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Original Research Article

CHALLENGES IN RENAL TRANSPLANT RECIPIENTS – A RETROSPECTIVE ANALYSIS OF 107 PATIENTS

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ABSTRACT

INTRODUCTION

Renal transplantation is the most successful of all organ transplant surgeries. End stage renal disease (ESRD) is a complex disorder with multisystem involvement-each system disorder highlighting in every other patient with individualised needs.

Poor fluid handling could present as fluid accumulation in every potential space / every areolar tissue to express as effusion and edema. IgA nephropathy, diabetic and/or hypertensive nephropathy have been attributed as the common causes of ESRD. An early and profuse albuminuria presented as progressive ascites as a predominant feature. High solute load of urea caused changes in pleura and pericardium to alter their membrane permeability to pleural and pericardial effusions. Uremic toxins, platelet dysfunction and hemolysis led to anemia centering or poor erythropoietin production by the juxta glomerular apparatus of the kidney.

AIMS AND OBJECTIVES

This study aims to analyse anaemia, pulmonary hypertension, Left ventricular dysfunction and fluid accumulation by clinical and laboratory parameters and establish interrelationship between the above challenges. By conducting this study we can list out anaesthetic challenges encountered during induction of general anaesthesia. And it can be used for offering reconditions for anticipated problems.

METHODOLOGY

This is a retrospective study where 107 patients who have undergone renal transplantation since 2015. The parameters are used for this study are Hemoglobin, Edema , ascites , right ventricular systolic pressure (RVSP), ejection fraction(EF) and blood pressure.

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RESULT

Retrospective analysis of the data showed severity of anemia to proportional to pulmonary hypertension measured non-invasively by right ventricular systolic pressure.(P=0.038).

The ejection fraction and blood pressure had negative correlation that is unique to ESRD. This is well observed in our analysis.

The parameter denoting the above 3 observations namely, hemoglobin, mean arterial pressure, ejection fraction and right ventricular systolic pressure were noted along with presence of ascites and / or effusions. A rapidly accumulating ascites or pleural needs aspiration to prevent organ distortion fluid and collapse of lungs.

The right ventricle and the left work as separate compartments. Hence a high BP exists with poor ejection fractions. Such patients are highly sensitive to vasodilators and an acute fall may jeopardise renal graft perfusion.

A moderate or severe pulmonary hypertension is often associated with haemoglobin of less than 7g% as the basic pathology is endothelial dysfunction. While improvement in haemoglobin necessitates packed cell transfusion, an RVSP of more than 50mmhg may point towards a need for elective post-operative ventilation following the transplant.

CONCLUSION

Though at undergraduate level concepts of pedal edema,hypertension, low blood pressure in poor left ventricular systolic function, ideal Mean Arterial Pressure, are drilled into - there may be contrasing findings in ESRD due to endothelial dysfunction leading to increasing vascular resistance. The key to effective management lies in individualisation of every patient, proper analysis and strategy formation

KEYWORDS

Esrd, Renal Transplantation, Pulmonary Hypertension, Rvsp, Ejection Fraction, Fluid Accumulation.

INTRODUCTION

End stage renal disease often presents with multi system involvement. The patient will have oliguria or anuria with contracted kidneys, signs of uremia and problems of AV fistula and hemodialysis. As a medical college hospital catering to around 15 villages, we evolved through my stages right from motivating, counselling, preparing them for life long immunosuppression and so on. Renal replacement therapy further alters the hemodynamics challenging every stage of conduct of anaesthesia .The outcome depends on the urine output and morbidity and mortality depends on cardiopulmonary status of the recipient.

Challenges that were commonly recurring included anemia, pulmonary hypertension, left ventricular dysfunction and fluid accumulation. In this study we intend to analyse the above parameters and discuss the anaesthetic implications.

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AIMS AND OBJECTIVES

1. To analyse anaemia, pulmonary hypertension, Left ventricular dysfunction and fluid accumulation by clinical and laboratory parameters.
2. To establish interrelationship between the above challenges.
3. To list out anaesthetic challenges encountered during induction of general anaesthesia.
4. To offer reconditions for anticipated problems.

