Investigation Role of IL-10 And IL-13 with Some Viral Species in Pathogenesis of Heart Diseases

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KEYWORDS
Heart diseases, Cardiomyopathy , IL-10, IL-13, Viruses.

ABSTRACT:
Background; cardiovascular disease (CVD) is the most common cause of mortality and impairment. Atherosclerosis is the primary underpinning pathophysiology of CVD, but several variables could trigger it. The occurrence of it is linked to multiple risk factors related to metabolism, such as overweight and dyslipidemia.
Objective; Detective predictive roles of IL-10 and IL-13 and positivity of viral infections in heart diseases.
60 blood samples were harvested (gel tube) from heart diseases patients who sleeping in hospital after diagnosis them by specialist physician.30 blood samples were taken from healthy individuals that labeled them as a control group. Interleukins (IL-10 and IL-13) and viral species (Parvovirus B19, SARS-CoV-2, HCV and HBV) were calculated by (ELISA).
Present outcomes mentioned the most patients were males (71.7%) with age groups 51-60 (26.7%) and 61-70 (33.3%), ex-smokers (65.0%), and lean BMI (63.3%). Our investigation showed Parvovirus B19 scored highest positivity (15.0%), followed by HBV (6.7%), SARS-CoV-2 (5.0%), and then HCV (3.3%) in heart diseases patients with significant difference ($p<0.05$). Based on interleukins levels, present outcomes showed significant raised levels ($p<0.05$) of IL-10 and IL-13 in patients than control. ROC curve results showed the IL-13 scored highest sensitivity (80%) and specificity (84%) at cut off (>2.50) compared to IL-10 that showed highest sensitivity (81%) and low specificity (57%) at cut off (>9.50).
Conclusions; gender, age and smoking are risk factors for heart diseases. Due to decreased immune state in patients, several viruses were discovered in those patients. IL-10 and IL-13 were raised in patients due to presence inflammation. IL-10 has paradoxical role (pro and anti-inflammatory) in pathogenesis heart diseases . IL-13 is more preferred in diagnosis heart diseases than IL-10 due to has (IL-13) highest sensitivity and specificity. Finally, there is no strong correlation between IL-10 and IL-13 in pathophysiology of heart diseases.

1. Introduction

The heart's myocardium, or heart muscle, is in charge of circulating blood within the circulatory system. Cardiomyopathy, which a general term for illness of the heart muscle, can lead to pathological alterations in the muscle and impair its ability to perform. Dilated cardiomyopathy (DCM), hypertrophic cardiomyopathy, restrictive cardiomyopathy, arrhythmogenic cardiomyopathy, and Takotsubo The most common types of cardiomyopathy are cardiomyopathies (Zsarnóczay et al., 2023). Myocarditis, also known as inflammatory cardiomyopathy of the heart muscle, is mostly caused by viruses, however it may additionally be brought on by bacteria, fungi, parasites, or an autoimmune reaction. Myocarditis could sometimes be idiopathic in origin, or it may be brought on by medications or poisons (Ammirati and Moslehi, 2023).

With over 18.5 million fatalities from cardiovascular disease (CVD) in 2019 alone, it continues to be the world's largest reason for disability and mortality (Network, 2020). Each of the member nations of the World Health Organization (WHO) have pledged to provide therapy and advice to a minimum of 50% of those with a significant likelihood of developing CVD by 2025 in an attempt to lessen the worldwide burden of CVD (Kaptoge et al., 2019). Atherosclerosis is the primary underpinning pathophysiology of CVD, despite the fact that it is a complicated multifactorial illness with environmental as well as genetic variables contributing to its genesis (Domingo et al., 2024).

Earlier in the 1800s, Jean-Nicolas Corvisart coined the name "myocarditis." Because of the variability in manifestations, which ranges from nonspecific tiredness complaints to active acute heart failure requiring transplantation of the heart, the precise prevalence of myocarditis (acute and chronic) is still unknown (Caforio et al., 2013).

While the degree of severity of every stage of myocarditis varies, an official diagnosis of the condition differentiates between an acute and a chronic (permanent) form. Acute myocarditis indications, which might include dyspnea, chest discomfort, exhaustion, or palpitations, can occur anywhere between just a few weeks to many months after a latest virus infection (Crisci et al., 2023).

