

Chronic Renal Failure And Hemodialysis; A Review And Statistics From Birendra Hospital (Chhauni)

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Introduction:

Chronic renal failure (CRF) is the clinical syndrome of the metabolic and systemic consequences of a gradual, substantial, and irreversible reduction in the excretory and homeostatic functions of the kidneys. It can be difficult to recognize because the symptoms and clinical manifestations are non-specific. However, if suspected, it is easily diagnosed by simple biochemical measurements. For the patients who suffer it, chronic renal failure is an ever-increasing burden that they carry for the rest of their lives. The illness intrude on every aspect of their life such as physical, social, vocational and emotional.

Definition:

CRF is a pathophysiologic process with multiple etiologies, resulting in the inexorable attrition of nephron number and functions and frequently leading to end-stage renal disease (ESRD). In turn, ESRD represents a clinical state or condition in which there has been an irreversible loss of endogenous renal function, of a degree sufficient to render the patient permanently dependent upon renal replacement therapy (dialysis and transplantation) in order to avoid life-threatening uremia. Uremia is the clinical and laboratory syndrome, reflecting dysfunction of all organ systems as a result of untreated acute or chronic renal failure. The severity of chronic renal failure is graded according to the fraction of kidney function remaining (TABLE-1). For accurate measurement of glomerular filtration rate (GFR) the Cockcroft-Gault formula is used:

$$\text{GFR (ml/min)} = \frac{140 - \text{age (yrs)} \times \text{weight (kg)}}{72 \times \text{plasma creatinine (mg/dl)}}$$

This grading of the severity of renal failure has limitations: as ESRD approaches there is poor correlation between the actual glomerular filtration

rate and symptoms which are caused by downstream consequences of the reduction. The decision when to start dialysis should be made after integrating knowledge of the estimated glomerular filtration rate, symptoms and recognition of complications.

S.No.	STAGE	GFR (ml/min/1.73m ²)
1.	Kidney damage with normal or increased GFR	≥90
2.	Kidney damage with mild decreased GFR	60-89
3.	Moderate decreased GFR	30-59
4.	Severe decreased GFR	15-29
5.	Kidney failure	<15

Table-1: Stages of CRF

Pathophysiology of CRF:

The pathophysiology of CRF involves initiating mechanisms specific to the underlying etiology as well as a set of progressive mechanisms that are a common consequence following long-term reduction of renal mass, irrespective of etiology. Such reduction of renal mass causes structural and functional hypertrophy of surviving nephrons. This compensatory hypertrophy is mediated by vasoactive molecules, cytokines and growth factors and is due initially to adaptive hyperfiltration, in turn mediated by increases in glomerular capillary pressure and flow. Eventually, they predispose to sclerosis of the remaining viable nephron population. Increased intrarenal activity of the rennin-angiotensin axis appears to contribute both to the initial adaptive hyperfiltration and to the subsequent maladaptive hypertrophy and sclerosis. The earliest stage common to all forms of CRF is a loss of renal reserve. When kidney function is entirely normal, glomerular filtration rate (GFR) can be augmented by 20 to 30% in response to the stimulus of a protein challenge. During the earliest stage of loss of renal reserve, basal GFR may be normal or even elevated (hyperfiltration). At this stage, the only clue may be at the level of laboratory measurements, the serum urea and creatinine concentrations. By the time serum urea and

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creatinine concentrations are even mildly elevated, substantial chronic nephron injury has already occurred.

As GFR declines to levels as low as 30% of normal, patients may remain asymptomatic with only evidence of the decline in GFR, i.e., rise in serum concentrations of urea and creatinine. However, careful scrutiny usually reveals early additional clinical and laboratory manifestations of renal insufficiency. These may include nocturia, mild anemia and loss of energy, decreasing appetite and early disturbances in nutritional status and abnormalities in calcium phosphorus metabolism (moderate RI). As GFR falls to below 30% of normal, an increasing number and severity of uremic clinical manifestations and biochemical abnormalities supervene (severe RI). When GFR falls below 5 to 10% of normal (ESRD), continued survival without Renal Replacement Therapy (RRT) becomes impossible.

Etiology

There has been a dramatic increase in the incidence of ESRD as well as a shift in the relative incidence of etiologies of CRF during the past two decades. Whereas glomerulonephritis was the leading cause of CRF in the past, diabetic and hypertensive nephropathy are now much more frequent underlying etiologies (Table-2). This may be a consequence of more effective prevention and treatment of glomerulonephritis or of diminished mortality from other causes among individuals with diabetes and hypertension. Hypertension is a particularly common cause of CRF in the elderly, in whom chronic renal ischemia due to renovascular disease may be an underrecognized additional contribution to the pathophysiologic process. Many patients present at an advanced stage of CRF, precluding definitive determination of etiology.

