CHAPTER -1

INTRODUCTION

1.1 OVERVIEW

Chronic kidney disease (CKD), a major chronic disease that is increasing globally. In India recent studies of Screening and Early Evaluation of Kidney Disease (SEEK) have shown the prevalence of CKD to be 17.2% of which 6% are at CKD stage 3.

The renal replacement therapy (RRT) for end stage renal disease (ESRD) patients includes dialysis process and renal transplantation. Due to unavailability of donors for renal transplantation most of the cases depend upon dialysis. There are two types of dialysis processes available that includes hemodialysis and peritoneal dialysis but most of the patients depend on hemodialysis. In ESRD patients the symptoms are still further aggravated and these groups of patients are at more risk towards mortality.

Cardiovascular disease is one of the major cause of mortality in CKD which includes both atheromatous and non-atheromatous pathological processes. The traditional risk factors like abnormal lipid profile and oxidation stress increases the atheroma burden whereas severe anemia, hypertension and volume overload are responsible for left ventricular hypertrophy (LVH). All these factors leads CKD towards cardio vascular risk but evaluation of cardiac biomarkers in CKD is inaccurate and proper evaluation is required to identify the best markers.

In CKD the research is needed for proper classification, identification of pathological changes which are responsible for cardiovascular diseases and identification of best biomarkers for cardiac disease in CKD. Furthermore, the research is needed in hemodialysis patients for the identification of the causative factors which are responsible for progression and deterioration. As the CKD progresses, the kidneys undergo complete deterioration leading to end stage renal disease (ESRD). In ESRD patients require RRT and this condition increases the morbidity and mortality rate.
This knowledge may be helpful to develop the preventive measures in CKD and finally reduce the mortality and economic cost.

1.2 THE KIDNEYS

1.2.1 Anatomy
The kidneys are a pair of organs situated in retroperitoneal position in the posterior abdominal wall by the side of the vertebral column and extends from 12th thoracic vertebra to third lumbar vertebrae and right kidney is slightly lower than left kidney (Snell, 1992).

1.2.2 Structure and function
The kidneys are covered by a fibrous capsule. Each kidney has two zones namely outer cortex and inner medulla. Medulla is composed of renal pyramids and the apices of each pyramid are called renal papillae. These papillae are placed into the minor calyces which are combined together to form major calyces and subsequently forms renal pelvis which serves as the upper end of the ureter (Snell, 1992).

Each kidney consists of approximately 1 million nephrons, which form the basic structural and functional unit of kidney. Nephron contains renal corpuscle and renal tubules. The renal corpuscle in turn contain glomerulus, which is a specialized capillary system placed within the Bowman’s capsule. The glomerular membrane contains three namely flattened capillary endothelial cells, gelatinous layer of basement membrane and an inner epithelial layer of the Bowman’s capsule consisting of podocytes which form slits along the capillary wall. Renal tubule starts from the end of the Bowman’s capsule and contains i) the proximal convoluted tubule within the cortex ii) U-shaped loop of Henle extending into the medulla and back into the cortex iii) distal convoluted tubule and these all are responsible for transport of filtered fluid. The fluid finally reaches the collecting ducts which pass through the cortex and medulla and empty into the renal pelvis (Ganong, 2005).

Normal healthy kidneys main function is to control sodium and volume homeostasis through changes in the activity of the renin-angiotensin-aldosterone system (RAAS).
Besides this, the other important functions are i) selective resorption of important compounds, ii) selective reabsorption of water by the action of antidiuretic hormone (ADH), iii) selective reabsorption or secretion of sodium, potassium, calcium, phosphate and hydrogen ions, iv) secretion of erythropoietin, V) conversion of 25-dihydroxycholecalciferol into 1,25-dihydroxycholecalciferol which is an active form of vitamin D (Ganong, 2005).

1.3 DIFFERENT TYPES OF KIDNEY DISEASE

1.3.1 Definition of Kidney disease
Kidney disease defined as a deterioration of renal function that results from the decrease in the Glomerular filtration rate (GFR) which in turn reflects the retention of nitrogenous waste products.

1.3.2 Types of Kidney diseases
The two types of kidney disease are as follows
   a) Acute kidney disease
   b) Chronic kidney disease.

1.3.2.1 Acute Kidney Disease
Acute Kidney Disease (AKD) in general is a reversible condition and characterized by impaired renal function (pre renal, renal, and post renal) with raised serum creatinine. AKD occurs suddenly and initiated by underlying causes, such as infection, dehydration, and serious injury to the kidney (Jover et al., 2008).

