CHAPTER ONE

INTRODUCTION AND LITERATURE REVIEW

1.1 Introduction

Hepatitis C virus (HCV) is human pathogen that infects the liver and can cause both acute and chronic disease (Muhammad *et al.,* 2013). Hepatitis C virus (HCV) was discovered in 1988 in the course of searching for the cause of non-A, non-B, transfusion-associated hepatitis. At that time, HCV accounted for ninety percent of the cases of non-A, non-B hepatitis (Richard *et al.,* 2007). The hepatitis C virus belongs to the genus Hepacivirus a member of the family Flaviviridae. Until recently it was considered to be the only member of this genus. However; another member of this genus has been discovered in dog's canine hepacivirus (Kapoor *et al*., 2011).Hepatitis C virus is predominantly a blood borne virus, with very low risk of sexual or vertical transmission (Shepard *et al*., 2005).

Diabetes mellitus is a chronic disease of metabolism causing abnormal glucose homeostasis. More than 171 million people in the world are affected by diabetes mellitus (Muhammad *et al.,* 2013).Type2 Diabetes mellitus (T2DM) imposes a growing public health burden worldwide, leading to complications, disability, mortality and higher healthcare costs. While, obesity is probably the most important explanatory factor (Ranee*etal.,* 2012).

Hepatitis C virus (HCV) infection and Type 2 diabetes mellitus (T2DM) are two major public health problems associated with increasing complications and mortality rates throughout the world. HCV infection is a cause of chronic liver disease, cirrhosis, and hepatocellular carcinoma (HCC), (Xuan*et al.,* 2013).Approximately 170 million of people are

infected with HCV and 3-4 million are infected each year(Alessandro *et al.*, 2012).

HCV infection and T2DM maycoexist in an individual (Xuan*et al.*, 2013).Diabetes mellitus is a chronic disease of metabolism causing abnormal glucose homeostasis. More than 171 million people in the world are affected by diabetes mellitus (Muhammad *etal.*, 2013).Patients with chronic hepatitis C are at risk of developing type 2 diabetes mellitus(T2DM) and impaired fasting glucose (IFG), and this risk may increase among hepatitis C virus (HCV) patients not responding to an antiviral therapy(Giordanino*etal.,* 2008).Chronic hepatitis C infection mainlyaffects liver but can be associated with various extrahepatic manifestations including cryoglobulinemia, sialadenitis, and glomerulonephritis(Muhammad *et al.*,2013). The association between T2DM and liver disease was recognised over 30yearsago (Xuan*et al.*, 2013).Scientific reports mentioned the relationship between T2DMand hepatitis C even at the stage of insulin resistance (IR),(FracescoandMhanaz2009). Several studies reported that HCV infection may lead to the development of diabetes, andhigher prevalence of type 2 diabetes mellitus was observed in the developed countries (2% to 9.4%) in patients with HCV infection compared to those with other forms of chronic hepatitisInsulin resistance (IR). Those studies reported that diabetes may develope at any stage of HCV infection. Multiple mechanisms have been accounted for insulin resistance and development of diabetes in patients with chronic hepatitis C, which interfere with insulin signaling pathway in hepatocytes and increasing inflammatory response with production of cytokines such as TNF alpha and IL-6 and increasing oxidative stress(Muhammad *et al.*, 2013).HCV affects glucose metabolism via cellular pathway mechanisms which are implicated in the

host innate immune response. IR and T2D can increase severity of chronic hepatitis C infection by interfering with the early virological response to interferon alpha-basedtherapy(Negro and Alaei2009). .

1.2 Literature Review

1.2.1Background

Hepatitis C virus (HCV) is an RNA-enveloped virus in the Flaviviridae family (other members: yellow fever, dengue, West Nile virus) and *Hepacivirus* genus. It has a very simple positive-sense single-stranded RNA genome, consisting of just three structural (C, core; E1 and E2, envelope glycolproteins) and five nonstructural genes. The HCV virion of 50 nm in diameter contains an RNA genome of 9.5 kb, which is enclosed in an icosahedral capsid or core (C) and a lipid-bilayer envelope containing two virus specific glycoproteins E1 (gp31) and E2 (gp70). The genome is encoded into a polyprotein, which is processed into individual proteins by proteases(Kenneth *et al.,* 2010).