METHODOLOGY

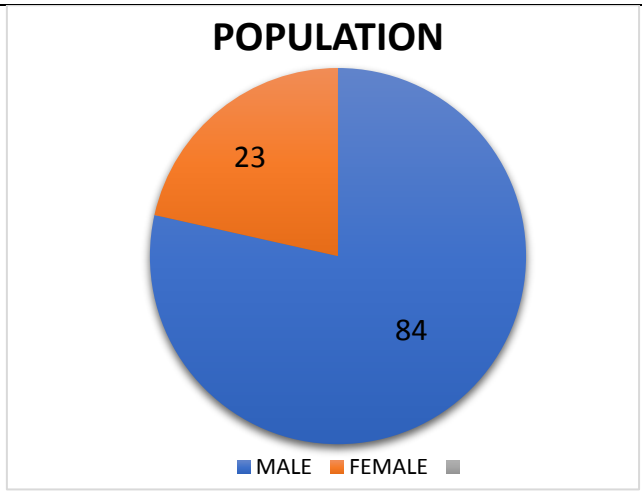
Study: Retrospective Study.

Study Population: All patients who have undergone renal transplantation since 2015.

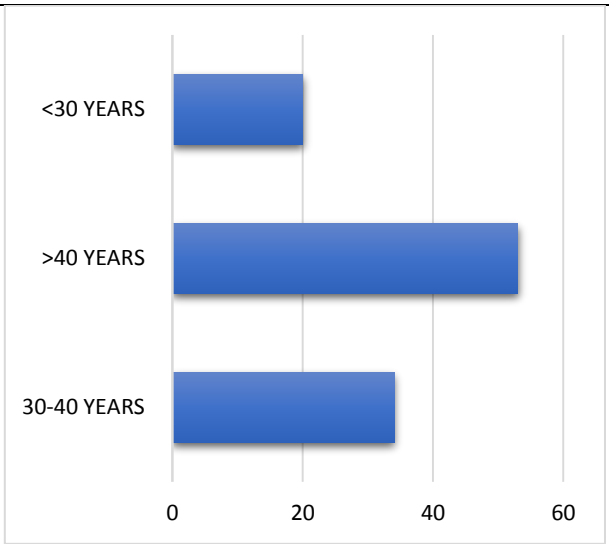
Sample Size: 107.

Parameters: Hemoglobin, Edema, ascites, right ventricular systolic pressure (RVSP), ejection fraction (EF), blood pressure.

