REVIEW ARTICLE

# Correlation Between HCV Infection and Creatinine Level in Thalassemia Patents

Saif Yassen Hassan, Saif Jabbar Yasir*

*Microbiology, College of Medicine, University of Kufa, Kufa, Iraq*

***Received: 22th Dec, 19; Revised: 21th Jan, 20, Accepted: 16th Feb, 20; Available Online: 25th Mar, 2020***

**ABSTRACT**

The current study aimed to fine the relationship between hepatitis C virus (HCV), and kidney impairment in thalassemia patient. This retrospective case-control study include sample size total number 102 patients ranged between 15 and 30 years were divided into two groups: first, 51patients suffering from kidney impairment - the kidney impairment detected by creatinine level in serum and second, 51-patient without kidney impairment as a control group. Both group monitored HCV infection. The patient attended to AL-Zahra hospital (Najaf) thalassemia department from January to Aug 2018. Biochemical test use for detection of creatinine, serological test use for detection HCV. The SPSS program version 24 uses for data analysis the results.

When observed the results in both groups the percentage of HCV in the first group (with abnormal creatinine level) is higher than in the second group (with normal creatinine level). 32/51 (62, 7%) and 19/51(37, 2%) respectively. A high level of HCV in a group with kidney defect indicates for viral effect on the normal kidney function, kidney defect patient of thalassemia patient has a higher susceptibility to HCV infection.

**Keywords:** Creatinine, HCV, Kidney defect, Thalassemia.

International Journal of Drug Delivery Technology (2020); DOI: 10.25258/ijddt.10.1.29

**How to cite this article:** Hassan SY, Yasir SJ. Correlation between HCV infection and Creatinine level In Thalassemia Patents. International Journal of Drug Delivery Technology. 2020;10(1):164-169.

**Source of support:** Nil.

**Conflict of interest:** None

## INTRODUCTION

Hepatitis C is an infectious disease that primarily affects the liver and is caused by the hepatitis virus type C.[1] People often have mild or no symptoms –silent during the initial infection and about 75% to 85% of those initially infected, the virus persists in the liver with no symptoms in early chronic infection typically. The virus often leads to occasionally liver cirrhosis over many years.[2] HCV belongs to the Flaviviridae family, which is RNA virus with single-stranded.[3-5] Many autoimmune disorders are also associated with Hepatitis C[6,7] such us insulin resistance, a low platelet count, autoimmune thyroiditis, diabetes mellitus, B-cell lymphoproliferative disorders, lichen planus Sjögren's syndrome, necrolytic acral erythema, porphyria cutanea tarda and diabetic nephropathy,[8,9] and glomerulonephritis (membranoproliferative).[10] Several disorders associated with hepatitis, non-hepatitis virus have been reported, involving the central nervous system, kidney, cardiovascular, and metabolic diseases. There is a higher proportion of deaths due to extracranial complications that appear in hepatitis infection.[11,12]

Thalassemia's are inherited blood abnormality characterized by abnormal hemoglobin (low RBC quality production).[13] Chronic hepatitis infection is one of the complications of continuous blood transfusion especially hepatitis B or C.[14] An antigen-antibody complex, which is immune complex formed during viral infection, involved integral binding of a soluble antigen to an antibody.[15] The bound antigen and antibody act as a unitary object, effectively an antigen of its own with a specific epitope. This binding acts as a subject to several types of immune responses such as opsonization and complement deposition.[16] Renal disease associated with hepatitis C virus infection There is a strong and likely causal association between chronic HCV infection and glomerular disease.[17] Several types of renal disease have been recognized, including mixed cryoglobulinemia, membranoproliferative glomerulonephritis (MPGN), membranous nephropathy, and polyarteritis nodosa (PAN). In some patients, the glomerular disease may be clinically silent.[18]

## MATERIALS AND METHODS

The present study was conducted in Al-Zahraa Hospital (thalassemia department). The study period was from December 2017 to August 2018. The samples of the present study were obtained from the following sources:

Fifty-one kidney defect patient blood sample in a tube without EDTA .with age range between 15–30 years who have abnormal high creatinine level history and thalassemia.

