.

Results: Anti-HCV prevalence in Lithuania is 2.78% and according to the standard European population the adjusted anti-HCV rate is 2.85%. It is more prevalent among men (crude rates: 4.02% males *vs.* 1.49% females, p=.0030) and this does not depend on age. Vilnius and Kaunas regions have higher infection rates than smaller rural regions (2.92% and 3.01% *vs.* 2.24%, 0.74% and 1.35%). Nowadays among our population HCV infection spreads mainly via intravenous drug use (OR=42.5, p<.0001). HCV transmission occurs through blood transfusions (OR=6.4, p=.0002), tooth removal (OR=4.1, p=.0048), childbirth (OR=5.0, p=.0224), multiple and a long-term hospitalization (OR=3.0, p=.0064), tattooing (OR=4.4, p=.0013), open traumas (OR=3.7, p=.0009) and intrafamilially (OR=11.3, p=.0002).

Conclusions: 2.78% of the population is anti-HCV-positive. The anti-HCV rate is higher in Vilnius and Kaunas in comparison with other regions. HCV spreads mainly through intravenous drug use, but intrafamilial and some nosocomial routes are also important. The anti-HCV prevalence did not depend on age. Despite active prevention of nosocomial HCV transmission, the incidence of HCV infection does not decrease due to virus spread mostly in "trusted networks" of intravenous drug users.

key words: **hepatitis C virus • anti-HCV antibodies • infection • spread**

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Background

Numerous publications present anti-HCV prevalence in particular groups: blood or plasma donors, hemodialyzed and post-transfusion subjects, intravenous drug users, subjects with high-risk behaviour, health care workers, and patients with liver diseases. Among these groups only data from studies of blood donor volunteers can more or less be treated as a reflection of anti-HCV prevalence in the general population. Such studies were conducted in many European countries shortly after HCV discovery [1–17]. Taking into account risk groups, blood donors' studies gave a picture of anti-HCV prevalence and routes of hepatitis C virus (HCV) spread in various parts of Europe. A systematic review by Esteban et al summarized those data up to 2007 [18]. According to this comprehensive review, in general European population the lowest anti-HCV prevalence occurs in Northern (0.1–1.0%) and Central Europe (0.2–1.2%). In Southern Europe and Spain anti-HCV prevalence is 2.5–3.5%. The authors stressed that up to now there were no sufficient data about anti-HCV prevalence in Eastern Europe. Naoumov (1999) reviewed and summarized data from Eastern European studies of blood donors, medical personnel and hemodialysed patients [19]. It was ascertained with reference to blood donor studies that the Eastern European population has a high prevalence of HCV infection – from 0.68% in Czech Republic to 4.9% in Romania. Later publications from this European region have confirmed this conclusion, but there are still no population-based studies published from Eastern European countries [20–22].

Prevalence of HCV infection in Lithuania has been studied in small groups of first-time blood donors, acute viral hepatitis patients and in risk groups (2.2% in first-time blood donors, 7.9% in commercial donors, 13.9% in commercial plasma donors, 48.3% in hemodialysed patients, 29.4% in prisoners, 9.4% in elderly nursing home residents, and 7.9% in hemodialysis staff) [23,24]. These data did not provide a clear picture of anti-HCV prevalence in the general population, but it allowed estimation of prevalence at from 2% to 3%.

We present a descriptive epidemiological study, prepared according to CONSORT [25] and STROBE [26,27] recommendations, aimed at assessing age-specific risk factors for HCV acquisition and prevalence of anti-HCV in the general population of Lithuania.

Material and Methods

Study design

An observational analytical cross-sectional study design was conducted to clarify the prevalence of anti-HCV and HCV transmission routes in the general population. Cross-sectional survey of random anonymous volunteers and testing them for anti-HCV was conducted May 17-22, 2010 in 5 cities of Lithuania (Vilnius, Kaunas, Klaipėda, Šiauliai, and Panevėžys) and corresponding rural regions where 75% of the population live (2 513 313 out of 3 329 039, according to the Lithuanian Statistical Department; *http://www.stat.gov.lt/lt/*).

Study population

According to data on anti-HCV prevalence in Eastern Europe and the study by Ambrozaitis et al. on Lithuanian blood donors and some risk groups [23,24], we expected the prevalence of anti-HCV in Lithuania to be approximately P=3%±1%. After calculation of an adequate sample size with precision 1% (d=0.01) and level of confidence of 95% (Z=1.96), a cohort of n=1118 subjects was estimated by the formula $n=(Z^2P(1–P))/d^2$ [28].

People over age 18 who were willing to be tested for anti-HCV were voluntarily enrolled into the study by a convenience sampling of shoppers at one of the biggest supermarkets in Vilnius, Kaunas, Klaipėda, Šiauliai and Panevėžys. The only eligibility criteria were age ⩾18 and residence in the selected cities and/or corresponding rural regions.