Viral elimination during the sub-acute form of myocarditis is initiated by stimulation of the adaptable immune responses (Gong et al., 2023). Following the initial attack has subsided, the viral infection may continue to exist in cardiac tissue for a long time and may harm cardiomyocytes directly or indirectly by causing persistent inflammation. Intermittent phases of viral reinstatement, silence infection, in which no virus activity is detectable, or ongoing viral genome replication can all be signs of prolonged viral contamination of the heart muscle (Ediger et al., 2024). Several virus genomes have been present to be correlated with myocarditis: parvovirus B19 (B19V), HCV, HBV, SARS-COV-2 and human herpesvirus 6 (HHV6), indicating a shift in the last years (Tavazzi et al., 2020; Schultheiss et al., 2021; Jou et al., 2024).

Important regulators of inflammatory processes, cytokines control a variety of biological processes via endocrine, paracrine, or autocrine pathways. One of the potent cytokines with several uses, IL-13 is extensively synthesized in the majority of tissues, including the skin, heart, liver, and lungs. It is known that IL-13 plays a role in the onset and progression of several diseases, such as cancer, schistosomiasis, liver fibrosis, allergic asthma, and chronic lung disease. It also regulates immunity generated by cells and modifies the proliferation of cells, improvement, and apoptosis (Allen, 2023). Recently, IL-13 is diagnosed to be associated with CVDs (Haybar et al., 2023). An increasing body of research indicates that IL-13 is critical to the onset and progression of heart disease. A prior investigation revealed that individuals who had ongoing heart failure had considerably higher blood levels of IL-13 (Qian et al., 2021).

The main producers of the anti-inflammatory cytokine IL-10 are Th2 cells and macrophage. Recent research has demonstrated that IL-10 exerts its anti-inflammatory effects through a variety of mechanisms, such as reducing the production of cytokines that promote inflammation, metalloproteinase matrix, and cyclooxygenase-2, as well as inhibiting the function of foam cells and changing their metabolism of lipids (Barcelos et al., 2019). Moreover, after atherogenesis is started by the infiltration of monocytes into the coronary intima, it has anti-atherogenic impacts throughout the formation of plaque at various stages of atherosclerosis. This is accompanied by an inflammatory response that converts the enlisted monocytes to macrophages (Liu et al., 2021). Rai et al., (2023) revealed negative correlation between IL-10 and cardiac activity.

Our investigation objective to detection predictive roles of IL-10 and IL-13 and positivity of some viral infections (Parvovirus B19, HCV, HBV, SARS-COV-2) in pathophysiology of heart diseases.

2. Material and methods

Samples collection

The present investigation was studying at Baqubah Teaching Hospital/ Internal department in Diyala province for time; October 2023 – January 2024. 60 blood samples were harvested (gel tube) from heart diseases patients who sleeping in hospital after diagnosis them by specialist physician. 30 blood samples were taken from individuals without diseases (healthy) that labeled them as a control group. Age groups of patients approximated from 40 to 95 years. Questioner filled with demographic features (gender, age, smoking and body mass index) of patients.

Methods

Blood putted in gel tube was centrifuged by centrifuge machine (5000 rpm for 5 minutes) to has serum for detection levels of interleukins (IL-10 and IL-13) and viral species in participants. IL-10 and IL-13 were calculated by enzyme-linked immune-sorbent assay (ELISA) with kits supplied from BioSource International (Camarillo, CA, USA). Viral species (Parvovirus B19, SARS-CoV-2, HCV and HBV) detected by ELISA technique (Bioactiva Diagnostic, Germay).

Statistical analysis

IL-10 and IL-13 were designed like Mean ± SD. Independent t test utilized to detect variation significance between mean values of interleukins between heart diseases patients than controls. Demographic features

and viral species were appeared like frequencies and percentages. The differences among percentages screened by Pearson-Chi-square test. Receiver operating characteristic (ROC) curve had to detect area under the curve (AUC), cut-off, sensitivity %, and specificity % of interleukins. Standard significant level was P≤0.05. SPSS v. 23.0 and Graph pad prism v.7 statistical software were used to analysis our data.