*Author for Correspondence: saif.alshehmani@uokufa.edu.iq

Fifty-one thalassemia patients without kidney defect blood sample in a tube without EDTA .limited age between 15–30 years who normal creatinine level history and thalassemia as a control group.

The total number of both groups is 102 patients—all samples used for (HCV ELISA test, RT-PCR, and creatinine level).

## RESULTS

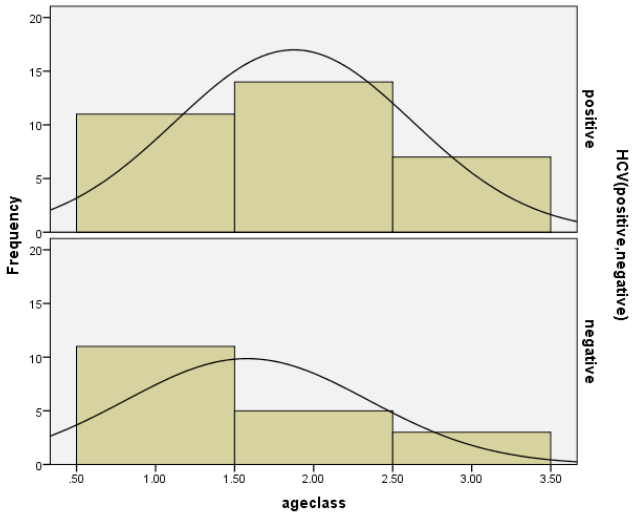
The serological test included the detection of anti-HCV antibodies by rapid test and then confirmed by the ELISA technique. The kidney defect group showed that a higher infection than control group 32/51 and 19/51, respectively. See Table 3.

The percentage of HCV infectivity was (61.6%) in the kidney defect group, while the Table (4.2.3.B) showed that the percentage of infectivity in the control group (30.8%).

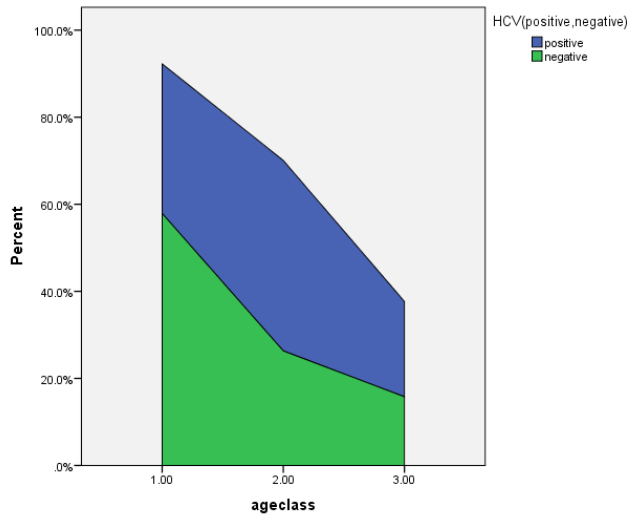
## DISCUSSION

A group of genetic and hereditary blood disorders characterized by alteration or absent β-globin chain synthesis that is known by (*β*-thalassemia syndromes); the result is a Hb decrease in (RBC), and anemia. Inherited as recessive traits that are; the most thalassemia's form[19,20] indicates the clinical appearance of the *β*-thalassemia major presented between 60 days and two years. The infants who carry this syndrome are suffering from an alteration in the maturation and normal growth**.** With a regular blood transfusion system that maintains a lower Hb concentration of (9.5 to 10.5 g/dL), the growth and development tend to be at a normal level up to ten to twelve years.