During this study, 1528 randomly selected adults of various ages were enrolled. Anti-HCV testing was wrongly performed or questionable for 14 (0.9%) participants or a tested person refused or could not repeat it. Anti-HCV tests was suitable for evaluation in a total of 1514 (99.1%) subjects (572 men and 942 women) – 651 (241 men and 410 women in Vilnius), 266 (128 men and 138 women in Kaunas), 313 (115 men and 198 women in Klaipėda), 148 (55 men and 93 women) in Panevėžys, and 136 (33 men and 103 women) in Šiauliai (Figure 1).

Data collection

The study was performed according to the World Medical Association Declaration of Helsinki, and all procedures were approved by the Lithuanian Bioethics Committee. All volunteers who wanted to know their anti-HCV status signed informal consent and answered an anonymous questionnaire with demographic data (age, sex, education, occupation, residence) and exposure to HCV risk factors (intravenous drug use, blood transfusions, blood donations, hemodialysis, tattooing, piercing, open trauma, surgery, multiple and the long-term hospitalizations, HCV infection among family members, dentistry, tooth removal, childbirth, abortions, and risky sexual behaviour).

Screening for anti-HCV was performed on the peripheral capillary blood using rapid lateral flow immunochromatography test (Core HCV-WB; Core Diagnostics, Birmingham B2 5HG, UK) with 99.99% diagnostic specificity and 100% sensitivity. All anti-HCV-positive subjects were admitted for further testing at the Centre of Hepatology, Gastroenterology and Dietetics of Vilnius University Hospital "Santariškių klinikos", where anti-HCV were confirmed with 2-step chemiluminescent microparticle immunoassay (Architect System anti-HCV; Abbott, 65205 Wiesbaden, Germany).

The following limitations of such data collection are:

a. Free anonymous testing for anti-HCV might be more attractive for having exposure to HCV risk (for example: intravenous drug users, subjects having family member infected with HCV) rather than for persons without suspected exposure. That is why detected anti-HCV prevalence can occur been higher than it really is. Such subjects could also be not fully overt in indication of possible risk factors, although the questionnaire used was fully anonymous. This can possibly distort data on HCV acquisition routes.
b. It was not possible to control age and sex proportions of the participants. That is why in a study cohort we had 37.8% men and 62.2% women; although in the general population we have 45% men and 55% women. In the