Major	Miscellaneous
DIABETES MELLITUS	METABOLIC
HYPERTENSION	VASCULAR
GLOMERULONEPHRITIS	HEREDITARY
CYSTIC DISEASE	VASCULITIS
ANALGESIC NEPHROPATHY	MALIGNANCY
REFLUX NEPHROPATHY/PYELONEPHRITIS	DYSPROTEINAEMIAS
	STRUCTURAL/INFECTION / INTERSTITIAL

Table-2: Causes of CRF

Clinical Presentation:

The presentation of chronic renal failure will depend on the degree of renal dysfunction at the time medical help is sought.

Asymptomatic

At one extreme are asymptomatic patients in whom an abnormal urea and creatinine is noticed on routine biochemical screen.

Associated Disease

Much renal failure is picked up in general medicine, hypertension, diabetic, cardiac and urology clinics because clinicians are aware of the effect of other diseases on renal function.

Symptomatic Presentations

Relatively few patients are diagnosed because they present with the non-specific symptoms of chronic renal failure, such as lethargy, dyspnoea and anorexia. At the extreme end of this category are the patients who present with an acute uraemic emergency requiring urgent dialysis, constituting about 5 per cent of patients entering RRT programmes. Another 25 per cent are close to ESRD when they are first seen by a nephrologist and need dialysis within 3 months of the first consultation.

Clinical complications of CRF

Fluid and electrolyte disturbances

Dermatological disturbances

- ◆ Pallor, Pruritus, Hyperpigmentation, Uremic frost, Ecchymoses
- ◆ Volume expansion and contraction
- ◆ Hyper- and hyponatremia
- ◆ Hyper- and hypokalaemia
- ◆ Hypocalcemia and hyperphosphatemia
- ◆ Metabolic acidosis

Gastrointestinal Disturbances

- ◆ Anorexia, Nausea and vomiting
- ◆ Gastroenteritis, Peptic ulcer, Hepatitis
- ◆ GI bleeding, Ascites, Peritonitis

Endocrine-Metabolic Disturbances

- ◆ Secondary hyperparathyroidism
- ◆ Vitamin D-deficient osteomalacia
- ◆ Protein-calorie malnutrition
- ◆ Infertility and sexual dysfunction
- ◆ Amyloidosis

Hematological And Immunologic Disturbances

- ◆ Anemia, Lymphocytopenia, Leukopenia
- ◆ Hyperuricemia, Bleeding diathesis, Hypocomplementemia
- ◆ Hypersplenism, Splenomegaly, Increased susceptibility to infection

Neuromuscular Disturbances

- ◆ Fatigue, Sleep disorders, Headache
- ◆ Asterixis, Peripheral neuropathy
- ◆ Restless legs syndrome, Seizures
- ◆ Coma, Muscle cramps
- ◆ Myopathy, Paralysis Myoclonus

Cardiovascular And Pulmonary Disturbances

- ◆ Arterial hypertension, Pericarditis
- ◆ Congestive heart failure or pulmonary edema
- ◆ Cardiomyopathy, Uremic lung
- ◆ Accelerated atherosclerosis
- ◆ Hypotension and Arrhythmias

Diagnostic Approach:

The most important initial step in the evaluation of a patient presenting de novo with biochemical or clinical evidence of renal failure is to distinguish CRF from acute renal failure. The demonstration of evidence of chronic metabolic bone disease and anemia and the finding of bilaterally reduced kidney size by imaging studies strongly favor a long-standing process consistent with CRF. Having established that the patient suffers from CRF, in the early stages it is often possible to establish the underlying etiology.

Establishing The Etiology:

Of special importance in establishing the etiology of CRF are history of hypertension, diabetes, systemic infectious, inflammatory or metabolic diseases, exposure to drugs and toxins and a family history of renal and urologic disease. Drugs of particular importance include analgesics, NSAIDs, gold, antimicrobials and ACE inhibitors. In evaluating the uremic syndrome, questions about

appetite, diet, nausea, vomiting, hiccoughing, shortness of breath, edema, weight change, muscle cramps, bone pain, mental acuity and activities of daily living are especially helpful.