3. Results

1.Relation of demographic features with heart diseases patients

Present outcomes mentioned the most heart diseases patients were males (71.7%) with age groups 51-60 (26.7%) and 61-70 (33.3%), ex-smokers (65.0%), and lean BMI (63.3%). The differences among percentages of demographic characters (gender, age groups and smoking) were significant (p<0.05), in exception, body mass index was non significant (p>0.05) (table 1).

Table 1; Distribution heart diseases patients according to demographic features

		Count	Percent	P value
Gender	Males	43	71.7%	P<0.001***
	Females	17	28.3%	
Age groups (years)	40-50	7	11.7%	P<0.01**
	51-60	16	26.7%	
	61-70	20	33.3%	
	71-80	10	16.7%	
	>80	7	11.7%	
Smoking	Smoker	9	15.0%	P<0.001***
	Ex-smoker	39	65.0%	
	No smoker	12	20.0%	
Body mass index (kg/m2)	Lean	38	63.3%	P>0.05
	Obese	22	36.7%	

2.Relation of infection with some viral species with heart diseases patients

Findings of our investigation showed prevalence some viral species in heart diseases patients, where it found Parvovirus B19 scored highest positivity (15.0%), followed by HBV (6.7%), SARS-CoV-2 (5.0%), and then HCV (3.3%) with significant difference (p<0.05) (table 2).

Table 2; Prevalence of some viral species among heart disease patients

		Count	Percent	P value
Parvovirus B19	Positive	9	15.0%	P<0.001***
	Negative	51	85.0%	
HCV	Positive	2	3.3%	P<0.001***
	Negative	58	96.7%	
HBV	Positive	4	6.7%	P<0.001***
	Negative	56	93.3%	
SARS-CoV-2	Positive	3	5.0%	P<0.001***
	Negative	57	95.0%	

3.Relation of IL-10 and IL-13 levels with study groups

Our research revealed significant (p<0.05) highest levels of IL-10 and IL-13 in heart diseases patients (13.88±3.87 and 5.23±2.30) than control (8.10±3.54 and 2.03±0.89) (table 3).

Table 3; Comparative concentrations of IL-10 and IL-13 between heart diseases patients than controls

groups		N	Mean	Std. Deviation	P value
IL-10 (pg/ml)	patients	60	13.88	3.87	P<0.05*
	controls	30	8.10	3.54	
IL-13 (pg/Ml)	patients	60	5.23	2.30	P<0.05*
	controls	30	2.03	0.89	

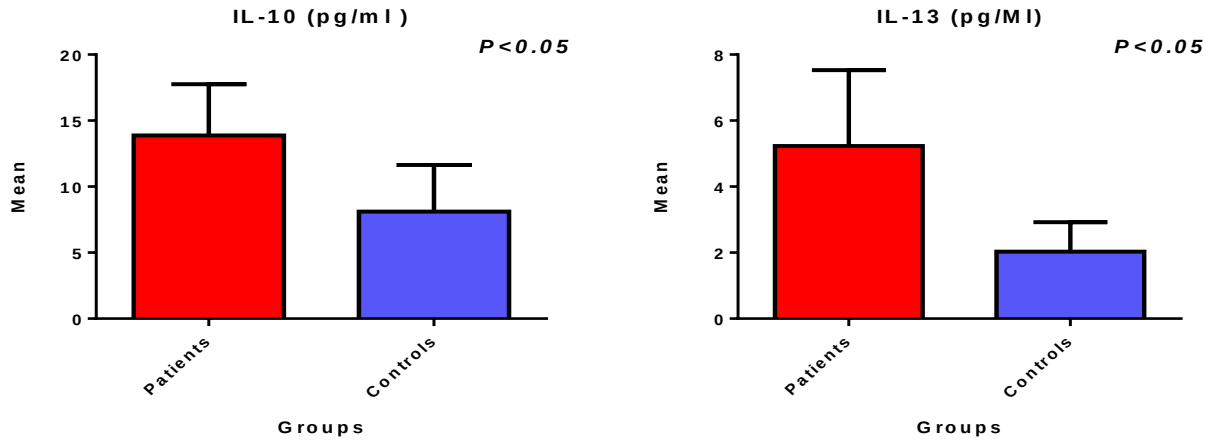

Figure 1; Mean levels of IL-10 and IL-13 between study groups

4. Receiver operating characteristic (ROC) curve of IL-10 and IL-13

ROC curve results showed the IL-13 scored highest sensitivity (80%) and specificity (84%) at cut off (>2.50) compared to IL-10 that showed highest sensitivity (81%) and low specificity (57%) at cut off (>9.50) in diagnosis heart diseases patients (table 4 and figure 2).