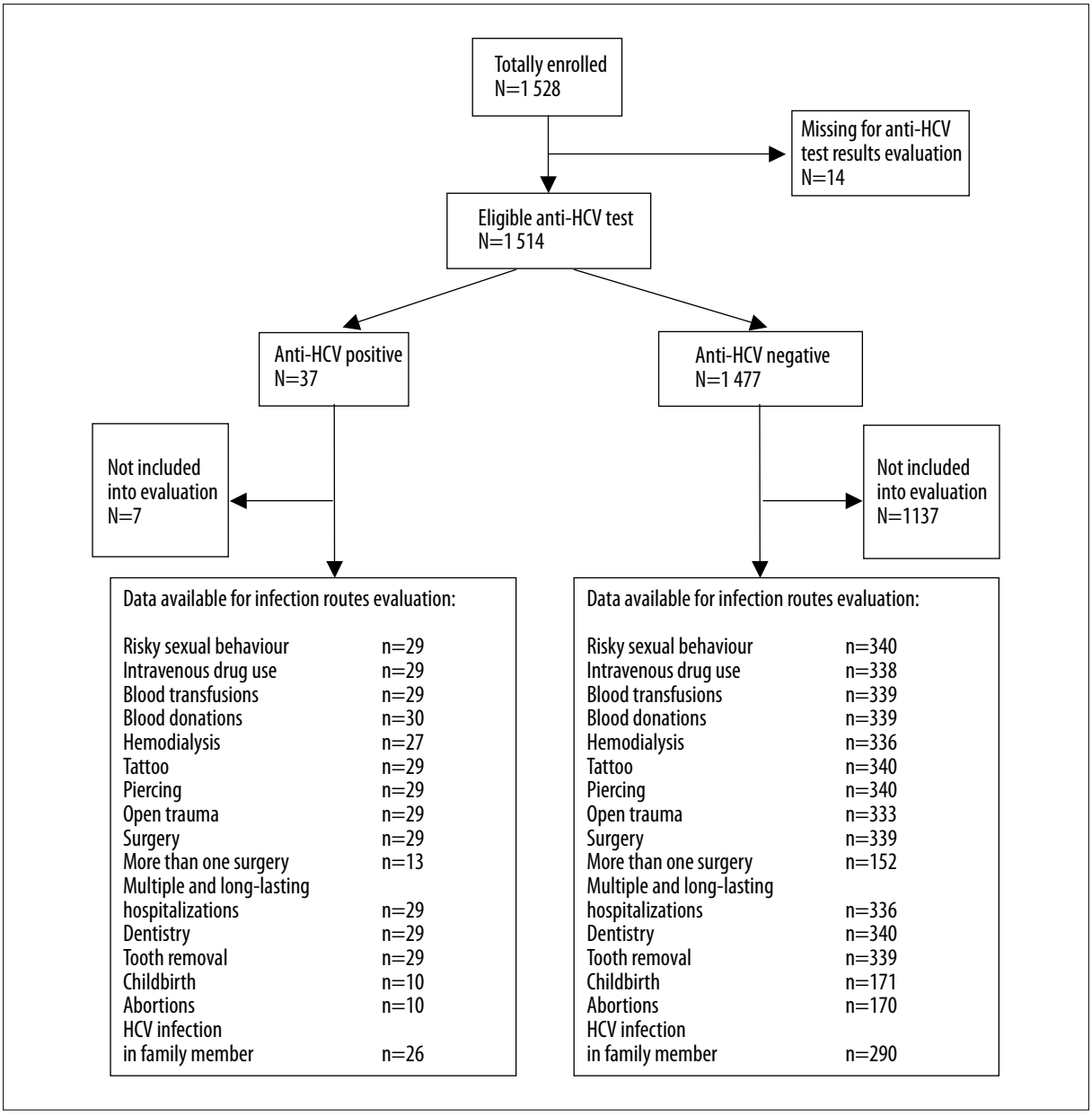

Figure 1. Enrolment diagram.

study cohort the age distribution differed from the general population. All those limitations were taken into consideration during statistical analysis of our data.

Statistical evaluation

The anti-HCV rate was calculated separately for men and women on age-dependent strata. Crude rate in age-dependent strata and in the study population overall were calculated as a mean of rates among men and women.

Age- and sex-dependent standardized anti-HCV rate in the general population was calculated using the direct standardization method and separate calculation of standard vectors for men and women in age-dependent strata ($w_j=n_j/N$ where n_j – number of males or females on age-depended stratum, N – population overall) [29]. The standardized rate was calculated as a sum of proportional rates. This rate was further standardized to the European population.

Comparison of different routes of exposure was evaluated with Fisher's exact test. For every statistically significant ($\rho \leq .05$) HCV route, an odds ratio was estimated using univariate logistic regression analysis with 95% confidence interval.

Differences in anti-HCV positivity between men and women on age-dependent strata were evaluated with Fisher's exact test.

Results

Anti-HCV positivity

Among 1514 tests, 37 (2.44%) anti-HCV-positive subjects were detected (23 men, 14 women), of these there were 3

Table 1. Crude anti-HCV rates in age-depended strata of study cohort.

Age, years	Men, n/%		Women, n/%		Total, n/%	
	Sample	Anti-HCV rate	Sample	Anti-HCV rate	Sample	Anti-HCV rate
18–19	21	1/4.76	33	1/3.03	54	2/3.7
20–24	104	1/0.96	118	1/0.85	222	2/0.9
25–29	48	2/4.17	70	1/1.43	118	3/2.54
30–34	33	1/3.03	64	0	97	1/1.03
35–39	46	3/6.52	84	2/2.38	130	5/3.85
40–44	45	4/8.89	90	1/1.11	135	5/3.70
45–49	60	4/6.67	99	0	159	4/2.52
50–54	49	1/2.04	102	1/0.98	151	2/1.32
55–59	52	2/3.85	90	0	142	2/1.41
60–64	32	1/3.13	61	2/3.28	93	3/3.23
65–69	40	2/5.0	63	2/3.17	103	4/3.88
70–74	25	1/4.0	27	0	52	1/1.92
75–79	12	0	31	3/9.68	43	3/6.98
80–84	4	0	10	0	14	0
≥85	1	0	0	0	1	0
Total 18–≥85	**572/37.8**	**23/4.02**	**942/62.2**	**14/1.49**	**1514**	**37/2.44**

Table 2. Prevalence of anti-HCV of adults in various Lithuanian regions (crude rate).

	Men, n/%		Women, n/%		Total, n/%	
	Sample	Anti-HCV rate	Sample	Anti-HCV rate	Sample	Anti-HCV rate
Vilnius	241	11/4.56	410	8/1.95	651	19/2.92
Kaunas	128	6/4.69	138	2/1.45	266	8/3.01
Klaipėda	115	4/3.48	198	3/1.52	313	7/2.24
Šiauliai	33	1/3.03	103	0	136	1/0.74
Panevėžys	55	1/1.82	93	1/1.08	148	2/1.35
Total	**572**	**23/4.02**	**942**	**14/1.49**	**1514**	**37/2.76**

(8.1%) people (2 from Vilnius region and 1 from Klaipėda) who knew their anti-HCV status because HCV infection had been diagnosed previously and/or they were treated for chronic hepatitis C, and 34 (91.9%) had never been tested for anti-HCV (Table 1).

In our cohort, anti-HCV positivity did not depend on age (p=.7216), but more men than women had been exposed to HCV (crude rates: 4.02% *vs* 1.49%, p=.0030). The mean of anti-HCV rates was 2.76% and was similar to the rate in the general population (2.78%).