Physical Examination:

Particular attention should be paid to blood pressure, fundoscopy, precordial examination, examination of the abdomen for bruits and palpable renal masses, extremity examination for edema and neurologic examination for the presence of asterixis, muscle weakness and neuropathy. In addition, the evaluation of prostate size in men and potential pelvic masses in women should be undertaken by appropriate physical examination.

Laboratory Investigations:

These should also focus on a search for clues to an underlying disease process and its continued activity. Therefore, if the history and physical examination warrant, immunologic tests for systemic lupus erythematosus and vasculitis might be considered. Serum and urinary protein electrophoresis should be undertaken in all patients over the age of 40 with unexplained CRF and anemia, to rule out paraproteinemia. Other tests to determine the severity and chronicity of the disease include serial measurements of serum creatinine and blood urea nitrogen, hemoglobin, calcium, phosphate and alkaline phosphatase to assess metabolic bone disease. Urine analysis may be helpful in assessing the presence of ongoing activity of the underlying inflammatory or proteinuric disease process and when indicated should be supplemented by a 24-h urine collection for quantifying protein excretion.

Imaging Studies: The most useful among these is renal sonography. The documentation of symmetric small kidneys supports the diagnosis of progressive CRF with an irreversible component of scarring (TABLE-3).

S.No.	Types of investigation	Pattern of investigation	Remarks
1.	BIOCHEMISTRY	Plasma creatinine, urea, creatinine clearance	Potassium, calcium, phosphates, bicarbonate, Parathyroid hormone, alkaline phosphatase, Lipids
2.	HAEMATOLOGY	Haemoglobin, white blood cells, Ferritin, Blood group	
3.	IMMUNOLOGY	Serum protein, immunoglobulins, Urine electrophoresis	ANA/ANCA
4.	URINE	Microscopy, culture, Urine protein excretion	
5.	VIROLOGY	HBsAg, anti-HCV, HIV	
6.	IMAGING	Ultrasound of kidneys, X-ray of Chest, Pelvis and hand	
7.	CARDIAC	ECG, Echocardiogram, Angiography	

Table-3: Investigations of patients with CRF

Treatment of CRF:

This refers to all of the preventive and therapeutic measures that precede and aim to prevent or postpone ESRD and renal replacement therapy.

Conservation Of Function And Prevention Of Progression:

A. Specific Measures:

- Urinary obstruction:** Relief of obstruction is very rewarding, allowing the patient many years of survival without the need for dialysis because natural progression seems to be relatively slower than for the parenchymal diseases. This can be done by using an indwelling bladder catheter for high-pressure bladder outflow obstruction, stenting of ureteric strictures, or even antegrade nephrostomy drainage.
- Drug-induced renal disease:** If analgesic abusers stop taking the drugs, renal function can stabilize.
- Myeloma:** Chemotherapy, which reduces the paraprotein load, improves renal function in patients with myeloma.
- Ischaemic renal disease:** Angioplasty with or without stenting of atheromatous renal artery stenosis seldom reverses renal failure, but it does seem to stabilize or slow progression.
- Urinary tract infection:** Treatment of urinary tract infection with appropriate antibiotics is effective in reducing renal destruction.

- Diabetes mellitus:** Control of blood pressure and blood sugar level halts or retards diabetic nephropathy.

B. General (Non-Specific) Measures-

- Hypertension:** Antihypertensive therapy patients with CRF aims to slow progression of nephron injury by ameliorating intraglomerular hypertension and hypertrophy. Progression of renal injury in CRF appears to be most closely related to the height of intraglomerular pressure and the extent of glomerular hypertrophy. Control of hypertension is important in slowing the progression of CRF. Furthermore, the target for pharmacologic therapy was highly dependent on the level of proteinuria. Elevated blood pressure increases proteinuria due to transmission to the glomeruli of the elevated systemic pressure. ACE inhibitors and angiotensin receptors blockers are mostly used and effective antihypertensive drugs in patients with CRF, which also possess significant antiproteinuric properties. Target blood pressure in CRF is 130/80-85mmHg, with proteinuria is 125/75mmHg.
- Dietary protein:** When patients with CRF consume excessive dietary protein, nitrogenous wastes and inorganic ions accumulate, resulting in the clinical and metabolic disturbances characteristic of uremia. Restricting dietary protein can ameliorate many of these disturbances.

uremic symptoms and may slow the rate of nephron injury. Metabolic and nutritional studies indicate that protein requirements for patients with CRF are approximately 0.6g/kg per day.