Table 4; ROC curve, cut off, sensitivity and specificity of IL-10 and IL-13 in detecting patients have heart diseases

Interleukins	Area under curve	Cut off	Sensitivity %	Specificity %
IL-10 (pg/ml)	0.846	>9.50	81%	57%
IL-13 (pg/Ml)	0.856	>2.50	80%	84%

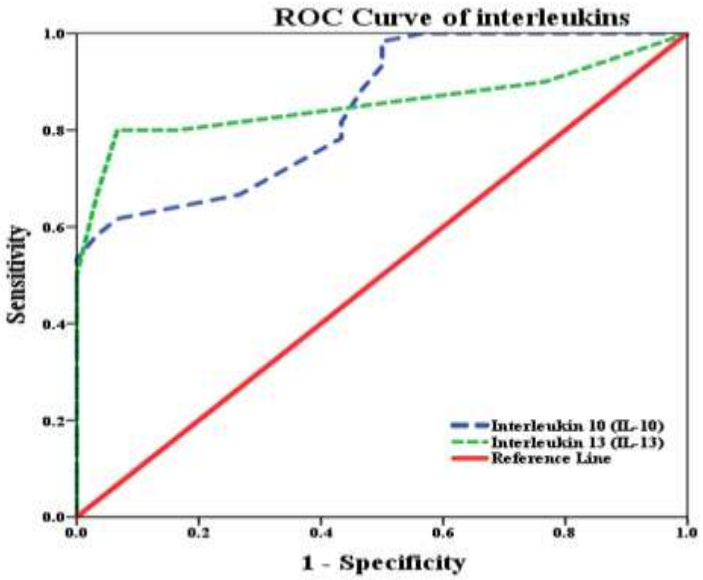

Figure 2; ROC curve of IL-10 and IL-13

5. Correlation relationship between IL-10 and IL-13 in heart diseases patients

Pearson correlation outcomes showed there is no significant correlation (p>0.05) between IL-10 and IL-13 (correlation coefficient= 0.068 and probability >0.05) in heart diseases patients (figure 3).

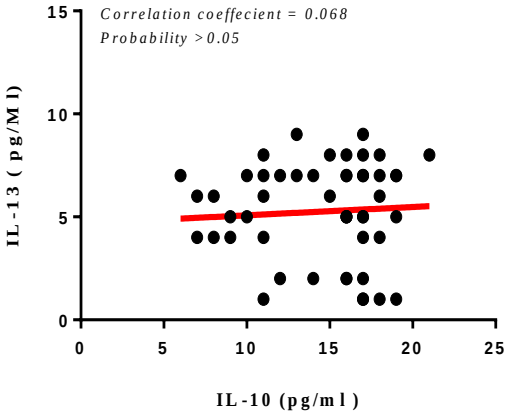

Figure 3; Correlation relationship between IL-10 and IL-13

4. Discussion

Similar to current data, Li et al. (2023) found that men (63%) made up the majority of patients with cardiac problems, with age categories >60 years (40$) and BMI <24 (61%). One important biological component that influences differences in the prevalence of sickness is gender. Consequently, it is imperative to provide distinct priority to illness risk incidence and preventative treatment for men and women, with an emphasis on executing more thorough screening and identification techniques along with customized therapies (Suanrueang, 2024). Stress resulting from sickness may increase throughout the adolescent-to-adult transition. During transitional schooling, healthcare practitioners should think about evaluating teenagers for higher disease-related stress and offering options to build resilience (Swenski et al., 2024). There are a number of variables that might explain this outcome, but the primary one is that men are normally more likely to develop heart disease since estrogen has a well-known cardioprotective impact on females. In addition, women smoke less and have less chronic illnesses, which makes them less prone to develop cardiac conditions that eventually lead to heart disorders (Alalawi et al., 2023).

