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CLINICAL STUDY OF CARDIOVASCULAR ABNORMALITIES IN PATIENTS WITH CHRONIC RENAL FAILURE.

General Medicine

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ABSTRACT

AIMS: To study the prevalence of cardio vascular abnormalities in chronic renal failure patients.

MATERIAL AND METHODS: Patients included in the study underwent following tests Complete Haemogram, Renal function tests , Liver function tests, Renal ultrasound, Lipid profile , Serum electrolytes, Serum Calcium, Serum Phosphorous ,Chest radiography,Electrocardiography-12 lead and 2D echocardiography.

RESULTS: 67% males and 33% females. In the present study, out of the 100 patients with CKD, 69 patients (69%) had Left Ventricular Hypertrophy (48% concentric and 21% eccentric LVH), Diastolic dysfunction was seen in 42 patients (42%) and Systolic dysfunction in 20 patients (20%), 20 patients (20%) had pericardial effusion and 31 patients (31%) had Normal Echo study.

CONCLUSION The present study shows that patients with chronic kidney disease have higher prevalence of left ventricular hypertrophy (LVH), which is more marked in patients with End Stage Renal Disease.

KEYWORDS

Chronic renal failure Cardiovascular abnormalities

INTRODUCTION

Chronic Renal Failure (CRF) is one of the common conditions which a physician comes across in day to day practice.

End stage renal disease and cardiac disease seem to be inextricably linked. Of various causes, infection and cardiovascular events contribute towards large proportion of increased morbidity and mortality.[2]

Death from cardiac causes is 10- 20 times more common in patients with renal failure than in matched segments of the general population. Left Ventricular Hypertrophy (LVH) is a major Echocardiographic finding in Chronic Renal Failure (CRF).Prevalence of LVH increases with decline of renal function.[3] Left ventricular hypertrophy is an independent predictor of survival, present in approximately 70% of patients at the initiation of dialysis. Echocardiography should be performed early in the course of CRF and may be valuable in the monitoring of therapy of these patients.[3]

AIMS OF THE STUDY

To study the prevalence of cardio vascular abnormalities in chronic renal failure patients admitted, attending OPD and patients undergoing dialysis in dialysis unit of Osmania General Hospital, Hyderabad.

MATERIALS AND METHODS

The data for this study was collected from the one hundred subjects fulfilling the inclusion /exclusion criteria admitted, patients visiting OPD and patients undergoing dialysis in dialysis unit of Osmania General Hospital.

Inclusion Criteria:

The study population consists of patients of Chronic Kidney Disease attending the Osmania General hospital as per National Kidney Foundation .Patients with Chronic glomerulonephritis Hypertensive nephropathy Diabetic nephropathy Chronic tubulointerstitial disease Autosomal dominant polycystic kidney disease .

Exclusion Criteria .Patients with other cardiac disorder such as valvular heart disease, congenital heart disease. Paediatric cases of chronic Kidney Disease.

METHODS:

The following set of investigations were done in the patients included in the study .Complete Haemogram, Renal function tests, Liver function tests, Urine analysis & culture (if required),Renal ultrasound, Lipid profile. Serum electrolytes, Serum Calcium, Serum Phosphorous, Chest radiography, Electrocardiography-12 lead and 2D Echocardiography.

RESULTS AND DATA ANALYSIS

The present study comprised 100 cases of chronic kidney disease admitted, patients visiting OPD and patients undergoing dialysis in dialysis unit of OsmaniaGeneral Hospital.

1. Age Distribution:

Table – 1: Showing age distribution of100 cases of Chronic Kidney Disease.

Age group (years)	Frequency	Percentage
31-40	4	4%
41 – 50	16	16 %
51 – 60	30	30 %
61 – 70	40	40 %
71 – 80	10	10 %
Total	100	100 %

2. Gender Distribution:

Table 2: Showing the Gender Distribution

Gender	Frequency	Percentage
F	33	33 %
M	67	67 %
Total	100	100 %

3. Aetiology of CKD:

In the present study, combined Diabetes and hypertension was the leading cause of chronic kidney disease in 44 patients (44%), followed by Diabetes in 39 patients (39%), hypertension in 13 patients (13%), Adult Polycystic Kidney Disease (APKD) in 2 patients (2%), Chronic glomerulonephritis in 1 patient (1%) and obstructive pathology in 1 patient (1%) respectively.