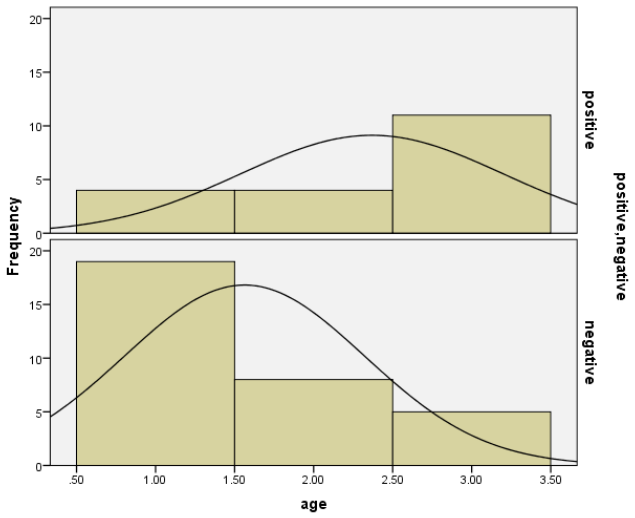
During the healthcare process such as the blood transfusion, the chance of infection with HCV occur. Without HCV screening, the transfusion of blood products and or organ transplants significantly increase the risks of infection.[21] The pathogenesis of the HCV includes the immune complex of the



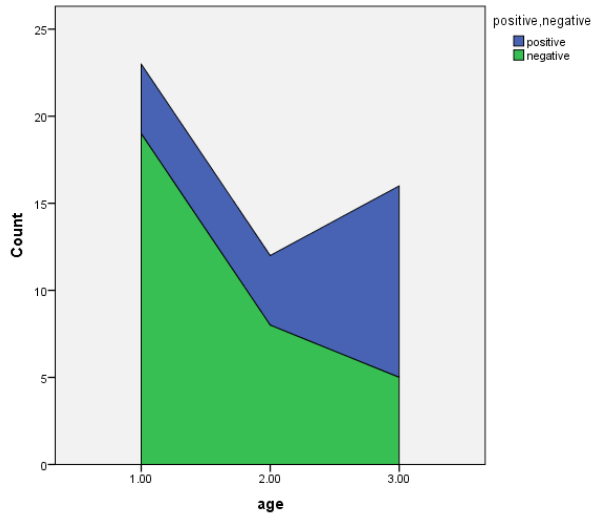

**Paragraph (1-A):** Explain the kidney defect according to age group.




**Paragraph 1-B:** Explains the percentage of infectivity according to age group.




**Paragraph 2-A:** Explains the non-kidney defected patient according to age group.




**Paragraph 2-B:** Explains the infectivity percentage according to age group.

glomerular and formation then deposition, the viral has the ability of direct invasion of the renal parenchyma, The drugs are used for treatment leading to extra-renal complications and nephrotoxicity. All that combines with HCV infection and cause alteration of the normal kidney function and its disease.[22]

The current study revealed that out of the 32 /51(62.7%) with a kidney defect suffered from HCV infection and 19/51(37.2%) suffered from HCV infection without kidney defect as a control group. The diagnosis of kidney defect by detection creatinine level and then HCV infectivity detection by present IgM and IgG in serum patients by ELISA and RT-PCR.

This result agrees with Satapathy S.K., *et al.*[23] who has used the same principle of Compared to the general population, the developing AKI diverse is a higher risk in HCV-infected patients, the unrelated etiology? As a noted, community-based study of (six hundred and forty-eight) subjects with HCV infection chronically, as many as (Sixty-three) patients (19.4/2%) experienced (one hundred and twenty-four) episodes of acute kidney disease events throughout follow-up ranging from ninety days to six years**.** According to risk-injury-failure-loss of function-end stage (RIFLE) standard, there are (fifty-eight) (93.6 /2 %) at risk, twenty (32.2/2%) injured, 44 (71/2%) failure, and two (3.2/2%).[23]

The random sample size of the kidney defect group in this study revealed that the age group 15-20 years was higher in a number of cases 22 out of 51 (43.1%) than another age group us which was found in Table 1 and 2. In case of normal kidney group (control group), the age group15 -20 years was higher than another group 23/51 (45.1%).