1.3.2.2 Chronic kidney disease
Chronic kidney disease (CKD) is considered by progressive decline of renal mass with irreversible sclerosis and loss of nephrons over a period of months to years, depending on the underlying etiology (Gooneratne et al., 2008). CKD remains silent in early stages and finally ends up with ESRD.
### 1.4 Definition of Chronic Kidney Disease

Chronic kidney disease (CKD) is categorized by altered kidney function or structure. In National Kidney Foundation (NKF) in 2002 published the Kidney Disease Outcome Quality Initiative (K/DOQI) providing guidelines for the evaluation, classification and stratification of CKD (National Kidney Foundation, 2002). The CKD is classified into 5 stages based upon i) evidence of kidney damage for ≥ 3 months (structural or functional abnormalities of the kidney within or without decrease GFR) and ii) Reduced GFR less than 60 mL/min/1.73m² for ≥ 3 months with or without kidney damage.

#### Table 1.1 Stages of Chronic Kidney Disease

<table>
<thead>
<tr>
<th>Stage</th>
<th>GFR</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>90+</td>
<td>Normal kidney function but urine findings or structural abnormalities or genetic trait point to kidney disease</td>
</tr>
<tr>
<td>2</td>
<td>60-89</td>
<td>Mildly reduced kidney function, and other findings (as for stage 1) point to kidney disease</td>
</tr>
<tr>
<td>3</td>
<td>30-59</td>
<td>Moderately reduced kidney function</td>
</tr>
<tr>
<td>4</td>
<td>15-29</td>
<td>Severely reduced kidney function</td>
</tr>
<tr>
<td>5</td>
<td>&lt;15</td>
<td>Very severe, or established renal disease.</td>
</tr>
</tbody>
</table>

Note: Stage Description GFR ml/min/1.73m²

Kidney damage include (abnormal renal biopsy, markers of renal damage (persistent proteinuria, albuminuria, haematuria) or structural renal abnormality in imaging studies. Kidney failure requires for renal replacement therapy.

### 1.5 Assessment of Glomerular Filtration Rate

Most widely accepted index for kidney function is glomerular filtration rate (GFR), but normal level of GFR changes based upon gender, age, body mass index and hemodynamic factors and these factors are important for its interpretation (National Kidney Foundation, 2002).

Accurate GFR is measured directly by radioisotope filtration markers like $^{51}$Cr-EDTA or $^{99m}$Tc-diethylenetriamine-pentaacetic acid (DTPA), these are not cost effective.
and not free of risk to overcome the above problem estimated GFR (eGFR) is introduced. The Cockcroft-Gault (CG) equation and Modification of Diet in Renal Disease (MDRD) equation are most commonly used equations for assessing the renal function but are limited by lack of validation in full range of GFR.

1.6 EPIDEMIOLOGY AND HEALTH BURDEN OF CHRONIC KIDNEY DISEASE

1.6.1 Prevalence
Chronic kidney disease (CKD) is an important emerging chronic disease worldwide. The increased incidence of CKD is due to rise of diabetes and hypertensions among the people around the world, which are causative factors for CKD. CKD affects 10-16% of the adult population in Europe, Australia, Asia and USA (Chadban et al., 2003; National Collaborating Centre for Chronic Conditions, 2008; Wen et al., 2008). In USA, National Health and Nutrition Examination Surveys (NHANES) collected data on albuminuria and serum creatinine. Subsequent re-calibration of serum creatinine to standardize the creatinine measurements which has enabled the estimation of eGFR by MDRD formula and finally demonstrated the prevalence of CKD with increasing over the last two decades. These data represents the needs of development of clinical practice guidelines and health care planning in CKD.

1.6.2 Epidemiology of CKD in India
There rising incidence of CKD is likely to be a major problem in both healthcare and economy. In India, Recently estimated data regarding age-adjusted incidence rate of ESRD is found to be 229 per million population (pmp) in India. More than 100,000 new patients enter renal replacement programs annually. However, the absence of any registry and data on incidence of ESRD in India or other countries of South Asia do not exist.