Compared to our findings, Domingo et al. (2024) found that obesity was a factor in 70% of cardiac illnesses. According to recent research, there may be an obesity paradox affecting the mortality rate of those with cardiovascular disease that has already been diagnosed. The detrimental effects of obesity on CVD events are mitigated by physical exercise and maintained cardiovascular wellness (Katta et al., 2021). Globally, cardiovascular disease (CVD) continues to be the primary cause of mortality and impairment. Atherosclerosis is the primary underlying pathophysiology of CVD, but several variables can influence it. Its growth is linked to multiple risk factors related to metabolism, such as overweight and dyslipidemia (Domingo et al., 2024).

About 20% of individuals with heart conditions appeared smokers, according to Arafa et al. (2024); these findings were consistent with the current investigation. It has been discovered that smoking affects both the position of the affected cardiac artery and the degree of severity of CVD. Smoking has been linked to a number of plausible processes that may raise the likelihood of heart attack and stroke, including decreased HDL cholesterol, enhanced aggregated platelets, disruption to the arterial endothelium, and carboxyhemoglobinemia. Additionally, smoking may be linked to a thicker typical carotid artery intima-media layer (Khoramdad et al., 2020).

Although protozoa, fungi, or bacteria may trigger inflammation, viral infections are the primary cause of inflammatory cardiomyopathy (Rauff et al., 2021). Adenovirus, human herpesvirus 6, cytomegalovirus, Epstein-Barr virus, and parvovirus B19 have been identified in large research studies as the viruses most frequently detected in human endomyocardial biopsy samples taken from patients with dilated cardiomyopathy, or cardiac discomfort. It has also been demonstrated that SARS-CoV-2 infection has an impact on the heart (Kloc et al., 2023).

According to current research, 15% of cardiac patients possess Parvovirus B19; however, this is less than the 25% of patients with cardiac problems who had Parvovirus B19, according to studies by Kloc et al. (2023). It has recently been proposed that parvovirus B19 may be a contributory factor for dilated cardiomyopathy and

myocarditis. Prior findings have demonstrated a strong correlation between B19 and a high incidence of myocarditis (Khatami et al., 2022). Between 70% and 88% of adults have serologic data showing prior B19V infections, indicating that the virus can begin in childhood and persist into adulthood (Schultheiss et al., 2021). According to estimates, more than 50% of people over 50 have antibodies specific to B19V, indicating that the virus is common in the community. B19V has been linked to several cases of acute myocarditis (Ackermann et al., 2020). However, B19V targeting the endothelial cells in cardiac arteries rather than infecting myocytes (Nathalie and Seebohm, 2021).

The World Health Organization (WHO) estimates that approximately 58 million people globally are chronically infected with the hepatitis C virus (HCV). In 6.3% to 37% of HCV-positive humans, there is a significant risk of HCV infection associated with cardiac conditions, including myocarditis and DCM (Jou et al., 2024). These outcomes surpassed our findings, which indicated that 3.3% of patients with heat-related illnesses also had HCV.

Growing data indicates that whereas HCV primarily affects the liver's function, it may also be involved in the etiology of cardiac conditions such as dilated cardiomyopathy (DCM) and myocarditis (Haykal et al., 2021). Chronic HCV infection is linked to a number of extrahepatic symptoms, including myositis, glomerulonephritis, and hepatitis C. The lymphotropism of HCV is thought to be the cause of extrahepatic symptoms, which include the buildup of circulating antibody complexes, modification of the host immunological response, and initiation of autoimmune reactions (Schultheiss et al., 2021). Although little is known about the pathophysiology of HCV-induced myocarditis and DCM, new research suggests that leukocytes, particularly CD68-positive monocytes, as well as macrophages, may be a key target of HCV among mononuclear cells. The inflammatory cells created by infection with HCV can trigger inflammatory in the organs included the heart tissue resulting in myocarditis, DCM, and various other cardiomyopathies (aykal et al., 2021).

According to a prior investigation, 12.5% of COVID-19 patients express a suspicion of myocarditis or cardiac damage (Deng et al., 2020). These outcomes surpassed our findings, which indicated that 5.0% of individuals with heat-related illnesses also had COVID-19. Ultrastructural examination of EMB from a 69-year-old patient who tested positive for SARS-CoV-2 revealed the initial evidence of coronavirus localisation in the heart (Tavazzi et al., 2020).