Compensation for the effects of CRF:

- 1. Water and electrolyte balance:** Only those with oliguric end-stage renal failure need to restrict their fluid intake precisely, when the usual recommendation is that the patients daily intake should be 500ml plus a volume equivalent to their daily urine output. Restriction of dietary NaCl intake to 6-8gm/day is important in the management of hypertension. Sodium balance and blood pressure will be improved by diuretics, usually by the loop diuretics. Food rich in potassium should also be restricted. If the potassium level rises above 7mmol/l, haemodialysis should be initiated.
- 2. Calcium, phosphate and vitamin-D:** Secondary hyperparathyroidism starts early in CRF, when the GFR falls below 40ml/min prevention requires countering the three key stimuli: hyperphosphataemia by diet and phosphate binders, provision of 1,25-dihydroxycholecalciferol, either as calcitriol and maintaining a normal ionized calcium level. To control phosphate, milk products and fish will be limited, phosphate binder like calcium acetate is taken three times a day with meals. A vitamin-D analogue alfacalcidol should be started in doses 0.25µg once a day.
- 3. Control of blood pressure:** A major focus of the follow up of patients with CRF is to achieve and maintain a satisfactory blood pressure. Good blood pressure control will delay progression to ESRD. Use of ACE-inhibitors or angiotensin receptors blockers as first choice as blood pressure lowering drugs has potential benefit.
- 4. Metabolic acidosis:** Acidosis is more common in patients with interstitial renal disease who have acquired renal tubular acidosis. The usual symptom is effort dyspnoea. A chronic acidosis will aggravate hyperkalemia, inhibit protein anabolism, and accelerate calcium loss from bone. Sodium bicarbonate 1.2-1.8gm thrice daily can be prescribed.

- 5. Anaemia:** Administration of recombinant human erythropoietin is the treatment of choice for anaemia in patients with CRF, both before and after initiation of haemodialysis. Treatment should be instituted if Hb level under 11gm/dl or Hct is less than 30%. The starting dose is 50u/kg per week in two divided doses, subcutaneously or intravenously. Increases in dosages may be warranted after 8-12 weeks. Iron preparations can also be used in patients with CRF having iron deficiency anaemia. This can either be a single dose of iron dextran (1gm) or intravenous iron saccharate 200mg weekly for 5 weeks. In approximately 30% of patients receiving chronic erythropoietin therapy, the severity of hypertension is increased.

Preparation For Dialysis And Transplantation:

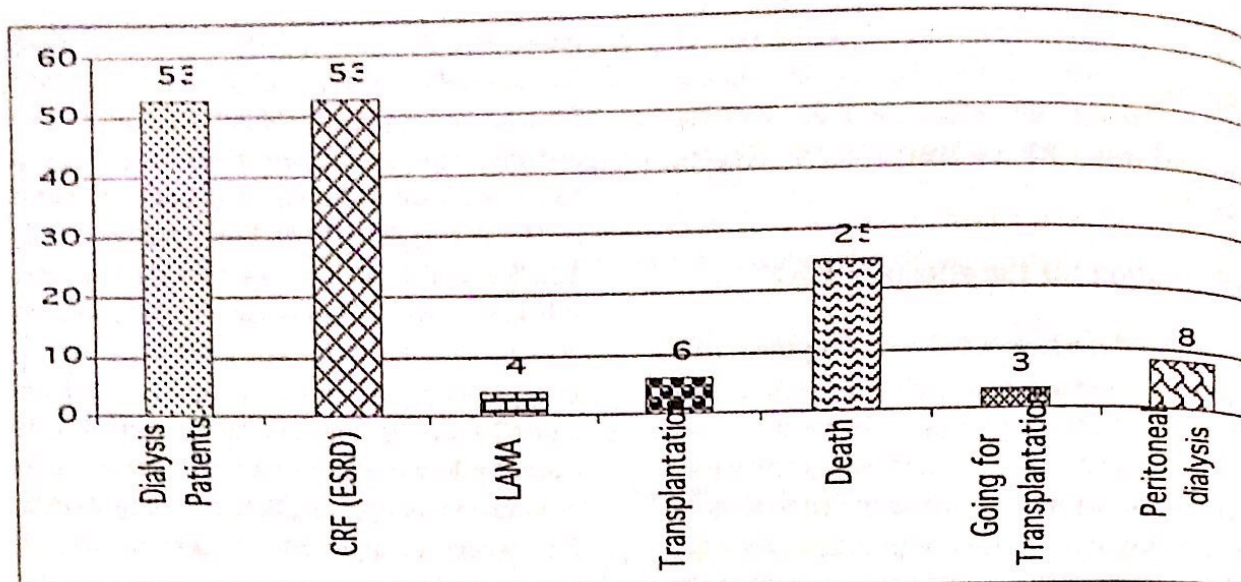
Once ESRD is inevitable, the patient must be prepared physically and psychologically for renal replacement therapy. One should avoid the temptation to delay starting dialysis for as long as possible, for the quality of life and health of a well dialysed patient is superior to that of a non-dialysed, uraemic malnourished one.