Ajay et al., (2013) studied the epidemiology of CKD in India by the study named as Screening and Early Evaluation Kidney disease (SEEK). This includes males and females over 18 years of age who are eligible to participate in the screening. In India, highest prevalence was observed in Visakhapatnam, (46.8%), followed by Kanpur,
(41.7%) and Delhi (41%). The lowest prevalence was observed in Bangalore and Mysore (4% and 4.2%). Diabetes, Hypertension, and anemia are common risk factors associated with CKD. Further hypertension (both systolic and diastolic blood pressure), low haemoglobin level and old age are also correlated with decreased eGFR in CKD.

1.6.3 Health care and economic burden
Chronic kidney disease can be detected by therapies to reduce or prevent the complications that has been improved over the last three decades. These preventive measures include pharmacological treatment of anemia, cardiovascular risk factors, proteinuria, bone metabolism and renal replacement therapies (RRT). Besides this, there was rise of incidence of CKD and in early stages of 2 and 3, which exceed the rates of end stage renal failure nearly 100-200 times (Sarnak et al., 2003). This will explain the improving awareness and detection of following publications of National Clinical Guidelines (National Collaborating Centre for Chronic Conditions, 2008; National Institute for Health and Clinical Excellence, 2008; National Kidney Foundation, 2002). The increasing incidence of CKD risk factors specifically with old age, obesity, diabetes and hypertension which also responsible for the raise of prevalence.

1.7 RISK FACTORS OF CKD
Risk factors influence the disease process, which includes susceptibility, initiation and progression factors.

Susceptibility factor, increases the kidney damage after exposure to initiation factors. Male and elderly people (Fox CS et al., 2004) are more susceptible to CKD that leads to high registry in RRT (Renal Replacement Therapy) (United States Renal Data System, 2003). USA and UK ethnic minorities have an increased susceptibility to CKD. CKD is susceptible to those having family history of CKD, which implies on genetic or familial predisposition (Bergman et al., 1996). Low birth weight and malnutrition causes reduction in the number of nephrons which leads to hypertension and CKD in later life (Brenner and Chertow 1994).
Initiation factors include those that directly initiate the kidney damage such as diabetes (Adler et al., 2003), high blood pressure (Schaeffner et al., 2008), hyperlipidemia, obesity and smoking (Muntner et al., 2000).

Progression factors degenerate the kidney damage more, that is generated by initiation factors. There was an evidence that GFR declines faster among male and elderly persons (Jungers et al., 1996). Proteinurias is one of the independent predictors of progressive CKD (Remuzzi and Bertani, 1998). Less glycemic control also increases the development of diabetic nephropathy in both the cases of type 1 and type 2 diabetic patients (Adler et al., 2003). Experimental data show that hyperlipidemia is also associated with nephropathies both in diabetic and non-diabetic conditions (Keane et al., 1991). Framingham study shows that obesity is risk factor of CKD (Cignarelli and Lamacchia, 2007). Smoking induces albuminurias causing progression of kidney disease to renal failure. (Wesson, 2003).

CKD shares several traditional and novel risk factors with cardiovascular disease (CVD). Older age, male gender, diabetes, hypertension, dyslipidemia, smoking, physical inactivity and family history of CKD are classified under traditional risk factors. Oxidative stress, endothelial dysfunction, microvascular damage, inflammation and socioeconomic status form the novel risk factors of CKD (Parikh et al., 2006).

1.8 PATHOPHYSIOLOGY OF CKD
The basic pathology of CKD is due to injury, inflammation or hypertensive scarring which results due to the loss of functional nephrons and progressive mechanisms that are consequence of long term reduction of renal mass. Experimental animal studies shows that this reduced renal mass causes structural and functional hypertrophy of reaming healthy nephrons (Brenner, 1985). This short time adaptive changes preserve the kidneys function initially, later cause adverse effects on the residual nephrons (Hostetter, 1995), this is due to increased glomerular capillary pressure and flow which will cause hyperfiltration and finally leads to hypertrophy. It was also
suggested that hyperfiltration and reabsorption of proteins by the kidneys activates the inflammatory reactions mediated by vasoactive molecules, such as cytokines, and growth factors that finally leads to glomerular scarring (Remuzzi and Bertani, 1998). The factors such as Proteinuria, endothelial dysfunction, low-grade inflammation, dyslipidemia and hypertension are high risk of CVD in CKD. The endothelial dysfunction also initiates the renal damage which causes glomerulosclerosis and finally renal failure. Hyperglycemia is a common condition in diabetics and hyperglycemia combined with oxidative stress will lead to diabetic nephropathy (Ha and Kim, 1999).