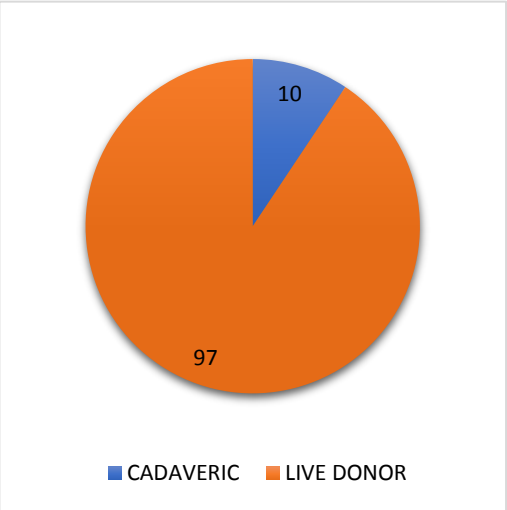
Patient Demography



Graph 1: Age Distribution



Graph 2: Age



Graph 3: Donor

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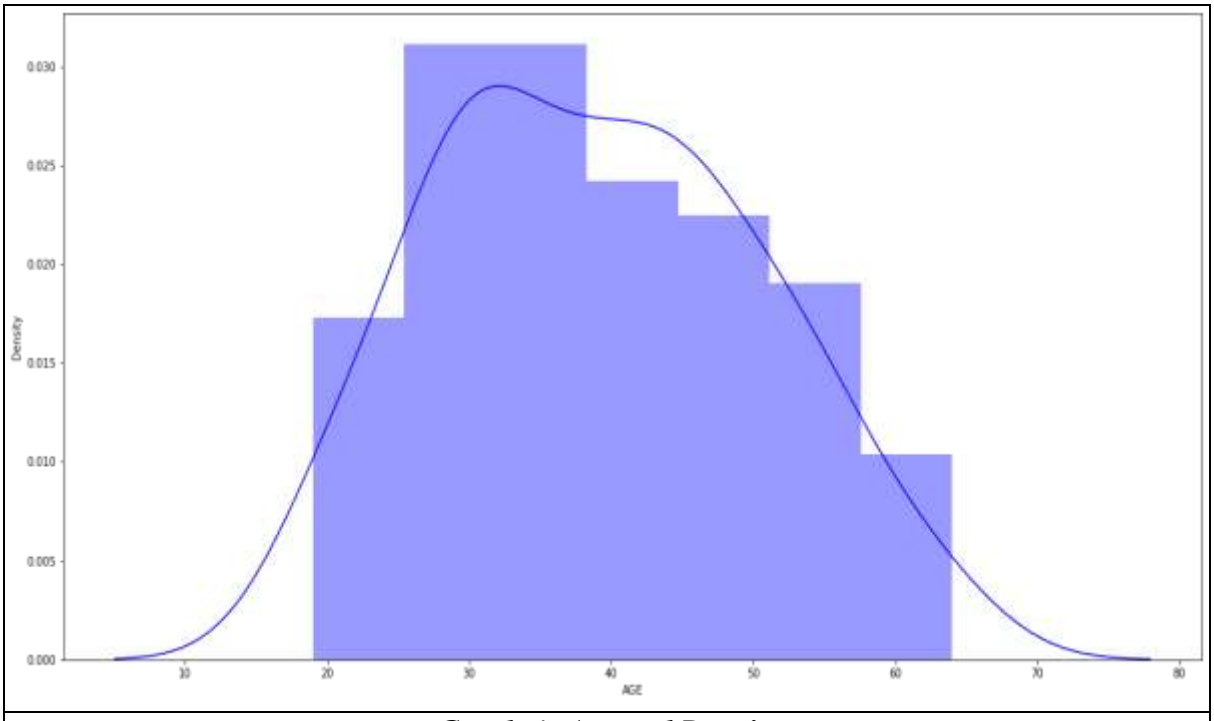
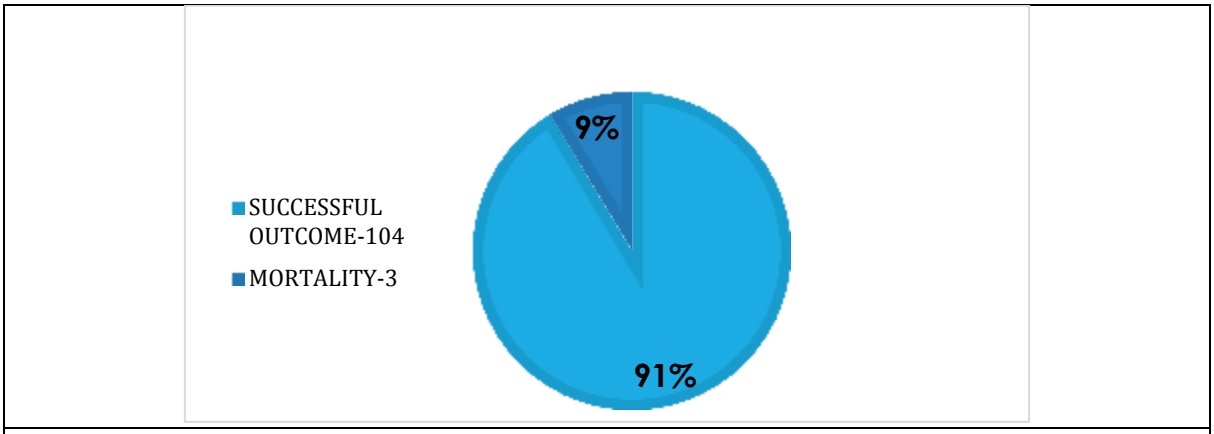


Graph 4: Age and Density



Graph 5: Outcome

OBSERVATION

Hemoglobin and Pulmonary Hypertension

- Right ventricle systolic pressure which indicates pulmonary hypertension correlates significantly with hemoglobin with p value of 0.038.
- Duration of renal disease categorically correlated with anemia (p 0.9) this parameters may have limitations as duration is subjective
- Ejection fraction which denotes LV systolic function correlated with duration of hemodialysis (p 0.5)
- 5 patients had global hypokinesia of LV along with anemia and moderate PHT
- The incidence of pulmonary hypertension is high in patients with ESRD