Hepatitis C virus has been identified as one of the leading causes of chronic liver disease with serious sequel as the end stage of cirrhosis and liver cancer. According to recent statistics, the worldwide prevalence of HCV infection is ~3% and affects around more than 170 million people globally. Chronic hepatitis C infection mainly affects liver but can be associated with various extrahepatic manifestations including cryoglobulinemia, sialadenitis, and glomerulonephritis (Mhammad*et al.*, 2013*).*

Hepatitis C virus (HCV) is a globally prevalent pathogen and a leading cause of death and morbidity (Cooke *et al.,* 2013).Persistent HCV infection is associated with the development of liver cirrhosis, hepatocellular cancer, liver failure, and death and HCV is now the most common cause of death in HIV-positive patients on highly activeantiretroviral therapy(Lauer *and* Walker, 2001).

While the rate of HCV infection is apparently decreasing in the developed world, deaths from liver disease secondary to HCV infection will continue to increase over the next 20 years, 130–150 million people globally have chronic hepatitis C infection. A significant number of those who are chronically infected will develope liver cirrhosis or liver cancer.350 000 to 500 000 people die each year from hepatitis C-related liver disease (Razavi*et al.,* 2013).

1.2.2Genotypes and Geographical distribution

There are 11 HCV genotypes: 1-11, with many subtypes: a, b, c, and about 100 different strains: 1, 2, and 3 based on the sequence of the HCV genome. Genotypes 1-3 are widely distributed globally, with genotypes 1a and 1 b accounting for 60% of infections worldwide. Genotype 4 is characteristic for the Middle East, Egypt and Central Africa (Mercy and Abraham 2013).

1.2.3 Replication and growth cycle of virus

Following initial binding of the hepatitis C virus (HCV) particle to scavenger receptor class B member 1 (SRB1) and CD81, the particle engages in further interactions with the tight junction proteins claudin 1 (CLDN1) and occludin (OCLN) and finally enters cells by receptor-mediated endocytosis (step 1). The viral RNA genome is released into the cytoplasm and translated at the rough ER, giving rise to a polyprotein that is cleaved into mature proteins (step 2). Viral proteins, in conjunction with host cell factors, induce the formation of a membranous compartment (designated the membranous web (MW)) composed of single-, double- and multi-membrane vesicles as well as lipid droplets (LDs) (step 3). RNA replication occurs at an unspecified site within the membranous web and proceeds via a negative-sense copy ((–) RNA) that

serves as a template for the production of excess amounts of positive-sense progeny RNAs ((+) RNA) (step 4). Assembly of HCV particles probably initiates in close proximity to the ER and lipid droplets, where core protein and viral RNA accumulate. The viral envelope is acquired by budding through the ER membrane in a process that is linked to lipoprotein synthesis (step 5). HCV particles are thought to be released via the constitutive secretory pathway (step 6) *(*Ralf *et al.,* 2013).

1.2.4 Mechanism of pathogenesis and interferon resistance

Once the virus enters the hepatocytes through receptor mediated endocytosis and starts replication, it initiate damaging of hepatocytes, the major component of which is through the host's own immune response(Nelson2001).

Interferon is the most potent natural weapon of the host against intra-cellular viral infection.HCV is capable of evading the natural interferon-mediated clearance through the intricate actions of genomic proteins. HCV core protein has been reported to decrease the robustness of the host's immune response by decreasing transcription of interferon induced antiviral genes, HCV NS3/4A protease also has been concerned in inhibiting the interferon amplification loop which otherwise results in suppression of HCV replication. Inhibition of HCV protease can reverse the effects of HCV infection that make protease inhibitors one of the most noteworthy potential therapeutic agents for HCV (De Lucas *et al.,* 2005; Karayiannis, 2005).

1.2.5 Transmission

HCV is spread by blood to blood contact e.g.unscreened blood transfusion, contaminated needles. HCV isnot as easily transmitted as

HBV. Only small numbers of thevirus are excreted and circulate in the blood (Monica 2006).