4. Blood Urea Levels

Table – 4: Showing the distribution of blood Urea levels

Level of Blood Urea (mg/dl)	Frequency	Percentage
50 -100	30	30 %
101-150	40	40 %
151-200	26	26%
> 200	4	4%
Total	100	100%

5. Serum Creatinine levels:

Table – 5: Showing the Distribution of Serum Creatinine

Level of serum Creatinine (mg/dl)	Frequency	Percentage
1.5 - 3.0	20	20 %
3.0 - 6.0	40	40 %
> 6.0	40	40 %
Total	100	100

The range of serum Creatinine level in the present study was between 1.8 - 13.1 mg/dl.

6. Staging of CKD Based on GFR as per National Kidney Foundation.

Table – 6 Distribution Based on GFR

Stage	No of cases	%
Stage 1 [GFR->90%]	0	0.00
Stage 2 [GFR; GFR60-89%]	0	0.00
Stage 3 [GFR 30-59%]	5	5.00
Stage 4 [GFR15-29%]	33	33.00
Stage 5 [; GFR <15%]	62	62.00
Total	100	100

7. Range of Haemoglobin levels in CKD:

Table – 7: Showing the distribution of the levels of Haemoglobin

Level of Hb% (gm%)	Frequency	Percentage
5.1 - 7.0	19	1 9 %
7.1 - 9.0	50	50 %
9.1 – 11	29	29 %
> 11	2	2 %
Total	100	100 %

8. Serum Potassium levels in CKD:

Table – 8: Showing levels of Serum Potassium

Level of Sr.Potassium meq/L	Frequency	Percentage
<3	1	1 %
3.1 - 4.0	21	21 %
4.1 – 5.0	40	40 %
5.1 - 7	38	38 %
Total	100	100 %

9. Serum Calcium levels in CKD:

Table – 9: Showing levels of Serum Calcium

Levels of Sr.Calcium mg/dl	Frequency	Percentage
6 - 7	9	9 %
7.1 - 8.0	21	21 %
8.1 - 9	38	38 %
9.1 - 10	21	21 %
10.1 - 11	10	10 %
> 11	1	1 %
Total	100	100 %

10. Serum Phosphorus levels in CKD:

Table – 10: Showing levels of Serum Phosphorus

Levels of Sr.Phosphorus mg/dl	Frequency	Percentage
2 – 4	19	19 %
4.1 - 5.0	46	46 %
5.1 - 6	27	27 %
6.1 - 7	6	6 %
> 7	2	2 %
Total	100	100 %

11. Total Cholesterol levels in CKD:

Table – 11: Showing serum Cholesterol levels

Level ofTotal Cholesterol (mg/dl)	Frequency	Percentage
< 150	5	5 %
151 - 200	63	63 %
> 200	32	32 %
Total	100	100 %

12. Triglycerides levels in CKD:

Table – 12: Showing Triglycerides levels in CKD

Level of Triglycerides (mg/dl)	Frequency	Percentage
< 150	14	14 %
151 – 170	57	57 %
> 170	29	29 %
Total	100	100 %

13. LDL cholesterol levels in CKD: Table - 13: Showing LDL levels in CKD

Level of LDL Cholesterol mg/dl	Frequency	Percentage
< 100	13	13 %
101 – 130	67	67 %
> 130	20	20 %
Total	100	100 %

14. HDL Cholesterol levels in CKD:

Table – 14: Showing HDL Cholesterol levels

Level of HDL Cholesterol (mg/dl)	Frequency	Percentage
< 30	52	52 %
31 – 40	34	34 %
> 40	14	14 %
Total	100	100 %

15. Electrocardiographic Changes in CKD:

Table – 15: Showing the Electrocardiographic Changes

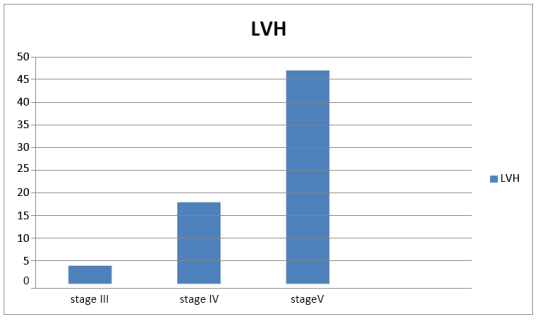
Particulars	Frequency	Percentage
LVH	63	63 %
ST-T changes	30	30%
NO LVH	31	31 %
Low voltage complexes	6	6%