The kidney abnormality associated with younger age may be due to high metabolic activity of the liver and high immune response to virus infection, all that cause load on the kidney, which reflected by increase creatinine level; this agrees with Pawa S, *et al.,* and Ozdogan M, *et al.*[24,25] Who reveals that the liver biopsy gives key data on the degree of HCV-related hepatic ailment, but requires wariness in CKD because of the probably depressed hazard of bleeding involvement, essentially in patients who are suffering from chronic kidney diseases. The internal inflammation of kidney as glomerulonephritis develops with advanced time, this maybe takes time to decades, after initial infection with HCV.[26] *That* the most common HCV-related nephropathy is MPGN, usually in the context of cryoglobulinemia. The majority of cryoglobulinemic HCV-infected patients have either no symptoms or nonspecific clinical manifestations. The triad of purpura, asthenia, and arthralgia is evident in nearly 30% of cases. Trials of Pennell DJ, *et al.,*[27] Indiscriminate judgment of inclusive contrast the effects of DFP on level of ferritin in serum at baseline and at from the 1990s follow-up have been written, combine dissection appeared a statistically significant reduction in the ferritin in the serum at half years duration in patronage of DFO, without variable difference between the 2 medicine at one year's duration.[28]

The serological test included the detection of anti - HCV antibodies by rapid test and then confirmed by ELISA technique. The kidney defect group showed that a higher infection than control group 32/51 and 19/51, respectively. See Table 3 and 4.

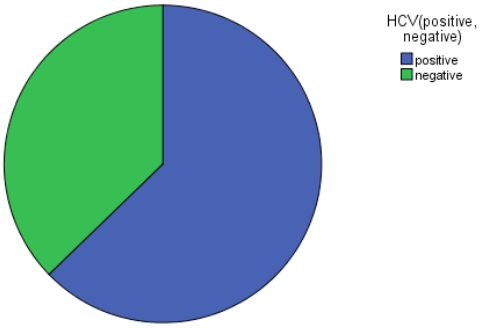
The variability degree of infection due to some of kidney

**Table 1:** Thalassemia patient with kidney defect according to age group

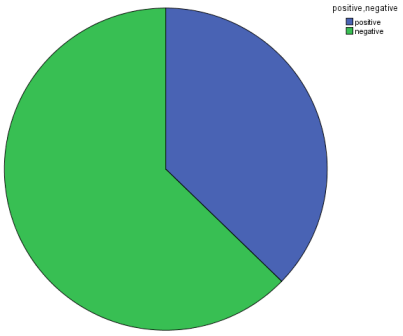
| *Age group* | *Kidney defect patient (above 1.4 mg/dL)* | *Percentage %* |
|---|---|---|
| 15-20 | 22 | 43.1 |
| 20-25 | 19 | 37.3 |
| 25-30 | 10 | 19.6 |
| Total | 51 | 100.0 |

**Table 2:** Thalassemia patient without kidney defect according to age group

| *Age group* | *Thalassemia patient without kidney defect* | *Percentage %* |
|---|---|---|
| 15-20 | 23 | 45.1 |
| 20-25 | 12 | 23.5 |
| 25-30 | 16 | 31.4 |
| Total | 51 | 100.0 |




**Paragraph 4-A:** Explains ration statically the percentage of HCV infectivity in the population of kidney defect groups.




**Paragraph (5-A):** Explain the ratio statically between HCV infectivity non-kidney defect population group.

**Table 3:** The HCV infectivity in kidney defect groups of a thalassemia patient

| *HCV* | *Kidney defect patients* |
|---|---|
| Positive | 32 |
| Negative | 19 |
| Total | 51 |

**Table 4:** The ratio of HCV infectivity in kidney defect in patient thalassemia

| *Price-related differential* | *C. V. Med. centered* | *C. of dispersion* |
|---|---|---|
| 1.000 | 30.8% | 0.186 |

**Table 5:** The percentage of HCV infectivity and normal kidney in thalassemia patient

| *Price related differential* | *Coefficient of dispersion* | *Coefficient of variation* *Median centered* |
|---|---|---|
| 1.000 | 0.186 | 30.8% |

defect patients receive the virus during dialysis in add to blood transfusion, which increases the chance of infection with HCV. The following study agrees with HCV infectivity in our study.[29] demonstrates that the HCV is the frontier cause of after –transported blood hepatitis contagion (PTH). The virus strikes hepatocyte and leads to severe sore in the liver with long-time disturbance and problems. Contagion with HCV may cause disabling presentation, fibrosis of liver tissue, and cancer of the liver cell.[30,31] state that thalassemia is an inherited disorder that is defined for the syndrome. A high risk of hepatitis C in patients with thalassemia major is due to the transported blood from donors that carry the HCV. Although, amendment in sifting of blood products since (Ninety-eight hundred and eighty ) to (Ninety-nine hundred) reduce the dangers of the transported virus through blood and blood-borne diseases. Also,[32,33] recommend that the infection with hepatitis C is till now stick around as a remarkable issue in thalassemia patients.