1.2.6 Sign and symptom

When person acquired infection by needle-stick or transfusion the incubation period for hepatitis C ranges from 2 to 26 weeks with an average about 7 weeks although most acute infections are asymptomatic, some patients present with typical acute viral hepatitis associated with malaise, nausea, and right upper quadrant pain, followed by dark urine and jaundice(Stanley *et al.*, 2007).

1.2.7 Diagnosis

Diagnosis of hepatitis is made by biochemical assessment of liver function.

Hepatitis C diagnosis depends on demonstration of anti-HCV detected by: EIA, ELISA and PCR.

1.2.8 Prevention and Vaccination

There is no vaccine to protect against hepatitis C. The only way to prevent this disease is to avoid the risk factors.

Prevention of HCV infectionby reducing or eliminating the risk of virus transmission through the blood supply and public health measures to prevent spread in high-risk populations, including intravenous drug users. Screening of donated blood using sensitive assays for HCV RNA genomes has eliminated what used to be a substantial window period of several weeks between exposure to the virus and seroconversion(Stanley *et al.*, 2007).

1.2.9 Treatment

A combination treatment of acute hepatitis C appears beneficial, but can be deferred for weeks to determine whether the infection resolves spontaneously. Combination therapy with gama Interferon and ribavirin is the current treatment of choice for patients with evidence of chronichepatitis due to hepatitis C(Kenneth*et al.*, 2010).

1.2.10 Otherstudy

A total of 604 study subjects in Ethiopia were studied prevalence of HCV in type II diabetes and nondiabetic controls was 9.9% and 3.3%, respectively, Sociodemographic and risk factor data were collected by questionnaire. From serum sample, HCV antibody screening was done by rapid antibody screening test. Liver functioning tests and total cholesterol tests were done by Dr. Lange LP 800 spectrophotometer.

The resultsshow that HCV sero-positives have high risk of developing diabetes as compared with seronegatives. In this study, were found a positive association between past HCV infection and type II diabetes (Solomon *et al.*, 2012).

A total of 438 patients with T2D (325 Kuwaitis and 113 Egyptians), and 440 control subjects, were enrolled for determine the prevalence of HCV infection in T2D-patients in Kuwait which has a high incidence of type 2 diabetes, and to investigate the association between HCV viremia and diabetes-related complications . HCV infection was assessed by testing for serum HCV-specific antibodies, and by detection of HCV RNA. HCV viral load and hemoglobin A1c (HbA1c) levels were assessed in patients with and without diabetes complications. Thirty one (7%) out of 438 T2D-patients had evidence of HCV infection compared to 4 (1%) out of

440 control adults ($p < 0.0001$). The prevalence of HCV infection in Kuwaiti and Egyptian T2D-patients was 3% and 18%, respectively. Most of the HCV sequences detected in T2D patients and control subjects were of genotype 4. The HbA1c levels in T2D-patients with HCV viremia were significantly higher than those in HCV-negative patients. HCV viremia, female sex, age, family history of diabetes were found to be independent risk factors for diabetes complications. The results suggest that T2D-patients in Kuwait have higher prevalence of HCV infection than controls, and that HCV viremia is associated with diabetes-related complications (Wassim*et al.*, 2011).

Ninety patients with type-2 diabetes attending the medical outpatient clinic of the University College Hospital (UCH) and 90 nondiabetic controls with comparable age, sex and risk factors of exposure to HCV were recruited into the study low prevelance of Hepatitis c virus patients with type-2 diabetes, mostly in western nations . All subjects were screened for anti-HCV using a third-generation rapid enzyme immunoassay (Dialab anti-HCV cassette). None of the diabetic patients tested positive for anti-HCV, while 1.1% of the control group tested positive for anti-HCV. There appears to be low prevalence of anti-HCV among type-2 diabetic patients in UCH Ibadan, and therefore no demonstrable risk of HCV in our patients (Williams *et al.*, 2006). Other study aimed to investigate HCV genotype distribution in diabetics and its relation to some clinical and laboratory variables in HCV-positive diabetic versus non-diabetic Egyptians in East Delta . The study included 100 HCV-positive patients of which 66 were diabetic in addition to 35 healthy adults as a control group .The main results were the presence of HCV genotype 3, in 31.8% of the diabetic group and in 26.5% of the non-diabetic group, while the remainder of cases had genotype 4, the predominant genotype in Egypt. This is the first report of the presence

of HCV genotype 3 in about 30% of an Egyptian cohort. However, there was no significant difference in genotype distribution between both groups(Omaymaet *al.*, 2013).