16. Echocardiographic Findings in CKD:

Table – 16: Showing the Echocardiographic Findings

Particulars	Frequency	Percentage
Concentric LVH	48	48%
Eccentric LVH	21	21%
Diastolic dysfunction	42	42%
Systolic dysfunction	20	20%
Pericardial effusion	20	20%
Normal	31	31%

Graph – 7: graph showing the distribution of patients based on stages of chronic kidney disease with echo changes:



Table–17: Comparing the Base line Characteristics Of Study With the stages of CKD

Parameter	Stage 5(a)	Stage 4(b)	Stage 3(c)	P-Value
Blood Urea (mg/dl)	160.16 ± 27.08	100.60 ± 20.08	89.2 ± 23.71	a vs b <0.001* a vs c <0.001* b vs c <0.001*
Serum Creatinine (mg/dl)	7.50 ± 2.01	3.20 ± 0.51	1.96 ± 0.15	a vs b <0.001* a vs c <0.001* b vs c <0.001*
GFR (ml/min)	7.09 ± 2.33	20.13 ± 3.73	37.26 ± 4.49	a vs b <0.001* a vs c <0.001* b vs c <0.001*
Hemoglobin (gm%)	7.41 ± 1.04	9.39 ± 0.80	11.04 ± 0.57	a vs b <0.001* a vs c <0.001* b vs c <0.001*
Total Cholesterol	200.41 ± 17.67	193 ± 13.07	188.6 ± 29.66	a vs b >0.05 a vs c >0.05 b vs c >0.05
Triglycerides	164.75 ± 12.50	166.91 ± 5.32	164.45 ± 12.20	a vs b >0.05 a vs c >0.05 b vs c >0.05
LDL Cholesterol	114.40 ± 10.61	124.48 ± 5.93	125.2 ± 9.50	a vs b <0.001* a vs c <0.001* bvs c <0.001*

* Denotes a significant difference

DISCUSSION

Premature cardiovascular disease is a significant cause of morbidity and mortality among patients with CKD.

Echocardiography provides an excellent non-invasive method to delineate details of the anatomy of cardiac cavity, wall dimensions and wall movements. It is now increasingly used in the assessment of cardiac performance and is also invaluable in the demonstration of structural abnormalities such as LVH and pericardial effusion.

Left ventricular hypertrophy is the single strongest independent predictor of adverse cardiovascular events. LVH is a major echocardiographic finding in ureamic patients. In the present study, 4 (6%) patients of Stage III, 18(26%) patients of Stage IV and 47(68%) patients of Stage V chronic kidney disease group had Left Ventricular Hypertrophy.

SA Kale, NS Kulkarni, S Gang, A Ganju, L Shah, MM Rajapurkar conducted prospective study includes 161 patients of end stage renal disease entering haemodialysis programme between 1-6-97 to 31-12-99. Patients were evaluated for left ventricular disease manifesting as systolic dysfunction, left ventricular hypertrophy & left ventricular dilatation on echocardiography after 4 to 12 weeks of initiating haemodialysis. Left ventricular disease was common & encountered in 105 (65.2%) patients. Only 56 (34.8%) had normal echocardiogram. We observed systolic dysfunction in 24 (14.9%), left ventricular hypertrophy in 88 (54.7%) & left ventricular dilatation in 42 (26.1%) patients. Hypertension, older age, male sex, anaemia, hypoalbuminemia and hypocalcaemia were found to be significantly associated with manifestations of left ventricular disorders. Patients of end stage renal disease with diabetes had higher frequency of systolic dysfunction (37.8%) as compared to non-diabetic patients (8.06%). It is concluded that left ventricular disorders are common in end stage renal disease patients entering haemodialysis programme and aggressive control of hypertension and anaemia can help to prevent these disorders.[32] N.A.Tomilina, G.V.Volgina, B.T.Bikbov, Yu.V.Perepechyonickh, I.I.Stenina conducted a study on 150 patients with CRF and 160 patients with ESRD . Concentric LVH was observed in 29.3% in the predialysis group with LVH, eccentric LVH was in 23.3%. In the group of HD patients LVH was detected in 78.1%: concentric LVH was found in 51.8% and eccentric LVH was present in 26.3%. In patients without LVH we found concentric remodeling of left ventricle in 16.7% of predialysis patients and in 13.1% of HD patients ($p<0.05$). We found that risk factors for LVH were the decline in Ccr ($p<0.05$), age ($p<0.001$), increase of blood pressure ($p<0.0001$), anaemia ($p<0.04$). In HD patients additional risk factors were: levels phosphorus ($p<0.0001$), product CaxP ($p<0.0001$) and interdialytic weight gain ($p<0.05$). Risk factors for concentric remodeling were age ($p<0.05$), duration of predialysis hypertension ($p<0.04$), creatinine plasma level ($p<0.05$), anaemia ($p<0.005$)[4].