1.9 THE NATURAL HISTORY OF CHRONIC KIDNEY DISEASE

Chronic kidney disease usually starts with asymptomatic period in the early stages later the renal function may deteriorate over months to years based on the etiology. The mechanism which is responsible for the progression of CKD is not completely understood. Besides this, there is an increase in the rate of CKD risk factors like diabetes mellitus, hypertension and cardiovascular disease as well as age and obesity with the progression of CKD (United States Renal Data System, 2010). The UK clinical guidelines also focused on identification of such risk factors as well as avoiding of nephrotoxic agents like Non Steroid anti-inflammatory drugs (NSAIDS) (National Collaborating Centre for Chronic Conditions, 2008).

1.10 MANAGEMENT OF ESRD

The ESRD patient’s treatment contains conservative management and RRT. Conservative management failed against the kidney damage and the RRT is considered as it includes hemodialysis (HD), peritoneal dialysis and renal transplantation. Main aim of renal replacement therapy is to increase the quality of life.

1.10.1 Peritoneal Dialysis

In peritoneal dialysis, catheter is inserted into the peritoneum. The dialysate is introduced through catheter and peritoneal membrane, which filters the blood waste products via osmotic forces. Peritoneal dialysis removes the solutes and water depending on the clearance characteristics of peritoneum and artificial dialysis membrane and time allowed for exchange.
1.10.2 Hemodialysis

Hemodialysis process is responsible for solutes clearance that depends on diffusion across the membrane driven by concentration gradient between the blood and dialysate. The clearance of solutes per unit of time depends on the solute molecular weight, dialysate flow, blood flow and dialysis membrane characteristics. The main aim of hemodialysis process is to correct the uremic symptoms by removing the solutes, maintain the acid-base and electrolyte balance and maintain the volume status. All these factors contribute to the improvement of quality of life and decrease the mortality and morbidity rate. (Jover et al., 2008).

In the year 1924, Georg Hass first treated Acute Kidney disease (AKD) patient with dialysis. Problems with dialysis therapy in early years include clotting of blood and difficult to obtain reliable access to blood circulation. This was overcome by the purified heparin and development of Teflon arteriovenous (AV) shunt. These are the achievements that were helpful for hemodialysis in CKD patients (Rosner, 2005).

Hemodialysis can be performed two to three times in a week each session contains 3-4 hours, the dialysis time depends on patient condition and varies from patient to patient(Kusiak et al., 2005). In hemodialysis process, blood filtration is carried out by hemodialyzer which contains semipermeable membrane which takes excess fluid and waste products and comes out as hemodialysis fluid. The hemodialysis process requires establishment of arteriovenous fistula which is helpful in vascular access. During hemodialysis process, the patients require anticoagulant heparin which will prevent clot formation and facilitate proper blood circulation between dialyzer and vascular access (Jover et al., 2008).

Hemodialysis processes will cause certain mild complications like headache, nausea and vomiting and sever complications like hemolysis and seizures. During hypotension the patients complain of nausea, dizziness, vomiting, chest pain and sweating (Rosner, 2005).
1.11 CARDIOVASCULAR RISK AND CHRONIC KIDNEY DISEASE

The observations of different studies in CKD over the past several years demonstrated CKD having an elevated risk of cardiovascular disease (Culleton et al., 1999). The National Kidney Foundation (NKF) Task Force on Cardiovascular Disease in CKD demonstrated the prevalence of cardiovascular disease in CKD and high death rate is associated with ESRD. Based on this, NKF Task Force also recommended patients with CKD to be considered as high risk group for cardiovascular disease and treated accordingly based on the high risk status (Levey et al., 1998).

1.11.1 Cardiovascular risk in end-stage renal disease

Annual risk of mortality for patients on dialysis is approximately 20% of which half of deaths in CKD are because of cardiovascular disease. The mortality is 10 to 100 times more in these group when compared with same age group of general population. This cardiovascular mortality is still higher in younger dialysis patients, it is up to 500 times compared with age-matched normal population (Levey et al., 1998). Structural cardiac abnormalities and symptomatic cardiovascular disease are associated with adverse prognosis. Before onset of RRT over two-third patients are prevalent for left ventricular hypertrophy (LVH) and it indicate that early stage of CKD is only mechanism promoting cardiovascular disease. (Foley et al., 1995).