Table 4 showed that the percentage of HCV infectivity was (61.6%) in the kidney defect group, while the Table 4 showed that the percentage of infectivity in the control group (30.8%). This means there are the relationship between HCV infectivity and alteration of normal kidney function, which agrees with this study. [35] Found that the hepatitis C virus (HCV) and the prevalence of chronic kidney disease (CKD) is between 10%-16% worldwide.

The prevalence of HCV positive that studied by Wreghitt TG.[36] among hemodialysis patients can vary from < 5% to as high as 60% from different regions in the world. The link between HCV infection and kidney disease is well recognized by Li WC, *et al*.[37] Another study, complements that the existence of anti-HCV Ig is correlating with kidney disease advancement with a higher average of (+) anti-HCV in those with more advance stages of CKD.[38]

Figure (4-1) and (4-2) illustrated the variability between kidney defect group and control group on different variable parameters as the relationship between HCV infection and compare it with ( variability of iron load, gender, age group, normal and abnormal of creatinine ). The kidney defect group contain (32 patients infected with HCV and control group contain 19 HCV infected patients), both Figures 4 and 5 dependent on a positive patient for HCV. The following abnormality associated with an extrahepatic abnormality in which, reflected on many parameters and caused alternated it,[42] mention that the outer liver disturbance which connects with HCV infection caused (immune system –relation outer live demonstration), skittish cryoglobulinemia, B-cell NHL**,** vasculitis Cryoglobulinemia, syndrome of Sicca**,** Arthralgia/ myalgia**,** self- antibody production (i.e., cryoglobulins, factor of rheumatoid, and antibody against nuclear, antibody against inner mitochondrial membrane, antibody against thyroid and antibody against smooth muscle, panarteritis nodosa**,** Monoclonal gammopathy of undetermined significance (MGUS), *immune thrombocytopenic purpura* (ITP), inflammation -related outer liver manifestations**,** diabetes mellitus type two insulin resistance**,** inflammation of nephron, kidney infancy**,** tiredness, reduce cognitive**,** sorrow**,** arthritis and Cardiovascular disease (i.e., stroke, ischemic heart disease).

Newly, different other non- hepatic hepatitis C virus – connected abnormality has been discovered, which involved cardiovascular, kidney, metabolic, and CNS diseases. HCV infection manifested a higher death percentage for outer liver complications.[43]

There are many studies connected between HCV and age as the age has an influence on the treatment of chronic HCV infection and is considered an important factor. The occurrence of anti-HCV serum (+) resorts to be a higher level in the old age compared to smaller age people in different countries across the world. Caducity is considered as a negative agent for hepatic disease evaluation, progression and treatment result in HCV infection. In older age and age, when infected with HCV are two agents that have an effect on the evaluated hepatic fibrosis and the development of liver cell cancer.[43] The age itself imitates to be a larger remarkable agent than the age at receive HCV in foretell the development of hepatic illness predominantly when the body exceeds sixty five years of age.[44]

In both group (kidney defect group and control group) detected the creatinine level and monitoring the presence of HCV. Table 4 showed statically the (61%) of kidney defect group suffering from HCV infection. And (30.8) of the control group suffering from infection with HCV. These statistical results conclude that there is a direct proportional relationship between viral infection and kidney defect.[46]

Although the firstly onus of the sick that is the relationship with deep-seated hepatitis C is hepatocyte connected (the thickening and scarring of connective tissue, usually as a result of virus injury for the hepatocyte, cirrhosis of the liver, and cancer of liver cell), different member systems may be included. In the urinary system, HCV appears to be most substantially connected with membranoproliferative glomerulonephritis (MPGN; which includes cryoglobulins or without cryoglobulins) and membranous glomerulonephritis.[47] reveal that the dispersal of HCV serum (+) between patients with MPGN case sequence is nearly ten-fold more than the national propagation for HCV.