Ifeoma I. Ulasi, FWACP; Ejikeme B. Arodiwe, FWACP; Chinwuba K. Ijoma, FMCP conducted study on One hundred consecutive patients with CKD . The most prevalent type of LVH was eccentric hypertrophy, which was found in 54.6%, while concentric was seen in 40.9%. Hypertension was present in 85.2% of the patients. The predominant causes of CKD were chronic glomerulonephritis (43.2%), hypertension (25%), and diabetes mellitus (14.8%). All the patients studied had advanced CKD, either stage 4 or 5 of the Kidney Disease Outcome Quality Initiative classification of CKD. Stepwise method of multiple linear regressions identified mean arterial pressure (32%), haemoglobin concentration (22%), male sex (17%), and creatinine clearance (24%) as predictors of LVH in CKD.

S Agarwal, P Dangri, OP Kalra, S Rajpal conducted study to assess the prevalence of systolic and diastolic dysfunction in patients of chronic renal failure on conservative management on Sixty patients with varying degree of chronic renal failure (CKD) The prevalence of left ventricular hypertrophy (LVH) along with systolic dysfunction in severe CRF group was 30%, which was significantly higher than mild/moderate group (3.3%). The prevalence of LVH along with diastolic dysfunction in severe CRF group was 53.2%, which was significantly higher than mild/moderate CRF group (30%)[3]. Parfrey PS, Foley RN, Harnett JD, Kent GM, Murray DC, Barre PE conducted study on 432 end-stage renal disease patients who survived at least 6 months had an echocardiogram on initiation of dialysis therapy. On initiation of ESRD therapy 16% of patients had systolic dysfunction, 41% concentric LV hypertrophy, 28% LV dilatation, and only 16% s had normal echocardiograms [21]. In our study Pericardial effusion was found in 20 (20%) cases.14 cases had mild and 6 patients had moderate pericardial effusion Frommer JP et al has reported an incidence of pericardial effusion in 18 out of 50 (36%) patients.[55]

Gupta et al reported an incidence of 8.8% in patients on maintenance Haemodialysis.[56] The present study shows that patients with chronic kidney disease have higher prevalence of left ventricular hypertrophy (LVH), which is more marked in patients with End Stage Renal Disease.

CONCLUSIONS

The high prevalence of Left ventricular hypertrophy in these populations on echocardiography implies that these patients require detailed cardiovascular evaluation despite absence of symptoms, and also that various efforts aimed at prevention and control of left ventricular hypertrophy should be started early during the course of renal insufficiency, such as effective control of hypertension ,anaemia.The progressive increase in the prevalence of LVH as a function of declining renal function is important information for planning the timing of interventions.