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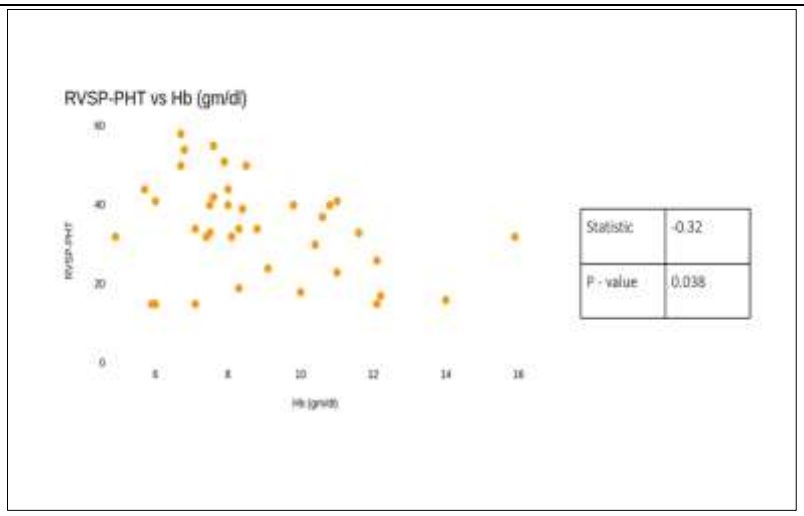
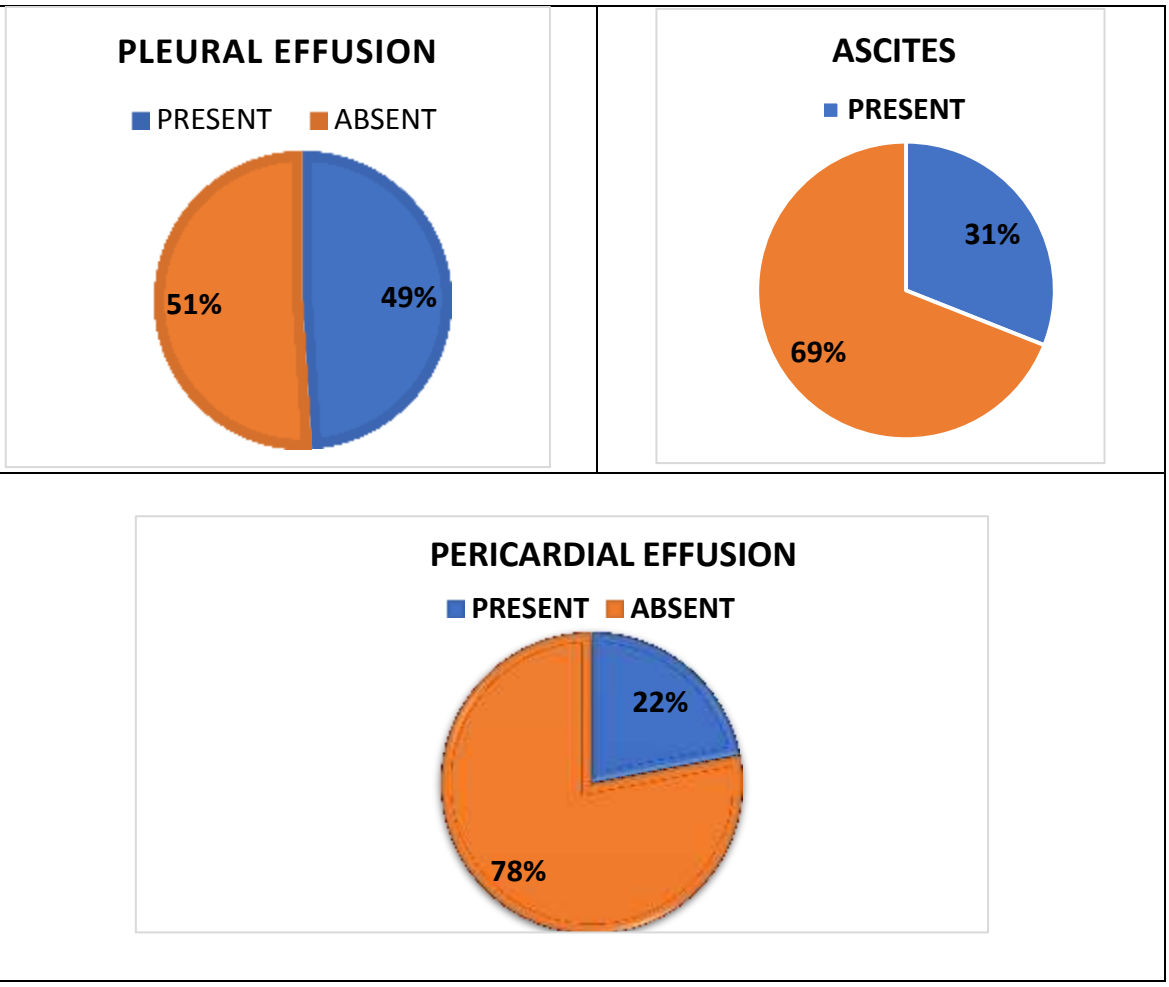
- The gold standard of pulmonary hypertension evaluation is right heart catheterization- an invasive procedure with risks
- Echocardiography provides measurement of right ventricle systolic pressure based on estimated flow through tricuspid valve