The absolute indications for dialysis are development of complications that cannot be contained by conservative and pharmacological means. These are hyperkalemia, fluid overload, severe hypertension, pericarditis, encephalopathy, neuropathy, and metabolic acidosis. Apart from potassium level and the degree of acidosis, blood tests such as urea and creatinine do not provide a safe guide to what to start. It is advisable to start dialysis at creatinine clearances of less than 10ml/min.

Birendra Hospital (Chhauni) Statistics from 2000 – 2004.

S.No.	Types	No of patients	Remarks
1.	Dialysis Patients	53	
2.	CRF (ESRD)	53	
3.	Lama	4	
4.	Transplantation	6	
5.	Death	25	
6.	Going for Transplantation	3	
7.	Peritoneal dialysis	8	

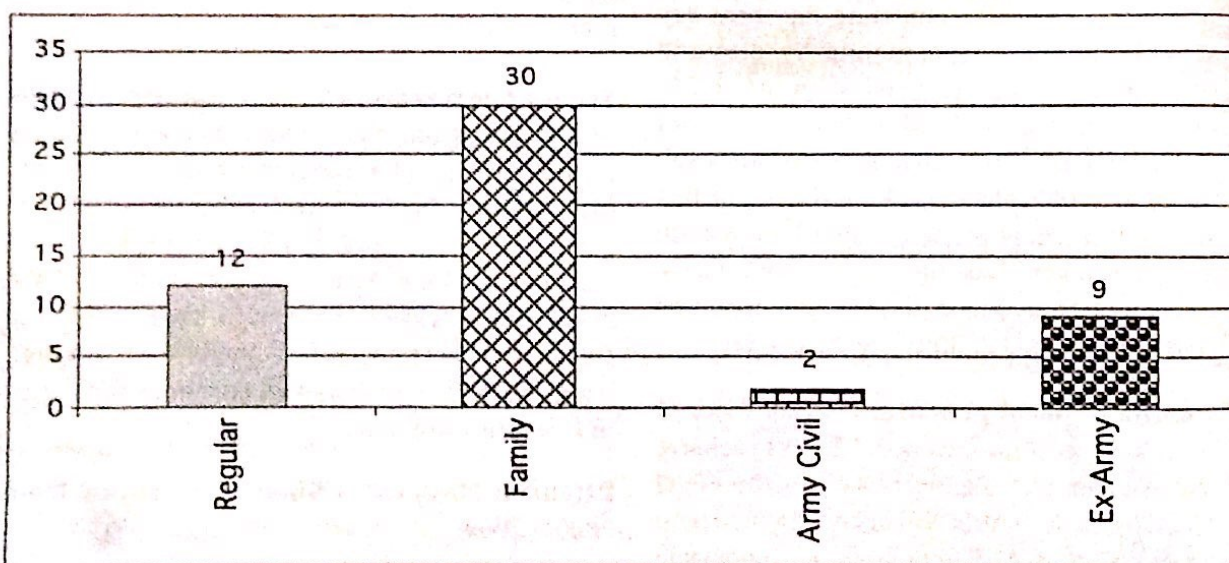
Table 4: Showing number of patients attending dialysis unit



Graph showing number of patients attending dialysis unit.

S.No.	Particular	Cases	Remarks
1.	Regular	12	
2.	Family	30	
3.	Army Civil	2	
4.	Ex-Army	9	