1.11.2 Cardiovascular risk in early stage chronic kidney disease

The observation on recent data suggests that CKD confers the risk of cardiovascular disease. Go et al. estimated GFR using MDRD equation in patients who had measured serum creatinine during 1996 and 2000. Over a three year follow-up it was noticed that there was an inverse graded relationship between eGFR below 60 mL/min/1.73 m² and increased rate of cardiovascular events (Go et al., 2004). The other studies also demonstrated that patients with early stage CKD were higher risk of dying from cardiovascular disease before progressing to ESRD (Coresh et al., 2007). Five year cardiovascular mortality rates for CKD stages 2, 3 and 4 were 19.4%, 24.5% and 19.9% respectively (Coresh et al., 2007).
1.12 THE CAUSES OF CARDIOVASCULAR DEATH IN CKD
Both in healthy individual and ESRD individuals CVD is common root of death. But in case of ESRD the general cause of cardiovascular death is sudden arrhythmic cardiac death, which will occur within a short time period, generally less than an hour from the onset of symptoms. In ESRD, this accounts approximately 60% of cardiovascular death and 26% of total mortality (Hage et al., 2009).

The above observations demonstrated that there was difference in the nature of cardiovascular death in CKD. In general population, atheroma related coronary heart disease is driving pathology and Framingham risk score will predict the cardiovascular mortality rate. In general population atheroma related cardiovascular mortality is decreased by pharmacological treatment such as statin and anti-hypertensive drugs.

The standard cardiovascular risk factor assessment score is not shown accurately in CKD due to non atheromatous pathogenic process such as arterial stiffening and abnormal cardiac structure. The risk factors like blood pressure, obesity and cholesterol have negative relation with mortality in ESRD (Baigent et al., 2000). It means low blood pressure and cholesterol wherein patient shows worst outcome. Recent studies demonstrated ESRD patients have high prevalence of non-atheromatous cardiovascular disease like LVH and fibrosis (Mark et al., 2006). Despite of these observations and recognition from the NKF Task Force, the individuals with CKD are the “highest risk group for subsequent development of cardiovascular disease” (Levey et al., 1998), data regarding the pathogenesis of cardiovascular mortality in early stage CKD remain sparse.

1.13 THE NATURE OF CARDIOVASCULAR DISEASE IN CKD
1.13.1 Changes in cardiac structure and function - uremic cardiomyopathy
The common cardiac structure abnormalities identified in ESRD are left ventricular (LV) dilatation, left ventricular hypertrophy (LVH), and changes in cardiac function because of left ventricular systolic dysfunction. These changes were originally described in echocardiographic studies on patients starting dialysis. Foley et al.,
(1995) studied that the prevalence of LVH is 74%, LV dilatation is 32% LV systolic dysfunction is 15% and these collective changes are termed as uremic cardiomyopathy. Only 16% of patients had normal echocardiograms.

1.13.2 Left ventricular hypertrophy
In uremic cardiomyopathy most prevalent subtype is left ventricular hypertrophy (LVH) in ESRD patients (Foley et al., 1995). LVH is an independent predictor of cardiac death in dialysis patients under all age groups including children have shown LVH (Mitsnefes et al., 2000). In ESRD, there was an increased cardiac work due to chronic pressure and volume overload which leads to pathogenesis of LVH, an adaptive response. LVH in response to increased systolic blood pressure, viewed the increase in ventricular wall thickening as a beneficial compensatory response to maintain wall tension. Epidemiological studies have shown that there was a relationship between increased left ventricular (LV) mass and adverse cardiovascular outcomes. Left ventricular hypertrophy in ESRD is strongly linked to poor cardiovascular prognosis and was thought to reflect pathological changes within the myocardium, specifically the development of fibrosis (Aoki et al., 2005).

1.14 CORONARY HEART DISEASE IN CKD
In ESRD patients the cause of cardiovascular death is sudden cardiac death whereas coronary heart disease (CHD) is the second cause of cardiovascular death (United States Renal Data System, 2010). Acute myocardial infarction (AMI) is the primary cause of coronary heart disease in ESRD. Furthermore, revascularisation process such as percutaneous intervention and coronary artery bypass surgery not shown any significant improvement in cardiac mortality rate in ESRD (Herzog et al., 2008). In ESRD patients, fibroatheromatous plaque was due to densely calcified plaques (Schwarz et al., 2000) which will differ from the normal plaque formation in general population. Histological studies of plaques composition in ESRD shows that it contains low levels of lipid and inflammation in contrast to plaque seen in the general population (Schwarz et al., 2000).
1.15 SCOPE OF PRESENT INVESTIGATION