In addition, the occurrence of MPGN between the live prospective (cohorts) and necropsy sequence of HCV-carrere people appears to have a higher percentage than for the ordinary population; ultimately, this what has been found by Gopalani A, *et al*.[48]

Other study *like*[51] who have shown that HCV-carrier individuals who are suffering from CKD have more death rates and a pressing rate of developing ESRD, reaching to the necessary inquiry of if therapeutic effect to acquire a sustained

viral restraint know as an undiagnosed viral load level three month after accomplishment of therapy (SVR12) would minify the percentage of decrease in GFR.

## CONCLUSION

A high level of HCV in abnormal creatinine level groups may indicate for viral effect on the kidney function, and the first group of thalassemia patients has a higher susceptibility to HCV infection.

## REFERENCES


1. Ryan KJ, Ray CG, eds. (2004). Sherris Medical Microbiology (4th ed.). McGraw Hill. pp. 551–2.
2. CDC. Hepatitis C FAQs for Health Professionals. Archived from the original on 21 January 2016. Retrieved 4 February 2016.
3. Lindenbach BD, Evans MJ, Syder AJ, Wölk B, Tellinghuisen TL, Liu CC, Maruyama T, Hynes RO, Burton DR, McKeating JA, Rice CM. Complete replication of hepatitis C virus in cell culture. Science. 2005; 309 (5734): 623-626
4. Lerat, H; Hollinger, FB. Hepatitis C virus (HCV) occult infection or occult HCV RNA detection? The Journal of Infectious Diseases. 2004; 189 (1): 3–6.
5. Pockros P. Novel and Combination Therapies for Hepatitis C Virus, An Issue of Clinics in Liver Disease, 2011. p. 47.
6. Dammacco F, Sansonno D. Review Article: Therapy for Hepatitis C Virus–Related Cryoglobulinemic Vasculitis. N Engl J Med. 2013; 369 (11): 1035–1045.
7. Iannuzzella, F; Vaglio, A; Garini, G. Management of hepatitis C virus-related mixed cryoglobulinemia. Am. J. Med. 2010; 123 (5): 400–408
8. Zignego AL, Ferri C, Pileri SA, *et al*. Extrahepatic manifestations of Hepatitis C Virus infection: a general overview and guidelines for a clinical approach. Digestive and Liver Disease. 2007; 39 (1): 2–17
9. Ko HM, Hernandez-Prera JC, Zhu H, Dikman SH, Sidhu HK, Ward SC, Thung SN. Morphologic features of extrahepatic manifestations of hepatitis C virus infection. Clinical & developmental immunology. 2012; 2012: 740138.
10. Ray, Stuart C.; Thomas, David L. "Chapter 154: Hepatitis C". In Mandell, Gerald L.; Bennett, John E.; Dolin, Raphael. Mandell, Douglas, and Bennett's principles and practice of infectious diseases (7th ed.). Philadelphia, PA: Churchill Livingstone. 2009.
11. Matsumori A. Role of hepatitis C virus in cardiomyopathies. Ernst Schering Research Foundation workshop. 2006; 55: 99–120.
12. Monaco, S; Ferrari, S; Gajofatto, A; Zanusso, G; Mariotto, S (2012). "HCV-related nervous system disorders". Clinical & developmental immunology.: 236148.
13. NHLBI. "What Are Thalassemias?". Archived from the original on 26 August 2016. Retrieved 5 September 2016.
14. Borgna-Pignatti C, Galanello R. Wintrobe's Clinical Hematology. 11. Vol. 42. Lippincott Williams & Wilkins. Philadelphia;. Thalassemias and related disorders: quantitative disorders of hemoglobin synthesis; 2004. pp. 1319–1365
15. Cush J, Kavanaugh A, Stein C. Rheumatology: Diagnosis and Therapeutics. Lippincott Williams & Wilkins. 2005; p. 78.
16. Jump up Goldsby, Richard Immunology. Macmillan. 2002; p. 381.