In Nigeria a total Three hundred (300) confirmed type 2 diabetic patients were screened for hepatitis C virus antibodies at the Plateau state specialist hospital, Jos, using Grand diagnostic test strip. Questionnaire comprising of age, sex, family history on diabetes, duration of disease and marital status were issued to subjects. his study was therefore carried out to determine the correlation of HCV infection and diabetes. Overall result showed that the prevalence rate of HCV infection was 33(11%) (James *et al.*, 2009).

ASerologic testing for anti-HCV antibody was done on a sample of 3000 individuals with T2DMvisiting Diabetes Clinic of Nishtar Medical College Hospital, Multan and 10,000 volunteer blood donors visiting blood bank of the same hospital during the study by using A third generation ELISA kit for positive cases. Data about various variables was collected from diabetic patients using a structured questionnaire after taking informed consent. carried out to determine the prevalence of HCV infection in diabetic patients and to elucidate the presence of any possible relationship between HCV and T2DM in this region. Prevalence rate of 13.7% for HCV infection was recorded among subjects having T2DM with sero-positivity rate of 4.9% among the control group of volunteer blood donors without diabetes (Naumanet *al.*, 2010).

Rationale1.3

The mechanisms through which Hepatitis C virus (HCV) infection increases the risk of diabetes are not very clear, but considerable evidence suggests that the effects of viral proteins on cellular processes are involved in hepatic lipid metabolisms, early defects in insulin.

The literature on the association between HCV infection and T2D in Sudan is limited to few reports; hence it is necessary to evaluate thewhich rolemight be played by HCV by screening Diabetic patients for HCV antibody to investigate if there is any correlation between HCV and T2D.

1.4 Research Objectives

The objectives of this study were

1.4.1General objective

To detect the frequency of Hepatitis C Virusinfection among T2DM patients in Asdigaa AL-Sukkary Medical Centre, White Nile State.

1.4.2 Specific objectives

1.4.2.1 To detect anti-HCV antibody among T2DM patients.

1.4.2.2 To identify the possible risk factors associated with HCV sero-positive among T2DMpatients.

CHAPTER TWO

MATERIALS & METHODS

2.1 Study design

Cross sectional study.

2.1.1Study area

This study was conducted in Asdigaa AL-SukkaryMedical ,Centre, White Nile State.

2.1.2 Study duration

The study was conducted during the period from April to June 2015.**2.2 Study population**

Both male and female of all age suffering from Type2 Diabetes and suspected to HCV infection.

2.3Sample size

A total of 92 blood samples (n=92).

2.4 Specimens collection

Blood specimens were collected by vein puncture cleaned with seventy percent alcohol, 2-5 ml of venous blood in sterile fluoride oxalate container and mixed. The plasma was separated from cells and transferred into new labeled sterile eppendorf tube and stored at -20 until use.

2.5 Data collection

The data was collected by direct interviewing questionnaire (Appendix).

2.6 Ethical consideration

The participants were informed about the purpose of research, and ethical permission was taken from Sudan University Research Board.

2.7 Data analysis

Data analysis carried out using Statistical Package for Social Sciences (SPSS) soft ware program version 15.0, using chi-square test.

2.8 Laboratory work

The samples were analyzed for the presence of HCV-antibody by a commercially available enzyme -linked immunosorbent assay “HCV ELISA” kit.

2.8.1 Assay procedure

The reagents were allowed to reach room temperature (18-30°C) and checked the wash buffer concentrate for presence of salt crystal. The stock wash buffer was diluted 1 to 20 with distilled water.

Strips were set in the strip-holder and wells were labeled including tow negative control and one positive control and one blank.

Hundred µl specimen diluent was added into each well except blank.

Ten µl positive control, negative control and specimen were added into their respective wells.

The plate was covered by plate cover appendix and incubated for 30 min at 37°C.