Graph 6: **Hemoglobin and Pulmonary Hypertension**

Fluid Accumulation



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Graph 7: **Fluid Accumulation**

Only 30% of patients had frank pedal edema. Ascites and pleural effusion were more common in ESRD had 36% and 50% respectively and pericardial effusion in 22%, only less than 5% needed pleural aspiration pre-op and only one had rapidly accumulating pleural effusion.

Ejection Fraction and Blood Pressure

Left ventricular systolic function denoted by ejection fraction had negative correlation with blood pressure.

A poor ejection fraction in end stage renal disease , may not present with hypotension as the poor left ventricle systolic function is often due to uremic toxins induced cardiomyopathy, pericarditis and pericardial effusion.

High blood pressure was only in 80% of cases- others had hypotension, frequency of pulmonary edema was more in patient needing more than two drugs for hypertension

In general population, a good ejection fraction indicated adequate mean arterial pressure and a low ejection fraction indicated poor mean arterial pressure, peripheral vasodilation and poor tissue perfusion.

In our study of end stage renal disease patients, ejection fraction had rather a negative correlation with systolic blood pressure, diastolicblood pressure and mean arterial pressure with a statisfically significant p value of an average of 0.2.

A poor ejection fraction in end stage renal disease thus may not present with hypotension as the poor left ventricle systolic function is often due to uremic toxins induced cardiomyopathy, pericarditis and pericardial effusion.

Though left ventricular hypertrophy was said to set in early in renal failure, it was not detected in Echocardiogram significantly and left ventricle diastolic dysfunction and hypokinesia were noted in 12 out of 50 patients.

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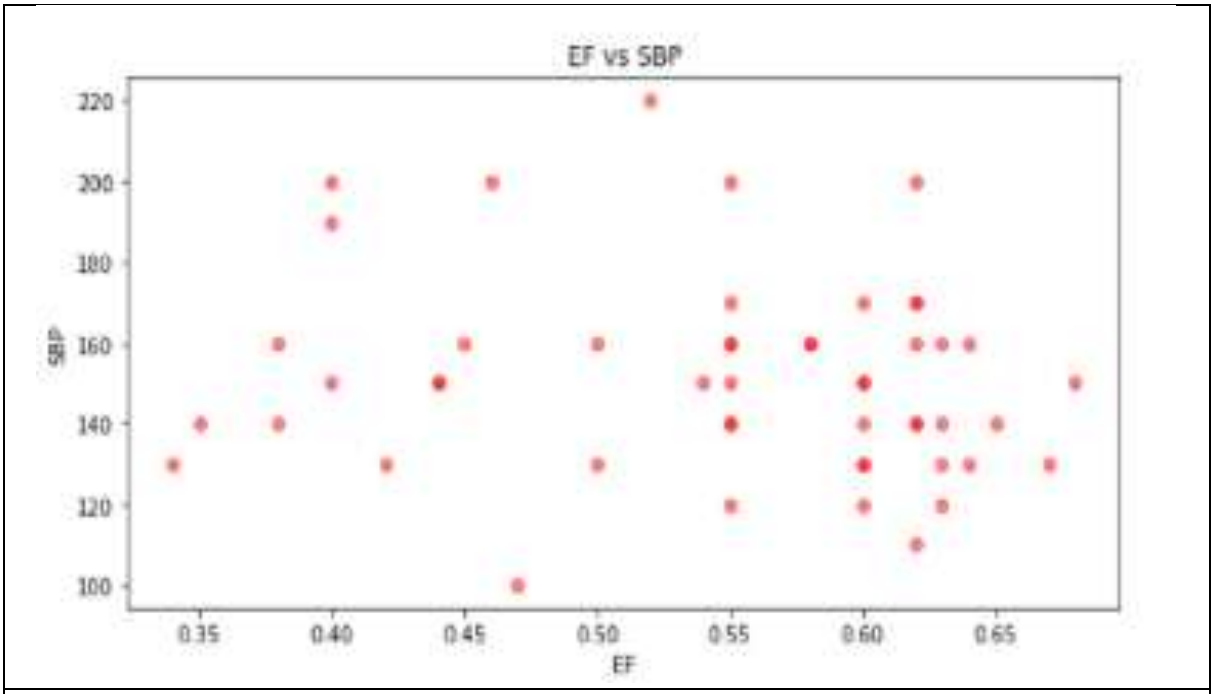