17. Morales JM, Kamar N, Rostaing L. Hepatitis C and renal disease: epidemiology, diagnosis, pathogenesis and therapy. 2012; Contrib Nephrol; 176:10.
18. McGuire BM, Julian BA, Bynon JS Jr, *et al*. Brief communication: Glomerulonephritis in patients with hepatitis C cirrhosis undergoing liver transplantation. Ann Intern Med. 2006; 144: 735.
19. Galanello R, Origa R. Beta-thalassemia. Orphanet J Rare Dis. Orphanet Journal of Rare Diseases. 2010; 5: 11.
20. Thalassemia International Federation. Guidelines for the clinical management of thalassemia. 2008.
21. Wilkins T, Malcolm JK, Raina D, Schade RR. Hepatitis C: diagnosis and treatment" . American Family Physician. 2010; 81(11): 1351–1357.
22. Barsoum RS. Hepatitis C virus from entry to renal injury—facts and potentials. Nephrol Dial Transplant. 2007; 22:1840–1848.
23. Satapathy SK, Lingisetty CS, Williams SE. Acute kidney dysfunction in patients with chronic hepatitis C virus infection: analysis of viral and non-viral factors. J Clin Exp Hepatol. 2014; 4(1):8–13
24. Pawa S, Ehrinpreis M, Mutchnick M, Janisse J, Dhar R, Siddiqui FA. Percutaneous liver biopsy is safe in chronic hepatitis C patients with end-stage renal disease. Clin Gastroenterol Hepatol. 2007; 5 :1316– 1320.
25. Ozdogan M, Ozgur O, Boyacioplu S, Coskun M, Kart H, Ozdal S, Telatar H. Percutaneous liver biopsy complications in patients with chronic renal failure. Nephron. 1996; 74 :442– 443
26. Monti G, Galli M, Invernizzi F, Pioltelli P, Saccardo F, Monteverde A, Pietrogrande M, Renoldi P, Bombardieri S, Bordin G, Candela M, Ferri C, Gabrielli A, Mazzaro C, Migliaresi S, Mussini C, Ossi E, Quintiliani L, Tirri G, Vacca A (for the GISC) Cryoglobulinaemias: A multi-centre study of the early clinical and laboratory manifestations of primary and secondary disease. Italian Group for the Study of Cryoglobulinaemias. QJM. 1995; 88:115–126,
27. Pennell DJ, Berdoukas V, Karagiorga M, *et al.* Randomized controlled trial of deferiprone or deferoxamine in beta-thalassemia major patients with asymptomatic myocardial siderosis. Blood. 2006;107:3738–3744
28. Gomber S, Saxena R, Madan N. Comparative efficacy of desferrioxamine, deferiprone and in combination on iron chelation in thalassemic children. Indian Pediatr. 2004;41:21–27.
29. Viral Hepat. Viral Hepatitis Prevention Board. Hepatitis A, B and C: Defining workers at risk. 1995; 3.
30. Tong MJ, El-Farra NS, Reikes AR, Co RL Clinical outcomes after transfusion-associated hepatitis C. N Engl J Med. 1995;332:1463–1466.
31. Agarwal M, Malkan G, Bhave A, Vishwanathan C, Billa V, Dube S, *et al.* Antibody to hepatitis-C virus in multi-transfused thalassaemics--Indian experience. J Assoc Physicians India. 1993; 41:195–197.
32. Ocak S, Kaya H, Cetin M, Gali E, Ozturk M. Sero-prevalence of hepatitis B and hepatitis C in patients with thalassemia and sickle cell anemia in a long-term follow-up. Arch Med Res. 2006;37:895–8
33. Prati D, Maggioni M, Milani S, Cerino M, Cianciulli P, Coggi G, *et al*. Clinical and histological characterization of liver disease in patients with transfusion-dependent beta-thalassemia. A multicenter study of 117 cases. Haematologica. 2004; 89: 1179–1186.
34. Angelucci E, Pilo F. Treatment of hepatitis C in patients with thalassemia. Haematologica. 2008; 93:1121–3.
35. Kidney Int Suppl. Chapter 1: Definition and classification of CKD.2013 Jan; 3(1):19-62.