After the end of incubation period plate cover was removed and discarded and each well was washed 5 times with diluted buffer.

Hundred µl of HRP conjugate was added to each well except blank.

The Plate was covered with plate cover and incubated for 30 min at 37°C.

At the end of the incubation period, the plate cover was removed, and each wells was washed again 5 times with diluted buffer.

Fifty µl of chromogen A and 50ml of chromogen B solution was dispended in to each well including the blank, strips were covered with plate cover and incubated at 37°C for 15 min in the dark. A enzymatic reaction between chromogen A/B produce blue colour in control anti HCV positive sample wells.

Fiftyµl stop solution were added into each wells and mixed by tapping the plate gently intensive yellow colour developed in positive control and positive anti-HCV sample wells.

Calibrated the plate readerwas with blank well absorbance which was read at 450 nm.

the cut-off value was calculated and the results were recorded.

Note: The absorbance was read with in 5 min after stopping the reaction.

Calculation of cut-off value: C.O = NC+0.12

NC = the mean absorbance value of three negative controls

Quality control

Reagent standard were checked for storage, stability and preparation before starting work. .

CHAPTER THREE

RESULTS

A total number of 92 blood samples from T2DM patients were collected from Asdigaa AL-Sukkary Medical Centre, White Nile State. The study reported the frequency of HCV- antibody and correlation between the presence of HCV antibody and determined risk factors such as (Blood transfusion history, Jaundice history, Diabetes history and presence of other disease). The present study showed that only 7(7.6%) were positive for HCV antibody while the remaining 85(92.4%) were negative for HCV antibody (Table 1).

Table [1] Frequency of HCV-antibody among diabetic Type2 patients

Result	Frequency	Percent
Positive	7	7.6%
Negative	85	92.4%
Total	92	100.0%

The majority of the study group were female 50(54.3%) and the remaining 42(45.7%) were male (Table 2), ranging in age from 14 to 82 years (mean, 45.5 years). Only 4(4.3%) of the males and 3(3.3%) of females in this study were positive for HCV-antibody. Statistically $P > 0.05$, it is hence not a significant value (Table 3).

Table [2] Distribution of Type2 diabetic patient according to gender

Gender	Frequency	Percent
male	42	45.7%
female	50	54.3%
Total	92	100.0%

Table [3] Correlation between Gender and HCV infection

Chi-square Test: (p>0.05)

Gender	Positive	Percent	Negative	percent	Total	Percent
Male	4	4.3%	38	41.3%	42	45.7%
Female	3	3.3%	47	51.1%	50	54.3%
Total	7	7.6%	85	92.4%	92	100.0%

The majority of patient's age was between 31 and 40 (Table 4)**.**The age group of 51-60 years had a prevalence rate of 4(4.3%), followed by age group 31-40 years which had a prevalence rate of 2(2.2%), while subjects aged 41-50years recorded 1(1.1%), in contrast individuals at remained age groups recorded 0(0%). There was insignificant difference within the age groups (P > 0.05) with a chi-square (Table 5).

Table [4]Distribution of Type2 diabetic patients according to age group

Age group	Frequency	Percent
10_20	3	3.3%
21_30	13	14.1%
31_40	23	25.0%
41_50	21	22.8%
51_60	13	14.1%
61_70	12	13.0%
71_80	6	6.5%
81_90	1	1.1%
Total	92	100.0%

Table [5] Correlation between Age groupof Type 2 diabetic patients and HCV infection

Age group	Positive	Percent	Negative	Percent	Total	Percent
10_20	0	0.0%	3	3.3%	3	3.3%
21_30	0	0.0%	13	% 14.1	13	14.1%
31_40	2	2.2%	21	% 22.8	23	25.0%
41_50	1	1.1%	20	% 21.7	21	22.8%
51_60	4	4.3%	9	9.8%	13	14.1%
61_70	0	0.0%	12	% 13.0	12	13.0%
71_80	0	0.0%	6	6.5%	6	6.5%
81_90	0	0.0%	1	1.1%	1	1.1%
Total	7	7.6%	85	% 92.4	92	% 100.0

Majority of Diabetic Type2 patients under study had no family history of diabetes 63(68.5%), and no jaundice history 64(69.6%), (Table 6, 7).Most of patients who had no family history of diabetes 5(5.4%) detected with presence of HCV-antibody and 2(2.2%) of the patients who had family history of diabetes detected with presence of HCV- antibody, (Table 8).Also 5(5.4%) of patients with no history of jaundice and 2(2.2%) with history of jaundice detected with presence of HCV-antibody, (Table 9).