After direct standardization of sex-adjusting rates by age distribution of standard European population prevalence of anti-HCV, a rate of 2.85% was obtained.

We did not standardize the anti-HCV rate of our cohort to the world population because the population of Lithuania is older and anti-HCV prevalence dependence on age was not ascertained.

In the study cohort anti-HCV prevalence depended on region of the country. Rural Lithuanian regions are less affected by HCV infection than the capital and bigger cities (Table 2).

HCV infection routes

After analyzing the questionnaire data, we found that intravenous drug use is the most important risk factor for HCV spread in our population (Table 3).

Table 3. Risk factors of HCV acquisition.

Risk factor	Anti-HCV positive, n/%	Anti-HCV negative, n/%	Fisher exact test, p	Univariate logistic regression	
				OR	p
Risky sexual behaviour	0/0	8/2.35	NS		
Intravenous drug use	8/27.6	3/0.9	7.98×10^{-8}	42.54	<.0001
Blood transfusions	7/24.1	16/4.3	.0009	6.424	.0002
Blood donations	10/33.3	80/21.7	NS		
Hemodialysis	1/3.7	1/0.3	NS		
Tattoo	8/27.6	27/7.3	.0029	4.416	.0013
Piercing	8/27.6	184/49.9	.0066	0.323	.0085
Open trauma	13/44.8	59/17.7	.0013	3.733	.0009
Surgery	18/62.1	179/52.8	NS		
More than one surgery	4/30.8	37/24.3	.0196		
Multiple and long-lasting hospitalizations	11/37.9	56/16.7	.0099	3.056	.0064
Dentistry	22/75.9	243/71.5	NS		
Tooth removal	24/82.8	182/53.7	.0029	4.141	.0048
Childbirth	7/70.0	54/31.6	.0324	5.056	.0224
Abortions	1/10.0	23/13.5	NS		
HCV infection in family member	5/19.2	4/1.4	.0008	11.270	.0002

Table 4. Multiple surgeries and anti-HCV positivity.

	Total	Number of surgeries							p
		0	1	2	3	4	5	6	
Anti-HCV positive, n/%	13/7.9	0	9/69.2	0	2/15.4	1/7.7	0	1/7.7	.0196
Anti-HCV negative, n/%	152/92.1	1/0.7	114/75.0	26/17.1	7/4.6	2/1.3	2/1.3	0	

Blood transfusions, tooth removal, childbirth, and long-term or multiple hospitalizations can be assigned to HCV acquisition risks (Table 3). Statistically, other healthcare procedures (blood donation, hemodialysis, surgery, dentistry, abortions) are not associated with HCV acquisition.

People who had a single surgery had generally similar rates of infection to the general population, but people having more than 2 surgeries were more often anti-HCV positive (Table 4).

Nine people had HCV-infected relatives. Among the 5 (19.2%) anti-HCV-positive people, 2 had HCV-infected brothers, 1 had an HCV-infected sister, 1 had an HCV-infected wife, and 1 had an HCV-infected husband. Among the 4 (1.4%) anti-HCV-negative people, 2 had HCV-infected fathers, 1 had an HCV-infected brother, and 1 had an HCV-infected sister. Risky sexual behaviour was not confirmed as a risk factor (Table 3).

Being rather often declared, piercing was ascertained as a safe procedure concerning HCV spread, but the tattoo is not safe. Open traumas were also confirmed as an HCV acquisition risk.

Discussion

Based on the results of this study we estimate that the anti-HCV prevalence in Lithuania is 2.78%, and adjusted to the standard European population the anti-HCV rate is 2.85%.

This rate is a bit higher then was expected. Perhaps the free anonymous testing provided by our study was more attractive for people possibly having exposure to HCV (eg, intravenous drug use, having a family member with HCV infection) than for those without such risks.

Our estimated anti-HCV prevalence is similar to that in Russia, but it is higher than in Poland, Estonia and Latvia [18]. However, the conclusion related to anti-HCV prevalence in Eastern European countries was based on studies of blood donors, as in case of Poland [22,30], or on the basis of personally communicated data, as in case of the Baltic states [19].

We could not find a single observational study presenting anti-HCV prevalence in the general populations of Estonia, Latvia, Poland or in other neighbouring countries (Russia, Byelorussia or Ukraine). In Lithuania blood donors, some small risk groups and chronic hepatitis C patients were investigated [23,31–34]. Similar data are obtainable in Latvia and Estonia [35–39].

The data on anti-HCV prevalence from a large cohort of 4216 healthy people from various regions of Russia and Mongolia were presented in 1996 [40]. According to this study, anti-HCV prevalence in those regions varied from 0.7% in Central Russia to 10.7% in Mongolia. There is no current data about HCV infection spread in Russia including the Kaliningrad region where an explosion of intravenous drug abuse was observed during the last decade. Namely this Russian region has a common border with Lithuania.