36. Wreghitt TG. Blood-borne virus infections in dialysis units--a review.Rev Med Virol. 1999; 9(2):101-109.
37. Li WC, Lee YY, Chen IC, Wang SH, Hsiao CT, Loke SSJ Viral Hepat. Age and gender differences in the relationship between hepatitis C infection and all stages of Chronic kidney disease. 2014 Oct; 21(10):706-15.
38. Lee JJ, Lin MY, Yang YH, Lu SN, Chen HC, Hwang SJ. Association of hepatitis C and B virus infection with CKD in an endemic area in Taiwan: a cross-sectional study.Am J Kidney Dis. 201); 56(1):23-31.
39. Price L, Kowdley KV.The role of iron in the pathophysiology and treatment of chronic hepatitis C. Can J Gastroenterol. 2009;23:822–8.
40. Foka P, Dimitriadis A, Karamichali E, Kyratzopoulou E, Giannimaras D, Koskinas J, *et al*. Alterations in the iron homeostasis network: A driving force for macrophage-mediated hepatitis C virus persistency. Virulence. 201);7:679–690.
41. Liu Y, An D, Sun R, Jin L, Wang Q. Inhibition of translation initiation factors might be the potential therapeutic targets for HCV patients with hepatic iron overload. Med Hypotheses. 2012;78:142–3.
42. Maasoumy B and Wedemeyer H. Natural history of acute and chronic hepatitis C.Best Pract Res Clin Gastroenterol. 2012; 26(4):401-12.
43. Ferri C, Ramos-Casals M, Zignego AL, *et al*. International diagnostic guidelines for patients with HCV-related extrahepatic manifestations. A multidisciplinary expert statement. Autoimmun Rev. 201); 15:1145.
44. Nguyen TT1, Sedghi-Vaziri A, Wilkes LB, Mondala T, Pockros PJ, Lindsay KL, McHutchison JG. J Viral Hepat. 1996;3(2):75-8.
45. Ferri C, Ramos-Casals M, Zignego AL, *et al*. International diagnostic guidelines for patients with HCV-related extrahepatic manifestations. A multidisciplinary expert statement. Autoimmun Rev. 2016; 15:1145.
46. Stehman-Breen C, Alpers CE, Fleet WP, Johnson RJ. Focal segmental glomerular sclerosis among patients infected with hepatitis C virus. Nephron 1999; 81: 37–40,
47. Young D.S., Effect of Drugs on Clinical laboratory Tests, 4thEd. (1995) p.3-190 to 3-211.
48. Gopalani A, Ahuja TS. Prevalence of glomerulopathies in autopsies of patients infected with the hepatitis C virus. Am J Med Sci. 2001; 322 : 57 –60,
49. Martin P, Fabrizi F. Hepatitis C virus and kidney disease. J Hepatol. 2008; 49: 613–624,
50. Park H, Adeyemi A, Henry L, Stepanova M, Younossi Z. A meta-analytic assessment of the risk of chronic kidney disease in patients with chronic hepatitis C virus infection. J Viral Hepat 2015; 22: 897–905,
51. Molnar MZ, Alhourani HM, Wall BM, Lu JL, Streja E, Kalantar-Zadeh K, Kovesdy CP. Association of hepatitis C viral infection with incidence and progression of chronic kidney disease in a large cohort of US veterans. Hepatology. 2015; 61: 1495–1502.
52. Klein MB, Rollet-Kurhajec KC, Moodie EE, Yaphe S, Tyndall M, Walmsley S, Gill J, Martel-Laferriere V, Cooper C; Canadian Co-infection Cohort Investigators. Mortality in HIV-hepatitis C co-infected patients in Canada compared to the general Canadian population (2003-2013). AIDS. 2014; 28: 1957–1965.