Graph 8: **Ejection Fraction and Blood Pressure**

Intraoperative Period

In intraoperative period , some patients exhibited seizure and increases pulmonary edema right before the surgery, upon induction .

Fluid allowance was maintained according to the individuals and after revascularization fluid challenge with the guidance of central venous pressure , elevating 2cms of water from the initial pressure was given

When patient had high RVSP >40 , elective extubation was performed.

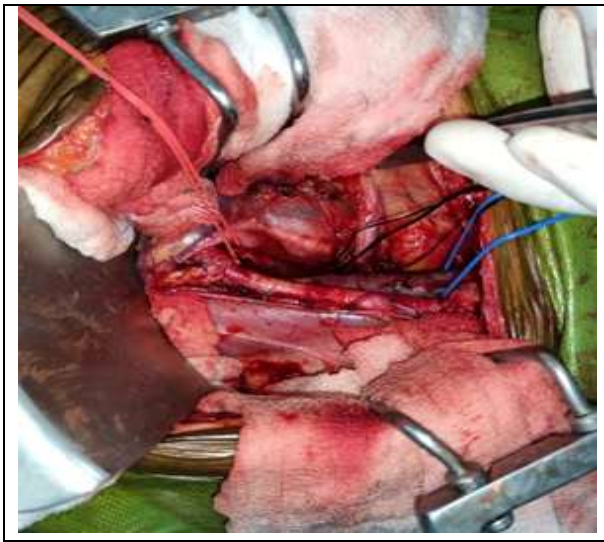

Image 1: Intra Operative Picture Showing Iliac Vessels

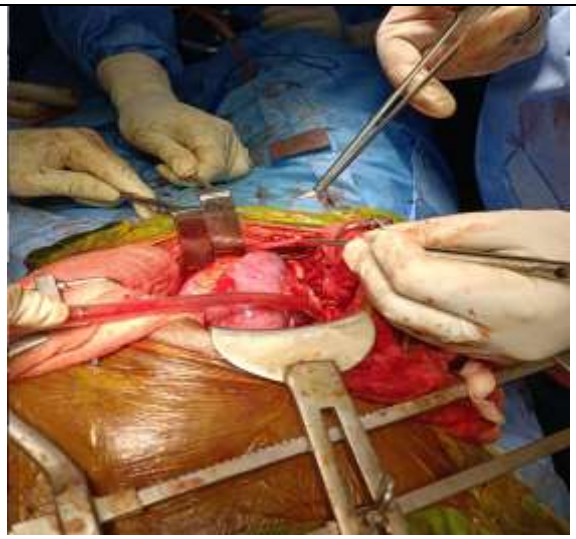

Image 2: Intra Operative Picture Showing Grafted Kidney

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DISCUSSION

CKD is divided into five stages based on the estimated GFR. It is classified as stage 1 or stage 2, there must be an accompanying structural or functional defect (e.g., proteinuria, hematuria) because the GFR is normal or near normal in these stages. Patients are usually asymptomatic until significant renal function is lost (late stage 4 and stage 5).

These patients have complications including hypertension, anemia, and mineral bone disorders (renal osteodystrophy and secondary hyperparathyroidism) often develop during stage 3 and thus must be investigated and addressed before patients become symptomatic.[1]

The decline in GFR may be followed by plotting the reciprocal of creatinine versus time, revealing a linear decrement. This can be useful in end-stage planning and in predicting when renal replacement therapy will be needed. Dialysis should be started before the worsening of the patient's metabolic or nutritional status.