A study of northern Ukrainian schoolchildren and blood donors found a 0.8% anti-HCV prevalence for schoolchildren and 2.3% for blood donors; anti-HCV prevalence directly correlated with the age – people ages 40–49 years had 4.0% positivity, while those older than 60 years had 6.25% [41]. Those data were published in 1993 and do not reflect the present situation of HCV infection in Ukraine. In addition, the correlation of anti-HCV prevalence with age was not reported anywhere in the literature, nor did we find such correlation in our cohort.

In Byelorussia, 1.26% anti-HCV prevalence was reported without reference to the source [21].

On the basis of the above-mentioned publications, Esteban and co-authors presented anti-HCV prevalence in Eastern Europe (Figure 1 in review) [18]. However, these data are not sufficient to provide a true picture of anti-HCV prevalence or the number of HCV carriers in this region. Those authors presumed that anti-HCV prevalence could be higher not only in Eastern Europe, but also in the general European population because there are not sufficient current data [18]. Epidemiological studies of the general population would be useful in order to clarify the situation of HCV infection in Europe in light of increasing intravenous drug abuse.

According to the obtained data, the main HCV infection route in Lithuania is currently intravenous drug use (OR=42.5). In our country about 80% of intravenous drug users are infected with HCV and men more often than women engage in this behavior [42]. This could explain the higher rate of anti-HCV positivity found in men of our cohort. Intravenous drugs are more accessible in cities (especially in the capital); accordingly, we found lower anti-HCV prevalence in rural regions.

Observations and data of other investigators taken together reinforce the fact that intravenous drug use is now the principal route of HCV spread in the European population [18,33].

Former nosocomial routes such as blood donations, surgeries, and hemodialysis seem to be well controlled in our country. Nevertheless, blood transfusion can still be a source of HCV (OR=6.4). In Lithuania every donor's blood has been tested for anti-HCV since 1994 and since 2004 for HCV RNA. Sufficient HCV RNA quantity for detection appears only after 4–5 days of HCV infection. HCV RNA is tested separately in every donation, not in pools, and NAT sensitivity is 3.01 IU/ml. Still, there exists a possibility for HCV transmission with blood or its products. Safety of donor's blood is still a worldwide health care problem which could be partially solved by introducing more sensitive NAT methods. However, it will not be solved completely, especially in the case of paid donations [31,32,43].

Tooth removal was also confirmed as an HCV transmission route in our population. The possibility of HCV transmission through saliva is questionable, but it cannot be ruled out. Taking into consideration the HCV RNA presence in saliva of 35–55% of chronic hepatitis C patients, there is a possibility to transmit HCV to dentists and others [44–49].

Childbirth, being a risk factor for HCV acquisition, was an unexpected finding for us. This HCV infection route was not investigated. Anti-HCV prevalence among pregnant women and mother-to-child HCV transmission have been discussed in the literature [50–54]. The number of anti-HCV-positive women in our cohort was only 14 and only 10 answered the question about childbirth – 7 (70%) had children – and 171 anti-HCV-negative women, answered a question about childbirth – 54 (32%) had children. So, the small group of anti-HCV-positive women in our cohort may indicate why childbirth became statistically significant as an HCV risk factor. We failed to find a single study of anti-HCV prevalence in women before and after childbirth. Such a study would be useful to confirm or deny our controversial finding and clarify a possible source of HCV infection if this exists in the maternity clinic.

Confirming that multiple and long-term hospitalization is an HCV risk factor raises the question of the specific route of transmission in hospitals [55]. The possible infection source can be asymptomatic HCV carriers who are admitted for surgery or conservative treatment, for example, heart disease, and they are not tested for HCV by diagnostic algorithm. A health care worker infected with HCV but not diagnosed can also be a source of infection [56–60].

There were only 2 patients in the study cohort who underwent hemodialysis: 1 was anti-HCV positive and the other one was not. Such limited data does not allow us to draw conclusions, but studies before 1995 indicated to a high prevalence of anti-HCV in hemodialyzed patients [23].

It is necessary to pay attention to a new risk factor for HCV acquisition in our population – HCV infection among family

members (OR=11.3). Nine people (5 anti-HCV-positive and 4 anti-HCV-negative) indicated presence of HCV infection in family members (usually it is sister or brother, but also it can be a spouse or parent); it confirmed a possibility of household and/or sexual HCV acquisition. However, risky sexual behaviour was not proved to be an HCV acquisition route. Still, intrafamilial HCV spread is not well elucidated, although it has been recorded and studied since the early 1990s. It was only recognized that family members of HCV-infected patients had a 3- to 5-fold higher prevalence of anti-HCV than the general population and are often infected with the same HCV strain [61–64].

Open traumas with a big blinding area can be considered as a risk for HCV acquisition but its reasons are unclear (OR=3.7). Receiving a tattoo is a risk factor for HCV infection (OR=4.4), possibly because of violation of sanitary norms during the procedure.

Our previous study of chronic hepatitis C cohort [33] found a changing trend in HCV transmission, from nosocomial to less controlled intravenous drug use or HCV infection in family member. HCV infection source depended on age of patients. We found that older patients often get HCV during surgeries or long-term and multiple hospitalizations, while younger ones get it through intravenous drug use and tattooing.