Table [6] Distribution of Type 2 diabetes according to the history of diabetes in family

Family history	Frequency	Percent
yes	29	31.5%
no	63	68.5%
Total	92	100.0%

Table [7] Distribution of Type2 diabetic patients according to jaundice history

Jaundice history	Frequency	Percent
yes	28	30.4%
no	64	69.6%
Total	92	100.0%

Table [8] Correlation between presence of HCV antibody and family history

Chi-square Test: (p>0.05)

Family history	Positive	Percent	Negative	percent	Total	Percent
Yes	2	2.2%	27	29.3%	29	31.5%
No	5	5.4%	58	63.0%	63	68.5%
Total	7	7.6%	85	92.4 %	92	100.0%

Table [9] Correlation between presence of HCV-antibody and Jaundice history

Chi-square Test: ($p>0.05$)

Jaundice history	Positive	Percent	Negative	percent	Total	Percent
Yes	2	2.2%	26	28.3%	28	30.4%
No	5	5.4%	59	64.1%	64	69.6%
Total	7	7.6%	85	92.4 %	92	100.0%

Majority of Type2 diabetic patients under study had no history of blood transfusion 77(83.7%), and no present of other diseases 66(71.7%), (Table 10, 11). One (1.1%) of patients with blood transfusion history and 6(6.5%) with no blood transfusion history detected with presence of HCV-antibody, (Table 12).And 3(3.3%) of patients who had disease other than Diabetic Type2 and 4(4.3%) with no other disease detected with presence of HCV-antibody, (Table 13).

Table [10]: Distribution of Type2 diabetic patients according to blood transfusion history

Blood transfusion history	Frequency	Percent
yes	15	16.3%
no	77	83.7%
Total	92	100.0%

Table [11] Distribution of Type2 diabetes disease according to presence of other diseases

Presence of other diseases	Frequency	Percent
Yes	26	28.3%
no	66	71.7%
Total	92	100.0%

Table [12]: Correlation between present of HCV-antibody and blood transfusion history

Blood transfusion history	Positive	Percent	Negative	percent	Total	Percent
Yes	1	1.1%	14	15.2%	15	16.3%
No	6	6.5%	71	77.2%	77	83.7%
Total	7	7.6%	85	92.4 %	92	100.0%

Chi-square Test: ($p>0.05$)

Table [13] Correlation between presence of HCV-antibody and presence of other diseases

Presence of other disease	Positive	Percent	Negative	percent	Total	Percent
Yes	3	3.3%	23	25.0%	26	28.3%
No	4	4.3%	62	67.4%	66	71.7%
Total	7	7.6%	85	92.4 %	92	100.0%

Chi-square Test: ($p>0.05$)

Most of Type2 diabetic patients under study were from Kosti 33(35.9%), followed by 23(25%) from Rabak, 22(23.9%) from Asalia, and 14(15.2%) patients from Kenana (Table 14).

Table [14] Distribution of Type2 diabetic patient according to residence

Residence	Frequency	Percent
Kosti	33	35.9%
Rabak	23	25.0%
Aslia	22	23.9%
kenana	14	15.2%
Total	92	100.0%

The majority of the patients under study had 0-2 years (48.9%) duration of disease, (Table 15). The higher prevalence of HCV antibody at 0-2 years duration 3(3.3%), followed by 2-4 years and 6-8 years with 2(2.2%) as same as, while others patients above than 8 years duration recorded 0(0%), (Table 16).