The prevalence of end-stage renal disease (ESRD) in the developing and developed nations is very high. There are dramatic increases in ESRD cases from previous decades. Now , hemodialysis, peritoneal dialysis, and kidney transplantation are the only managements for ESRD. In Comparisons with the patients on dialysis who are waiting for the renal transplantation and with the patients who are transplanted prior to dialysis have better outcome and being a main stay of treatment for end stage renal disease which have more advantages that includes better survival of the patients, reduced costing in dialysis and better quality if life . Live kidney donation is the best effective therapy, with average graft survival of approximately 12 to 15 years, with longer survival for well-matched sibling transplants. The donors having many morbidity which needs to be optimized for a better outcome of the graft survival.Most common problem being edematous patients with generalized or local edema ,electrolyte imbalance or acid base disorders,malignant hypertension and so on.[2]

Renal transplantation offers patients an improved quality of life and survival as compared to other renal replacement modalities. Pretransplant evaluation focuses on cardiopulmonary status, vascular sufficiency, and human lymphocyte antigen typing. Structural abnormalities of the urinary tract need to be addressed. Contraindications include most malignancies, active infection, or significant cardiopulmonary disease. In adult recipients, the renal allograft is placed in the extraperitoneal space, in the anterior lower abdomen. Vascular anastomosis is typically to the iliac vessels, whereas the ureter is attached to the bladder through a muscular tunnel to approximate sphincter function. Immunosuppression protocols vary among institutions. A typical regimen would include prednisone along with a combination of a calcineurin inhibitor (cyclosporine or tacrolimus) and an antimetabolite (mycophenolate derivative, azathioprine, or rapamycin). Evaluation of allograft dysfunction frequently requires kidney biopsy. Current laboratory and radiologic tests cannot reliably distinguish acute rejection from drug toxicity, the two most common causes of a rising creatinine in the transplant population. Post-transplant lymphoproliferative disease, interstitial nephritis, and infections such as cytomegalovirus, Polyomavirus (BK virus), and pyelonephritis may present similarly to acute allograft dysfunction and should be excluded.

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Fluid Accumulation and Poor Handling

- Two third of the total body fluids is in the intracellular fluids ICF and one third is the extracellular fluids ECF.
- Water makes up approximately 60% of total body weight in the average adult. Adipose tissue contains little water compared with other tissues, leading to marked variability in total body water (TBW) proportion between lean (75%) and obese (45%) individuals.
- The patient with generalized edema has an excess of ECF. The ECF is further divivded into two portions, in the vascular compartment as the plasma and outside the vascular compartment which is called as the interstitial fluid.
- In the vascular compartment, approximately 85% of the fluid resides on the venous side of the circulation and 15% on the arterial side . An excess of interstitial fluid constitutes edema. On applying digital pressure, the interstitial fluid can generally be moved from the area of pressure, leaving an indentation; this is described as pitting edema. If it's a non pitting edema , then interstitial fluid cannot move freely which can be due to lymphatic obstruction and chronic venous stasis.
- Generalized edema always due to excess of ECF that is mainly the interstitial space where as the intravascular compartment being an independent volume might be decreased or normal or increased.[3]
- In Starling's law states that the rate of fluid movement across a capillary wall is proportional to the hydraulic permeability of the capillary, the transcapillary hydrostatic pressure difference, and the transcapillary oncotic pressure difference.
- the fluid leaving the capillary at the arterial end due to the transcapillary hydrostatic pressure difference which increases than the transcapillary oncotic pressure difference and In contrast, fluid returns to the capillary at the venous end because the transcapillary oncotic pressure exceeds the hydrostatic pressure difference.
- Here the oncotic pressure plays a major role which is contributed by thr serum albumin , which acts to maintain fluid in the capillary.
- Hypoalbuminemia[4] can lead to excess transudation of fluid from the vascular to interstitial compartment. Hypoalbuminemia being then major cause of generalised edema and also the lymphatic flow into the jugular veins, which returns transudated fluid to the circulation, increases.There are other causes contributing to the edema in a ESRD patients.
- In end stage renal disease , Periperal edema is caused due to the fluid shift due to hyperosmolarity, In Pleural and pericardial effusion there is an altered membrane potential due to uremia, in case of Ascites - reduced oncotic pressure therefore hypoalbuminemia, Anemia is due to hemodilution , Hemodialysis causes rapid fluid shifts.[5]

Anemia in ESRD

The mechanisms of anemia in ESRD is due to multiple reasons. Low endogenous erythropoietin levels plays a important role for the cause of anemia.[6]