REFERENCES

1. EL Nahas and CG Winerals. Chronic renal failure 20.17.1 In: Oxford Textbook of Medicine. 3rd ed., DJ Weatherall, etal.Oxford Medical Publications USA 1996; Vol. 3:3294-3306.
2. P Dangri, S Agarwal, OP Kaira, S Rajpal. Echocardiographic assessment of the left ventricle hypertrophy in patients of chronic renal failure. Indian Journal of Nephrology 2003;13:92-97
3. S Agarwal, P Dangri, OP Kaira, S Rajpal. Echocardiographic assessment of cardiac dysfunction in patients of chronic renal failure. JIACM 2003;4(4): 296-303
4. NA Tomilina, GV Volgina, BT Bikbov, YuVPerepechyonickh, II SteninaMoscw Russia. Prevalence of the left ventricular hypertrophy and geometric modelling in patients with chronic renal failure.2nd International Congress of Nephrology in Internet.16/09/2007;1-12
5. Adeera Levin, Joel Singer, Christopher R, Thompson, Heather Ross and Mary Lewis RN. Prevalent Left Ventricular in the Predialysis Population: Identifying opportunities for intervention. American Journal ofkidney Diseases, Vol 27, No 3(March), 1996:pp347-354.
6. Masaru Horio, YoshimasaOrita and MegumuFukunaga. Assessment of Renal Function. Chapter 3.In: Comprehensive Clinical Nephrology.2nd ed. Richard J Johnson, JohnFeehally.27-34.
7. Murugesan Ram Prabahar, VenkatramanChandrasekaran, PeriasamySoundararajan. Epidemicof ChronicKidneyDiseaseinIndia-Whatcanbe Done? Saudi Journal of Kidney Diseases and transplantation 2008; 19(5): 847-853.
8. C Shyam, V Sreenivas. Chronic Kidney Disease:a missing component of integrated control of non-communicable diseases. Correspondence. Indian J Med Res 122, November 2005, pp451-453.
9. Madhumathi Rao, Brain JG Pereira. Chronic Kidney Disease in India- a hidden epidemic. Commentary. Indian J Med Res 126, July2007, pp6-9.
10. Suresh Chandra Dash, Sanjay K Agarwal. Incidence of Chronic Kidney Disease in India. Nephro Dial Transplant 2006, 21:232.
11. Joanne M. Bargman, Karl Skorecki. Harrison's Principles of Internal Medicine: 17thEdition.
12. K Amann, E Ritz. The Heart in Renal failure: Morphological changes of the Myocardium- New Insights. Journal of Clinical and Basic Cardiology 2004; 4(2),109-113.
13. Robert N Foley,MB, Patrick S Parfrey,MD, and Mark J Sarnak,MD. Clinical Epidemiology of Cardiovascular Disease in Chronic Renal Disease. American Journal of Kidney Diseases,Vol 32,no 5,suppl 3 (November),1998:pp S112-S119.
14. Goran J Paunovic, Karolina Paunovic, Svetislav et al. Cardiovascular risk factors and Echocardiographic findings in patients on waiting list for cadaveric kidney transplantation. Medicine and Biology Vol12, No1.2005, pp28-32.
15. Patrick S Parfrey and Robert N Foley. The Clinical Epidemology of Cardiac Disease in Chronic Renal failure. J Am SocNephrol 1999, 10:606-1615.
16. Rachel j Middleton, Patrick S Parfery and Robert N Foley. Left Ventricular Hypertrophy in the renal patient. J Am SocNephro 2001, 12:1079-1084. 8273
17. SancharíDatta, G Abharam, Milly Mathew et al. Correlation of Anaemia, Secondary Hyperparathyroidism with left ventricular hypertrophy in chronic kidney disease patients. JAPI, Vol 54; September2006:699-703.
18. Lionel U Mailloux,MD, and Andrew S Levey,MD. Hypertension in patients with chronic renal disease. American Journal of Kidney Diseases 1998;Vol 32, No5,Suppl 3:ppS120-S141.
19. JoseJGdeLima,HenryAbensur,EduardoMKriegerandFulvioPileggi. Arterial blood pressure and left ventricular hypertrophy in haemodialysis patients. Journal of Hypertension1996, Vol 14, No 8:1019-1024.
20. Braun Wald, Textbook of Cardiovascular Medicine
21. PS Parfrey, RN Foley, JD Harnett, GM Kent, DC Murray and PEBarre. Outcome and risk factors for left ventricular disorders in Chronic Uraemia. Nephrol Dial Transplant 1996;11:1277-1285.
22. Sally C Greaves, Greg D Gamble, John F Collins et al. Determinants of Left Ventricular Hypertrophy and Systolic Dysfunction in Chronic Renal Failure. American Journal of Kidney Diseases 1994; November, Vol 24, No5:768-776.
23. Yashpal, CSV Subramanyam, VK Gulati and JC Chatterji. Pattern of Cardiovascular involvement in Chronic Uraemia. JAPI, Vol 28,September,1980:263-267.
24. Scott M Grundy, Ivor J Benjamin, Gregory L Burke et al. Diabetes and Cardiovascular Disease – A statement for healthcare professionals from the American Heart Association. Circulation: J of the American Heart Association march 24, 2009:1134-1143.
25. Robert N Foley, Patrick S Parfrey, John D et al. Clinical amd Echocardiographic disease inpatients starting end-stage renal disease therapy. Kidney International, Vol 47 (1995), pp186-192.
26. Gerard M London, Francoise Fabiani, Sylvain J Marchais et al. Uremic Cardiomyopathy: An inadequate left ventricular hypertrophy. Kidney International, Vol