Myocarditis and other cardiac injuries have been noted as a significant consequence in coronavirus-infected individuals. Even previously known coronavirus varieties, including severe acute respiratory syndrome-coronavirus-1 (SARS-CoV-1) and middle eastern respiratory disease (MERS), have been found to be related to cardiac injury (Alhogbani, 2016). Acute respiratory distress syndrome (ARDS) and viral pneumonia can result after a primary SARS-CoV-2 infection, increasing the risk of morbidity and death. Additionally, coagulation problems and cytokine storm are linked to SARS-CoV-2 infection, which can result in thromboembolic complications and multiple organ dysfunction (Eberhardt et al., 2023). Notably, there is a significant relationship between the severity of COVID-19 and cardiovascular illnesses (CVD). Cardiovascular complications are thought to play a major role in both predisposition and clinical causation, and indicators of risk for CVD, such as high blood pressure and diabetes, are thought to be strongly associated with mortality in COVID-19 patients (Szpulak et al., 2023).

The current data indicated that 6.7% of those diagnosed with heart conditions also had HBV, which was consistent with findings by Ke et al. (2022) that indicated 6.29% of individuals with cardiac disease also had HBV. Recent research found a correlation between HBV infection and a decreased risk of coronary artery disease (CAD). Nevertheless, Ke et al. (2022) found no evidence of a significant correlation between HBV and all-cause mortality in patients with CAD. Congenital heart disorders (CHDs) in kids were shown to be substantially correlated with mother prospective and prior HBV infection, according to a separate study. Furthermore, women with husbands free of HBV were shown to have a much higher risk of coronary heart disease (CHD) if they had previously contracted the virus before becoming pregnant. In order to reduce the incidence of congenital heart disorders (CHDs) in children, it is imperative that couples obtain HBV screening and vaccination-induced immunity before to becoming pregnant. Couples who have already contracted HBV should also be given careful consideration (Wu et al., 2023).

In general, the prevalence positivity of microbial infection among heart diseases patients related to weak immune status, chronic diseases, viruses exposure, inflammation severity, and organ dysfunction of patients.

Additionally, the differences between positivity of viruses in heart diseases patients among studies related to sample participants and microbial contacts .

The heart's primary pathophysiological reaction to both acute and long-term damage is inflammatory processes, although its molecular cause and underlying processes are still unknown (Qian et al., 2021). Because interleukin-13 (IL-13) has the best sensitivity and specificity in the pathogenicity of heart illnesses, it is used as a diagnostics and predictive indicator in cardiac pathology. Positive effects of IL-13 include helping the heart heal from an infarction of the myocardium and encouraging early cardiac growth. Continuous IL-13 production appeared to be associated with a higher risk of unfavorable outcomes in chronic cardiovascular disorders, including heart failure, since it induces fibrosis and adversely remodels the heart (Alieva et al., 2022).

The addition of IL-13 can lessen heart failure and increase cardiomyocytes' ability for regeneration. Lack of IL-13 inhibits cardiomyocyte expansion, causes hypertrophy as a result of compensation through in vitro and IL-13 removal in heart cells, causes myocardial dysplasia, and hinders in vivo wound healing. The specific signaling channels and fundamental mechanisms that govern the action of IL-13 are still unclear, despite its associations with cardiovascular fibrosis, heart cells development, myocardial enlargement, the recruitment of immune cells and distinction, and chemokine release in the cardiac muscle (Hong et al., 2021).

An increasing body of research indicates that IL-13 is critical to the onset and progression of heart disease. A prior investigation revealed that individuals who had ongoing heart failure had considerably higher blood levels of IL-13 (Qian et al., 2021). These studies were compared to the current findings. The research conducted using ageing mouse models demonstrates a rising trend in IL-13 production in heart tissue with age, which is associated with worsening cardiac failure.