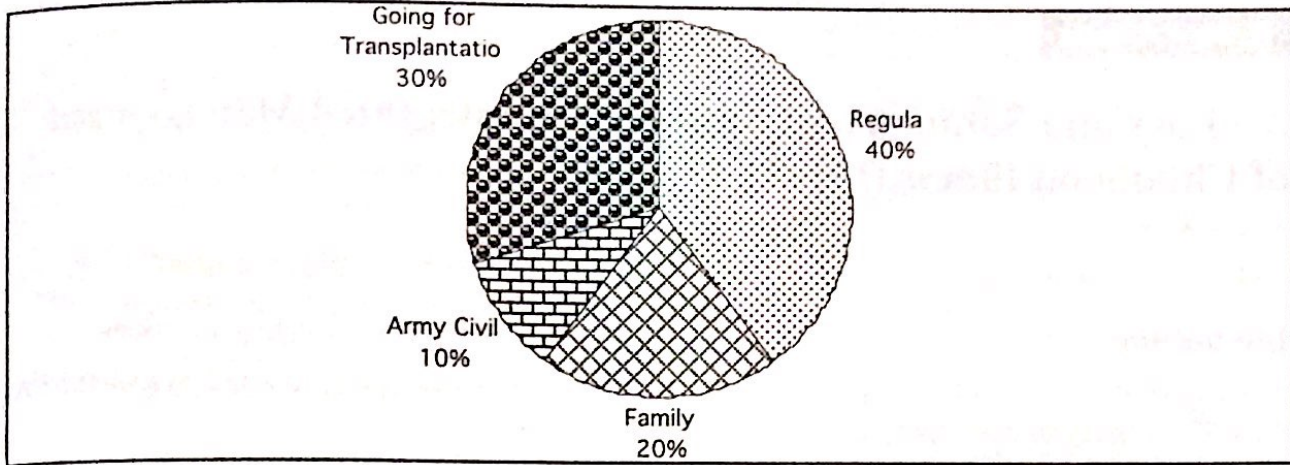
Table 5: Category of patients undergoing dialysis.



Graph showing category of patients undergoing dialysis.

S.No.	Particular	Cases	Remarks
1.	Regular	4	
2.	Family	2	
3.	Army Civil	1	
4.	Going for Transplantation	3	

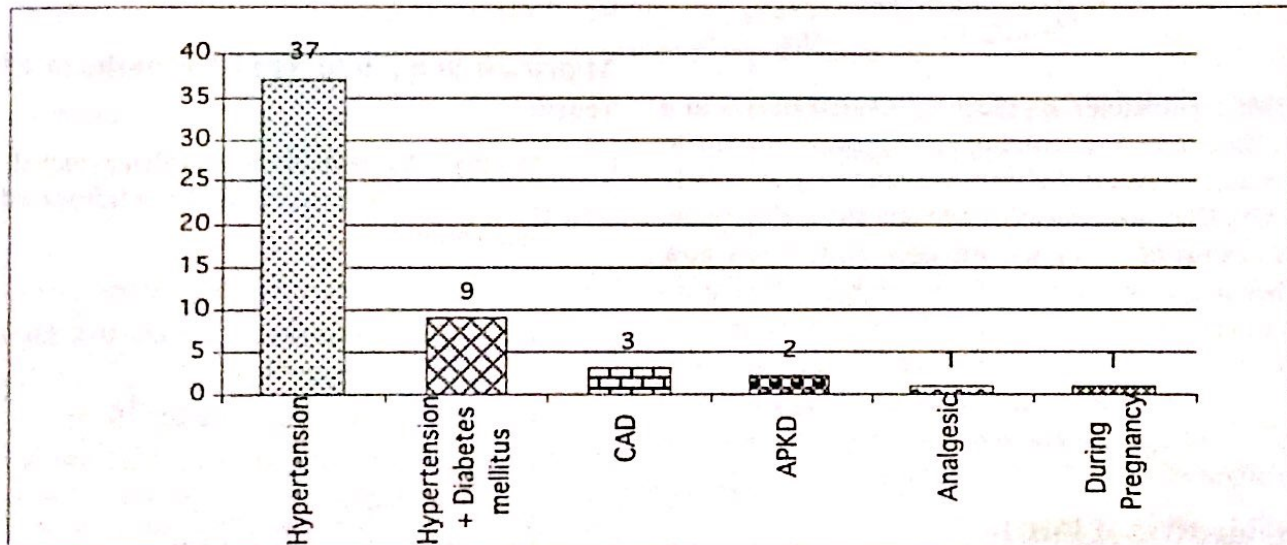
Table 6: Showing the category of patients undergone transplantations.



Pie chart showing the category of patients undergone transplantation.

S.No.	Particular	Cases	Remarks
1.	Hypertension	37	
2.	Hypertension + Diabetes mellitus	9	
3.	CAD	3	
4.	APKD	2	
5.	Analgesic	1	
6.	During Pregnancy	1	

Table 7: Showing factors leading to CRF.



Graph showing factors leading to CRF.

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