31 (1987), pp973-980.
27. Anthony N De Maria, David G Blanchard. The Echocardiogram, Chapter 15, In: Hurst – The Heart, 11th ed. Valentin Fuster, et al. McGraw Hill Publishing Division, USA: Vol1:351-363.
28. Richard B Devereux, Nathaniel Reicheck. Echocardiographic Determination of Left Ventricular Mass in Man.Anatomical Validation of the Method. J of Am Heart Association;vol 55, No 4, April1977:613-618.
29. DS Chafekar, RM Rajani, BA Krishna, AF Almeida, VN Acharya. Left Ventricular Function in End Stage Renal Disease – Non-Invasive assessment in patients on maintenance Hemodialysis. JAPI 1994; Vol 42,No3:216-218.
30. Mark M.Mintsnefes, Thomas R.Kimball, Jains Kartal et al. Progression of Left Ventricular Hypertrophy in children with early chronic kidney disease: 2-year follow-up study. Journal of Pediatrics, Sept2007.
31. FC Luft. Cardiovascular risk in patients with end-stage renal disease. Editorial Review. Indian J Nephrology; 11:77-81.
32. SA Kale, NS Kulkarni, S Gang, AGanju, L Shah, MM Rajapurkar. Left ventricular disorders in patients of end stage renal disease entering hemodialysis programme. Indian Journal of Nephrology 2001; 11:12-16.
33. KerstinAmann, IvanRychlik,GabrielMiltenberger-Milteny,EberhardRitz. Left ventricular hypertrophy in renal failure. Kidney International, Vol 54, Suppl. 68 (1998), pp.S-78-S-85.
34. Ali Akbar Zeinaloo, Abbas Madani, Mohammad TaqiHaqiAshtiani. Cardiac Abnormalities in the Iranian Pediatric and Adolescent Population with Chronic Renal Failure. The Journal of Tehran Heart Center; 33-41.
35. Michel Dahan, Pascale Siohan, Beatrice Viron, et al. Relationship Between Left Ventricular Hypertrophy, Myocardial Contractility, and Load Conditions in Hemodialysis Patients: An Echocardiographic Study. American Journal of Kidney Diseases, Vol 30, and No 6 (December), 1997: pp780-785.
36. Luis Henrique Wolff Gowdak, Flavio Jota de Paula, Dante Marcelo Artigas Giorgi, et al. Cardiovascular Disease and Risk Factors in Candidates for Renal Transplantation. ArquivosBrasileiros de Cardiologia. Volume 84, No 2, Fevereiro2005.
37. Robert N.Foley, Patrick S.Parfrey, Gloria M.Kent, John D.Harnett, David C.Murray, and Paul E.Barre. Serial Change in Echocardiographic Parameters and Cardiac Failure in End-Stage Renal Disease. Journal of the American Society of Nephrology. 2000; 11:912-916.
38. ArunasMalikenas, VilijaCerniauskiene, MarijaJakutovic, AugustinaJankauskiene. Left ventricular geometry in children with chronic renal failure. Medicina (Kaunas) 2005; 41 Supplement1.
39. Mark M. Mitsnefes, Thomas R. Kimball, Sandra A. Witt et al. Left Ventricular Mass and Systolic Performance in Pediatric Patients with Chronic Renal Failure. Circulation 2003; 107:864-868.
40. Kai-Uwe Eckardt. Cardiovascular consequences of renal anaemia and erythropoietin therapy. Nephrology Dialysis Transplant 1999; 14:1317-1323.
41. Adeera Levin et al. Anaemia and left ventricular hypertrophy in chronic kidney disease populations: A review of the current state of knowledge. Kidney International 2002; Volume 61, Supplement 80, PageS35-S38.