The investigators demonstrated the dynamic production of IL-13 in heart cells in the laboratory and in mouse MI model following myocardial infarction (MI). In the area of infarction zone, the amount of IL-13 increases right away, peaks three days following MI, falls until day seven, and then increases once again (Cao et al., 2023). According to Yuan et al.'s (2019) study, the amount of IL-13 in blood and cardiac tissues increase seven days after ischaemia/reperfusion (I/R) and are still noticeably high on day fourteen in the mouse model. Yet, those suffering from MI in the acute stage have significantly lower blood levels of IL-13 than do healthy persons (Yan et al., 2021). Additionally, after three months, those with MI receiving primary angioplasty as reperfusion treatment have a decrease in serum IL-13, which is positively correlated with worsening heart function. According to Xie et al. (2023), it is thus assumed that IL-13 dynamically acts in MI and the subsequent I/R damage.

Researchers showed that blood levels of IL-13 were elevated in individuals with dilated cardiomyopathy (DCM) (Zhang et al., 2024). A quantified echocardiographic method called integrated backscatter (IB) was also utilized to evaluate the relationship between IL-13 and fibrosis of the myocardium in DCM. In addition to left ventricular (LV) hypertrophy in DCM, greater corrected IB, which indicates heavier myocardial fibrosis, was strongly correlated with elevated blood levels of IL-13. Nevertheless, in DCM patients, IL-13 did not significantly correlate with indicators of LV systolic efficiency. Therefore, IL-13 may be a target for treatment or a possible predictor in DCM (Geissen et al., 2022).

Liu et al.'s (2021) findings, which were consistent with the current investigation, indicated a negative correlation between IL-10 and cardiac activity. In comparison, people with cardiac problems have low levels of IL-10, according to Barcelos et al. (2019). The contradictory roles that IL-10 (pro and anti-inflammatory) plays in the etiology of cardiac disorders are indicated by these variations in study designs.

It is relatively indirect that IL-10 limits heart damage and fibrosis. Particularly, bone marrow-derived progenitor cells from endothelial cells are essential for attracting and keeping at the location of cardiac damage. These cells' stem-like characteristics subsequently impact healing and regrowth. IL-10 and its downstream signaling pathways, particularly STAT3, play a crucial role in this process (Rada et al., 2020). The the vast majority of IL-10 communication in the heart appears to arrive from non-cardiomyocytes, but IL-10 elimination affects cardiac tissue at everything stages, highlighting the significance of even indirect IL-10 signaling. In such animal designs, both regional (myocardial ischemia-reperfusion models) and systemic (LPS injection) insults result in more difficult histologic and medical effects (Samanta and Dawn, 2016).

Myocardial fibrosis was reduced as a consequence of IL-10 treatment's strong suppression of proinflammatory cytokines manufacturing, MMP-9 activity, and inflammatory cell invasion of the myocardium. As a result, there was less abnormal remodeling, decreased wall thinning, and an improvement in the function of the left ventricle (Sikking et al., 2023).

On the other hand, a recent investigation on the pathophysiology of heart failure in individuals with retained ejection fraction by Hulsmans et al. (2018) illustrates the contradictory function of IL-10 in fibrosis. The study showed that both human patients as well as mice with models of the condition exhibited extra cardiac macrophage amounts and IL-10 secretion. It has been demonstrated that particular fractions of cardiac living macrophages (MHCIIhigh) produce IL-10 in responses to the systemic inflammation brought on by left ventricular diastolic failure. This created an autocrine loop that encouraged the development of a novel fibrogenic macrophage phenotype that released TGF-β and osteopontin. It has been demonstrated that such mediators cause profibrotic cytokines to be secreted by cardiac fibroblasts, draw in immune cells, and eventually increase the accumulation of collagen, which exacerbates diastolic disorders and heart rigidity. Removing IL-10 produced by macrophages reduced fibrosis and enhanced clinical markers of cardiac function. In light of their indirect influence on cardiac reconstruction, they suggest that systematic neutralization of myeloid-specific IL-10, either through direct action or by moderating modifications to the macrophage phenotype, may be a potential therapeutic in this particular patient subset (Steen et al., 2020).

5. Conclusions

Gender, age and smoking are risk factors for heart diseases. Due to decreased immune state in patients, several viruses were discovered in those patients. IL-10 and IL-13 were raised in patients due to presence inflammation. IL-10 has paradoxical role (pro and anti-inflammatory) in pathogenesis heart diseases. IL-13 is more preferred in diagnosis heart diseases than IL-10 due to has (IL-13) highest sensitivity and specificity. Finally, there is no strong correlation between IL-10 and IL-13 in pathophysiology of heart diseases.

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