Considering the asymptomatic course of infection, a high HCV rate in intravenous drug users and existence of their "trusted networks", a new peak of HCV infection can be expected in the near future [65,66]. This is important not only for Lithuania, but also for other European countries where intravenous drug use is becoming a core of the HCV epidemic [18].

HCV spread through intravenous drug use is not only a healthcare problem; it is a social problem as well. It cannot be resolved only with prevention or other healthcare tools, especially in the absence of effective immunization. Only a complex of coordinated means directed to intravenous drug use prevention, public education and preventive efforts can be effective in prevention of HCV spread.

Conclusions

In our population, anti-HCV prevalence is 2.78%; adjusted to the standard European population, prevalence is 2.85%. This rate is higher in Vilnius and Kaunas in comparison with other regions of Lithuania.

The anti-HCV prevalence does not depend on age.

The main HCV transmission route is intravenous drug use; intrafamilial transmission is significant as well.

Blood transfusions, tattooing, open trauma, tooth removal, uncertain nosocomial transmission during multiple and long-term hospitalizations and childbirth are also HCV infection routes.

Despite active prevention of nosocomial HCV transmission, the incidence of HCV infection does not decrease, due to virus spread in "trusted networks" of intravenous drug users. Nowadays, HCV transmission control cannot be carried out without controlling intravenous drug use and active prevention educational tools.

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Conflict of interest

The authors who have taken part in this study declare that they do not have anything to disclose regarding funding or conflict of interest with respect to this manuscript.

References:

1. Suarez A, Rodriguez M, Riestra S et al: [The prevalence of anti-HCV positivity among blood donors in Asturias. A clinical-epidemiologic study]. Med Clin (Barc), 1994; 103: 606–10
2. Brind AM, Codd AA, Cohen BJ et al: Low prevalence of antibody to hepatitis C virus in north east England. J Med Virol, 1990; 32: 243–48
3. Hetland G, Skaug K, Larsen J et al: Prevalence of anti-HCV in Norwegian blood donors with anti-HBc or increased ALT levels. Transfusion, 1990; 30: 776–79
4. Wantzin PS, Krogsgaard K, Dickmeiss E: [Screening of Danish blood donors for hepatitis C virus antibodies]. Ugeskr Laeger, 1990; 152: 2846–48
5. Sirchia G, Almini D, Bellobuono A et al: Prevalence of hepatitis C virus antibodies in Italian blood donors. The Italian Cooperative Group. Vox Sang, 1990; 59: 26–29
6. Krusius T: [Risk of hepatitis after blood transfusion in Finland]. Duodecim, 1990; 106: 1412
7. Ayob Y, Davidson JI, Baxter A et al: Risk of hepatitis C in patients who received blood from donors subsequently shown to be carriers of hepatitis C virus. Transfus Med, 1994; 4: 269–72
8. Lindholm A: Epidemiology of viral infections in the Swedish blood-donor population. Blood Coagul Fibrinolysis, 1994; 5(Suppl.3): S13–17
9. Crawford RJ, Gillon J, Yap PL et al: Prevalence and epidemiological characteristics of hepatitis C in Scottish blood donors. Transfus Med, 1994; 4: 121–24
10. Goodrick MJ, Gray SF, Rouse AM et al: Hepatitis C (HCV)-positive blood donors in south-west England: a case control study. Transfus Med, 1994; 4: 113–19
11. Wolff C, Kleesiek K, Petersen N, Beyer J: Hepatitis C viremia in German blood donors: serum alanine aminotransferase is not a valid marker for screening. Transfusion, 1994; 34: 361–62
12. Nordoy I, Schrumpf E, Elgjo K et al: Liver disease in anti-hepatitis C virus-positive Norwegian blood donors. Scand J Gastroenterol, 1994; 29: 77–81
13. Aguelles O, Janot C: Epidemiology of anti-HCV antibodies in France. Viral Hepatitis Study Group of the French Blood Transfusion Society. Arch Virol Suppl, 1992; 4: 249–52
14. Wiegand J, Luz B, Mengelkamp AK et al: Autologous blood donor screening indicated a lower prevalence of viral hepatitis in East vs West Germany: epidemiological benefit from established health resources. J Viral Hepat, 2009; 16: 743–48
15. La TG, De VE, Langiano E et al: Epidemiology of hepatitis C virus antibodies in blood donors from the province of Latina, Italy. Eur J Epidemiol, 2003; 18: 691–94
16. Zervou EK, Boumba DS, Liaskos C et al: Low prevalence of HCV, HIV, and HTLV-I/II infection markers in northwestern Greece: results of a 3-year prospective donor study (1995–1997). Eur J Intern Med, 2003; 14: 39–44
17. Klofera M, Chalupa P, Jezek P: [Hepatitis C antibodies (anti-HCV) in blood donors at the transfusion department in Brno]. Cas Lek Cesk, 1994; 133: 459–62
18. Esteban JI, Sauleda S, Quer J: The changing epidemiology of hepatitis C virus infection in Europe. J Hepatol, 2008; 48: 148–62