From the detailed survey of literature discussed in review of literature, it is understood that CKD is associated with decreased GFR. Estimation of eGFR requires proper classification of CKD and better estimated GFR (eGFR) predictive equation is needed for diagnosis. CKD associated with high rate of cardiovascular abnormalities includes sudden cardiac death, LVH and coronary heart disease. Findings of lipid profile, lipid peroxidation and anemia profile may help in evaluating the threat of CVD in CKD. However development of cardiovascular disease in CKD is not yet completely understood.

CKD patients are having high incidence of LVH observed during ECG followed by 2D electrocardiogram revealed the incidence of LVH in nondialysis and hemodialysis patients. Cardiac biomarkers are specific for cardiovascular diseases but these markers raise is insignificant to CKD because other complications are being associated with CKD that influence the cardiac biomarkers and evaluation of better marker in CKD both nondialysis and hemodialysis is necessary. In dialysis group the metabolic changes are still worse and patients conditions becomes more deteriorated and are at high risk of mortality. Therefore complete proteomic analysis of serum from hemodialysis patients with LVH may reveal the answer to this problem. In view of the above the current study was undertaken with following objectives.

1. Defining the best formula for estimating GFR in the selection of control and cases.
2. Assessing the cardiovascular risk factors such as lipid profile, lipid peroxidation and anemic profile in chronic kidney disease with respect to nondialysis and hemodialysis patients.
3. Cardiac biomarkers assessment in CKD patients based on left ventricular hypertrophy.
4. Proteomic profile assessment in CKD hemodialysis patients with LVH.

The first objective was to estimate the eGFR in control and CKD by using CG, MDRD and MCQE and compare these three formulae. Furthermore compare these
formulae based on age and study the categorization of controls into various stages based on eGFR. It will be helpful in proper classification and staging of CKD and also provides the best predictive equation for eGFR.

The second objective was to estimate the lipid profile which may explain the reason why ESRD patients have normal LDL-C levels and declined HDL-C. Furthermore, study of oxidative stress markers like SOD and MDA in control and both groups of nondialysis and hemodialysis group estimate the effect of hemodialysis in oxidative stress by measuring SOD and MDA levels before and after hemodialysis. It will be helpful in studying the atheroma risk factors in CKD.

The third objective is determination of erythrocyte indices and iron profile markers like serum iron, TIBC, TSAT % and ferritin in control and both groups of nondialysis and hemodialysis. Finally examinations of peripheral blood smear will be done in both nondialysis and hemodialysis groups. This study is helpful in evaluating the anemia and its types in CKD of both groups. In anemia there is poor oxygen delivery which leads to increased heart rate and stroke volume and these factors causes pathogenesis of left ventricular hypertrophy (LVH). The poor oxygen delivery also influences myocardial oxygen delivery and leads to exacerbation of angina symptoms.

The fourth objective is to evaluate the LVH using ECG and Echocardiography and also study the blood pressure, which is a causative factor of LVH. Dialysis adequacy was calculated by using Kt/V and urea reduction ratio. In present thesis myocardial infarction traditional cardiac biomarkers like myoglobin, Creatine kinase isoenzyme MB (CK-MB) and upcoming cardiac biomarkers for myocardial infarction like N-terminal pro Brain Natriuretic Peptide (NTpro BNP), heart fatty acid binding protein (HFABP), ischemia modified albumin (IMA) and cardiac specific isoform of Troponin I (CTnI) were estimated in CKD of both groups that are nondialysis and hemodialysis. Because in CKD there was increased oxidative stress, decreased renal clearance, high incidence of LVH and skeletal muscle damage, and these factors causes the alteration of cardiac biomarkers. This study will help in evaluation of best marker in CKD for diagnosis of cardiovascular abnormalities.
The fifth objective was comparison of proteomic profile in control and hemodialysis patients with LVH by using 2D- DIGE and find out the number of protein over expressed and under expressed and select the desired protein for mass spectroscopy. Furthermore 3D structure of protein was predicated by using Prime 3.0 (Schrodinger 2011) followed by protein structure validation using PROCHECK and ERRAT. Finally protein interaction was studied using STRING analysis. This study is helpful in identifying number of proteins that are differently and differentially expressed in CKD patients with LVH.