42. Gerard M. London, Bruno Pannier, Alain P. Guerin, et al. Alterations of Left Ventricular Hypertrophy in and Survival of Patients Receiving Hemodialysis: Follow-up of an Interventional Study. Journal of the American Society of Nephrology 2001; 12:2759-2767.
43. BTucker,FFabbian,MGiles,RCThuraisingham,AERaine,RIBaker. Left ventricular hypertrophy and ambulatory blood pressure monitoring in chronic renal failure. Nephrology Dialysis Transplant 1997; 12: 724-728.
44. G Cannella. Left ventricular hypertrophy in the dialysedpatient.What can be done about it? Nephrology Dialysis Transplant 1996; 11:418-420.
45. SK Trivedi , OP Gupta, AP Jain, UN Jajoo, AN Kamble, MS Bharambe. Left Ventricular M-mode Echocardiographic Measurements of Indian Population. JAPI 1993, Volume 41, No1.
46. Lindsay, Robert M. Alhejaili, Fayez Nesrallah, Gihad Leitch, Rosemary Clement, Laurie Heidenheim, A Paul Kortas, Claude. Calcium and phosphate balance with quotidian hemodialysis. American Journal of Kidney Diseases. Jul 2003; 42 (1 Supplement):24-29.
47. Ifeoma I Ulasi, Ejikeme B Arodiwe, Chinwuba K Ijoma. Left Ventricular Hypertrophy in African Black Patients with Chronic Renal Failure at First Evaluation. Ethnicity and Disease, autumn 2006; Volume16.
48. K Amann, K Thyralla. Cardiovascular changes in Chronic Renal Failure – Pathogenesis and therapy. Clinical Nephrology, 2002; Volume 58-Supplement 1: S 73 - S96.
49. Afshar R, Sanavi S, Salimi J. Epidemiology of chronic renal failure in Iran: a four year single- center experience Saudi J Kidney Dis Transpl. 2007 Jun;18(2):191-4.
50 Malekmakan L, Haghpanah S, Pakfetrat M, Malekmakan A, Khajehdehi P. Causes of chronic renal failure among Iranian hemodialysis patients. Saudi J Kidney Dis Transpl 2009; 20:501-4
51. Rizvi SA, Manzoor K. Causes of Chronic Renal Failure in Pakistan: A Single Large Center Experience. Saudi J Kidney Dis Transpl [serial Online] 2002 [cited 2011 Nov3]; 13:376-9.
52. Manes MT, Gagliardi M, Misuraca G, Rossi S, Chiatto M. Left ventricular Geometric patterns and cardiac function in patients with chronic renal failure Undergoing hemodialysis. Monaldi Arch Chest Dis. 2005Mar;64(1):27-32
53. AlaattinYildiz, EsatMemisoglu, HuseyinOflaz, HalilYazici, HamdiPusuroglu, VakurAkkaya , FarukErzengin and SavasTepe. Atherosclerosis and vascular calcification are independent predictors of left ventricular hypertrophy in chronic haemodialysis patients. Nephrol Dial Transplant (2005) 20:760–767
54. Gupta Amit, Malhotra KK, Dash SC. Late pericarditis in patients on maintenance hemodialysis. J Assoc Physicians India, 34: 857-859.1986
55. zriasoulis A, Bakris GL. Chronic kidney disease as a coronary artery disease risk equivalent. CurrCardiolRep 2013;
56 Braam B, Joles JA, Danishwar AH et al. Cardiorenal syndrome—current understanding and future perspectives Nat Rev Nephrol 2014;
57 Centers for Disease Control and Prevention, Division of Diabetes Translation . National chronic kidney disease fact sheet: general information and national estimates on chronic kidney disease in the United States. 2014.