19. Naoumov NV: Hepatitis C virus infection in Eastern Europe. J Hepatol, 1999; 31(Suppl.1): 84–87
20. Nemecek V, Strunecky O: [Genotypic heterogeneity of hepatitis C virus (HCV) from blood donors in the Czech Republic]. Epidemiol Mikrobiol Imunol, 2009; 58: 63–72
21. Olinger CM, Lazouskaya NV, Eremin VF, Muller CP: Multiple genotypes and subtypes of hepatitis B and C viruses in Belarus: similarities with Russia and western European influences. Clin Microbiol Infect, 2008; 14: 575–81
22. Seyfried H, Brojer E, Grabarczyk P et al: [Prevalence of hepatitis C virus markers in Polish blood donors in 1994–2003]. Przegl Epidemiol, 2005; 59: 807–14
23. Ambrozaitis A, Zagminas K, Balciuniene L, Widell A: Hepatitis C in Lithuania: incidence, prevalence, risk factors and viral genotypes. Clin Diagn Virol, 1995; 4: 273–84
24. Ambrozaitis A, Balciuniene L, Widell A: Hepatitis C virus genotype distribution in Lithuanian first time blood donors. Acta Med Lituanica, 1994; 4: 21–24
25. Moher D, Schulz K, Altman D: The CONSORT statement: revised recommendations for improving the quality of reports of parallel-group randomised trials. Lancet, 2001; 357: 1191–94
26. von Elm E, Altman D, Egger M et al: The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. J Clin Epidemiology, 2008; 61: 344–49
27. Vandenbroucke JP, von Elm E, Altman DG et al: Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): explanation and elaboration. Epidemiology, 2007; 18: 805–35
28. Daniel W: Biostatistics: A Foundation for Analysis in the Health Sciences, 1999
29. Handler A, Rosenberg D, Kennelly J, Monahan C: Analytic Methods in Maternal and Child Health, 1998
30. Chlabicz S, Bonifatiuk I, Radziwon P: Prevalence of hepatitis C virus antibodies among blood donors in north-eastern Poland. Hepatol Res, 2005; 33: 206–10
31. Kalibatas V: [The results of nucleic acid testing for viruses in individual donor test and its importance for the safety of blood]. Medicina (Kaunas), 2008; 44: 791–98
32. Kalibatas V: Payment for whole blood donations in Lithuania: the risk for infectious disease markers. Vox Sang, 2008; 94: 209–15
33. Liakina V, Speiciene D, Irnius A, Valantinas J: Changes in hepatitis C virus infection routes and genotype distribution in a Lithuanian cohort with chronic hepatitis C. Med Sci Monit, 2009; 15(4): PH17–23
34. Stikleryte A, Griskeviciene J, Magnius LO et al: Characterization of HCV strains in an oncohematological pediatric department reveals little horizontal transmission but multiple introductions by un-screened blood products in the past. J Med Virol, 2006; 78: 1411–22
35. Tallo T, Lappalainen M, Tefanova V, Priimagi I: Distribution of hepatitis C virus genotypes in patients with chronic hepatitis C in northern Estonia. Acta Virol, 2000; 44: 175–78
36. Tallo T, Norder H, Tefanova V et al: Genetic characterization of hepatitis C virus strains in Estonia: fluctuations in the predominating subtype with time. J Med Virol, 2007; 79: 374–82
37. Zusinaite E, Metskula K, Salupere R: Autoantibodies and hepatitis C virus genotypes in chronic hepatitis C patients in Estonia. World J Gastroenterol, 2005; 11: 488–91
38. Rozental R, Bicans J, Shevelev V et al: Kidney transplantation from hepatitis C virus positive donors. Transplant Proc, 2002; 34: 2581
39. Dumpis U, Kovalova Z, Jansons J et al: An outbreak of HBV and HCV infection in a paediatric oncology ward: epidemiological investigations and prevention of further spread. J Med Virol, 2003; 69: 331–38
40. Lvov DK, Samokhvalov EI, Tsuda F et al: Prevalence of hepatitis C virus and distribution of its genotypes in Northern Eurasia. Arch Virol, 1996; 141: 1613–22
41. Tretskaia TA, Shakhgil'dian IV, Iashina TL et al: [The incidence of detecting hepatitis C viral antibodies in different age groups of the population in northeastern Ukraine]. Vopr Virusol, 1993; 38: 137–38
42. Karnite A, Uuskula A, Raag M et al: Prevalence of hepatitis C infection (HCV) and related factors among infecting drug users (IDUs) in Estonia, Latvia and Lithuania. XVIII international AIDS conference, Vienna, July 18–23, 2010 Abstract book, 2010; 2: 180
43. Esteban JI, Gonzalez A, Hernandez JM et al: Evaluation of antibodies to hepatitis C virus in a study of transfusion-associated hepatitis. N Engl J Med, 1990; 323: 1107–12