Table [15] Distribution of Type2 diabetic patients according to duration of the disease

Disease duration	Frequency	Percent
0-2	45	48.9%
2-4	25	27.2%
4-6	9	9.8%
6-8	6	6.5%
8-10	2	2.2%
10-12	4	4.3%
12-14	1	1.1%
Total	92	100.0%

Table [16] Association between HCV and duration of type 2 diabetes among patients under study

Duration rang	Positive	Percent	Negative	Percent	Total	Percent
0-2	3	3.3%	42	45.7%	45	48.9%
2-4	2	2.2%	22	23.9%	24	26.1%
4-6	0	0.0%	10	10.9%	10	10.9%
6-8	2	2.2%	4	4.3%	6	6.5%
8-10	0	0.0%	2	2.2%	2	2.2%
10-12	0	0.0%	4	4.3%	4	4.3%
12-14	0	0.0%	1	1.1%	1	1.1%
Total	7	7.6%	85	92.4%	92	100.0%

Chi-square Test: ($p>0.05$)

The analyzed data exhibited that the possible risk factor namely, Family history of diabetes, Jaundice history, blood transfusion history and presence of other disease, all were no significant effect($p>0.05$).

CHAPTER FOUR

4.1 Discussion

This study was conducted in Sudan University of Science and Technology College of Graduate Studies to detect the frequency of Hepatitis C Virus infection among Type2 Diabetic patients inAsdigaaAlsukkaryMedical Center.

The frequency of HCV in T2D patients in this study was 7(7.6%). Similar research conducted in Ethiopia indicated that the prevalence of HCV in type 2 diabetes was (9.9%), the high percentage in the study conducted in Ethiopia might be due to the large sample sizein that study (Ephraim *et al.,* 2014).

Other study in Brazil showed low prevalence of anti-HCV in diabetic patients (1.4%) (Luce *et al.,* 2008).Where as in the United States suggested low prevalence of HCV inwhich 4.2% of 594 patients with T2DM and 1.6% of 377 controls with thyroid disease were positive for HCV antibody. (Graeme*et al.,* 2000). Also other studies conducted in western nations (2006) and Cape Coast Metropolis in which the presence of HCV in T2D patients was zero percent (williams*et al.*, 2006).

In India a similar study hada prevalence of (5.7%), lower compared to this study (7.6%) despite the larger sample size, but this could be justified by the significant history of jaundice in that study which is assumed to play a role as a risk factor. A study done at Saudi Arabia showed that (21.2%) of patient with HCV had T2D which shows the association between T2D and HCV (Akbar *et al.,* 2002).

A study in Pakistan also showed similar results (13.7%), the high percentage in the study conducted in Pakistan could be attributed tothe large of sample size in that study (Jadoon*et al.*, 2010).

In Nigeria similar results were also obtained (11%), probably due to the large sample size with no significant different in the history of diabetes and blood transfusion [(P = 0.275; P.0.07)]. The main difference between the studyconducted in Nigeria and this study was in the duration of developing diabetes, where patients within the range of 1to10 years diabetic status record was high compared to this study where the record was lower than 8 years (James *et al* ., 2009)

In a study conducted in USA study show that people over 40 years of age or older with HCV infection were more than three times more likely than those without HCV infection to have T2D(Shruti*et al.*, 2000).Therewas no much differencebetween the study in the States and this study where theaffected age group was 51-60 andthe differencecould be justified by the un equal distribution of age in this study.

Twelve representative epidemiological studies from 1994 to December 2012, demonstrated a relationship between HCV infection and the development of T2DM. Analyses have shown a higher prevalence of diabetes mellitus in patients who weresero-positive for HCV than in controls with P.value (P< 0.001). This high in prevalence might be attributed to the large sample size. (Alessandro *et al.*, 2014).

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4.2 Conclusion

The study concluded that low frequency rateof HCV among T2DMpatients at Asdigaa AL-Sukkary Medical Centre, White Nile State, and the risk factors associated with HCV sero-positive among Type2 diabetic patients were insignificant.

4.3 Recommendations

The HCV in Sudan have low level of frequency compared with other Middles East countries.The low prevalence in of HCV in this study should prompt further studies with larger sample size covering the whole country in order to determine the prevalence of HCV infection and the impact of the risk factors in Sudan.

The health authorities in Sudan should make the screening for HCV mandatory to all foreign nationals seeking entrance to Sudan particularly for nationals coming from countries with known high HCV prevalence such as Egypt. This study should be repeated using other methodologies such as PCR to confirm these results.

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