44. Mohebati A, Davis JM, Fry DE: Current risks of occupational blood-borne viral infection. Surg Infect (Larchmt), 2010; 11: 325–31
45. de Mattos Camargo GS, Teixeira R, de Oliveira GC, do Carmo MA: Detection of HCV RNA in saliva does not correlate with salivary flow or xerostomia in patients with chronic hepatitis C. Oral Surg Oral Med Oral Pathol Oral Radiol Endod, 2010; 109: 851–56
46. Ashkenazi M, Fisher N, Levin L, Littner MM: Seroepidemiology of hepatitis C antibodies among dentists and their self-reported use of infection control measures. Community Dent Health, 2009; 26: 99–103
47. Nagao Y, Matsuoka H, Kawaguchi T et al: HBV and HCV infection in Japanese dental care workers. Int J Mol Med, 2008; 21: 791–99
48. Eirea M, Dios PD, Hermida M et al: Detection of HCV-RNA in saliva of HIV-HCV coinfected patients. AIDS Res Hum Retroviruses, 2005; 21: 1011–15
49. Ferreiro MC, Dios PD, Scully C: Transmission of hepatitis C virus by saliva? Oral Dis, 2005; 11: 230–35
50. Ransy DG, Akouamba BS, Samson J et al: [Maternal immunity and mother-to-child transmission of HCV and HIV-1: challenges and recent advances]. Med Sci (Paris), 2007; 23: 991–96
51. McIntyre PG, Tosh K, McGuire W: Caesarean section versus vaginal delivery for preventing mother to infant hepatitis C virus transmission. Cochrane Database Syst Rev, 2006; CD005546
52. Goldberg D, Anderson E: Hepatitis C: who is at risk and how do we identify them? J Viral Hepat, 2004; 11(Suppl.1): 12–18
53. Steininger C, Kundi M, Jatzko G et al: Increased risk of mother-to-infant transmission of hepatitis C virus by intrapartum infantile exposure to maternal blood. J Infect Dis, 2003; 187: 345–51
54. Lima MP, Pedro RJ, Rocha MD: Prevalence and risk factors for hepatitis C virus (HCV) infection among pregnant Brazilian women. Int J Gynaecol Obstet, 2000; 70: 319–26
55. Ak O, Batirel A, Ozer S, Colakoglu S: Nosocomial infections and risk factors in the intensive care unit of a teaching and research hospital: a prospective cohort study. Med Sci Monit, 2011; 17(5): H29–34
56. Erhabor O, Ejele OA, Nwauche CA: Epidemiology and management of occupational exposure to blood borne viral infections in a resource poor setting: the case for availability of post exposure prophylaxis. Niger J Clin Pract, 2007; 10: 100–4
57. Otedo AE, Mc'Ligeyo SO, Okoth FA, Kayima JK: Seroprevalence of hepatitis B and C in maintenance dialysis in a public hospital in a developing country. S Afr Med J, 2003; 93: 380–84
58. Pena MJ, Molina L, Hortal L et al: [Epidemiologic study of infection by hepatitis C virus in a hemodialysis unit]. Enferm Infecc Microbiol Clin, 2000; 18: 496–99
59. Catalani C, Biggeri A, Gottard A et al: Prevalence of HCV infection among health care workers in a hospital in central Italy. Eur J Epidemiol, 2004; 19: 73–77
60. Baghaei A, Sarrafzadegan N, Rabiei K et al: How effective are strategies for non-communicable disease prevention and control in a high risk population in a developing country? Isfahan Healthy Heart Programme. Archives of Medical Science, 2011; 6: 24–31
61. Ho MS, Yang CS, Chen PJ, Mau YC: Intrafamilial transmission of hepatitis C virus. J Clin Microbiol, 1994; 32: 2824–26
62. Vegnente A, Iorio R, Saviano A et al: Lack of intrafamilial transmission of hepatitis C virus in family members of children with chronic hepatitis c infection. Pediatr Infect Dis J, 1994; 13: 886–89
63. Kojima T, Yamanaka T: [Transmission routes of hepatitis C virus: analysis of anti-HCV-positive pregnant women and their family members]. Nippon Sanka Fujinka Gakkai Zasshi, 1994; 46: 573–80
64. Chang TT, Liou TC, Young KC et al: Intrafamilial transmission of hepatitis C virus: the important role of inapparent transmission. J Med Virol, 1994; 42: 91–96
65. Gyarmathy VA, Neaigus A, Li N et al: Infection disclosure in the injecting dyads of Hungarian and Lithuanian injecting drug users who self-reported being infected with hepatitis C virus or human immunodeficiency virus. Scand J Infect Dis, 2011; 43: 32–42
66. Gyarmathy VA, Neaigus A, Li N et al: Liquid drugs and high dead space syringes may keep HIV and HCV prevalence high – a comparison of Hungary and Lithuania. Eur Addict Res, 2010; 16: 220–28