Other factors contributing to the anemia in CKD patients, are an absolute iron deficiency due to blood losses or an impaired iron absorption, an ineffective use of iron stores

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due to increased hepcidin levels, systemic inflammation due to CKD and associated comorbidities, a reduced bone marrow response to EPO due to uremic toxins, a reduced red cell life span, or vitamin B12 or folic acid deficiencies.[7]

Pulmonary Hypertension and ESRD

Pulmonary hypertension is defined as mean pulmonary artery pressure (mPAP) of at least 25 mm Hg at rest.[8] PAH is a progressive condition characterised by endothelial dysfunction and remodelling of pulmonary vascular medial and intimal layers which results in constrictive and occlusive vascular lesions respectively. To fulfil the diagnostic criteria for PAH, the pulmonary capillary wedge pressure (PCWP) should be <15 mm Hg with pulmonary vascular resistance >3 WU.[9]

Pulmonary hypertension (PH) is highly prevalent in end-stage renal disease. Its prevalence in ESRD of 30-60% and an association with increased mortality and poorer outcome following renal transplantation. The pathogenesis of pulmonary hypertension remains unclear. Associations might include arteriovenous fistulae, cardiac dysfunction, fluid overload, bone mineral disorder and anemia. The uremic toxins which causes ‘uraemic vasculopathy' on the pulmonary vasculature plays a major role in pulmonary hypertension. Given the similarities between vascular changes in uraemia and those seen in pulmonary arterial hypertension, it is possible that a pulmonary vasculopathy may be present in a proportion of patients.[10]

Adaptation of Cardiovascular System in ESRD

- In end stage renal disease there is an Increased in vascular resistance and increased circulating fluid volume which leads to the right atrial dilatation which in turn causes Tricuspid Regurgitation.[11]
- Right ventricular overload increases RVSP (right ventricular systolic pressure) which increasesv the Pulmonary Artery Hypertension leading to increased Pulmonary Interstitial Pressure and Pulmonary Venous Hypertension.
- This leads to left atrial Dilatation and Left ventricular diastolic dysfunction.
- -Increased LV Preloaded and Afterload-->MR Features-->LV Systolic Dysfunction ->Poor EF-->Pulmonary edema and CCF[12] leads to Fluid accumulation and poor handling.

CONCLUSION

Though at undergraduate level concepts of pedal edema,hypertension, low blood pressure in poor left ventricular systolic function, ideal Mean Arterial Pressure, are drilled into - there may be contrasing findings in ESRD due to endothelial dysfunction leading to increasing vascular resistance.

Meticulous evaluation and clinical correlation with echocardiographic findings to choose anaesthetic drugs and timing of ionotropic support along with fluid handling before developing an idea on left ventricular function depending solely on ejection fraction

- Early proteinuria presents with ascites.

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- Early pulmonary congestion presents as plueral effusion.
- Severity of anemia is proportionate to pulmonary hypertension.
- Pre-operative packed cells transfusion could help in successful outcome without fear of immunomodulation.
- Poor ejection fraction may also have severe hypertension.
- Dilated cardiomyopathy delays drug response

The key to effective management lies in individualisation of every patient, proper analysis and strategy formation.

REFERENCE

[1] Foster C Washington University (Saint Louis Mo). Department of Medicine. The Washington Manual of Medical Therapeutics. 33rd edn. Wolters Kluwer/Lippincott Williams & Wilkins 2010.

[2] Schrier, Robert W. Manual of nephrology. 8th edn. Lippincott Williams & Wilkins (LWW).2014.978-1-45-119295-7

[3] Abdalla MS, Saad E, Abdalla M, Musa TI, Mohamed K. Nephrogenic ascites: an unusual culprit of refractory ascites in a hemodialysis patient-a case report and review of literature. Cureus 2022;14(10):e30876.

[4] Cinque, Teresa and Joseph M. Letteri. Idiopathic ascites in chronic renal failure. New York State Journal of Medicine 1973;73(6):781-4.

[5] Markov, Marko et al. Ascites and Kidney Transplantation: Case Report and Critical Appraisal of the Literature. Digestive Diseases and Sciences 2007;52():3383-8.

[6] Portolés J, Martín L, Broseta JJ, Cases A. Anemia in chronic kidney disease: from pathophysiology and current treatments, to future agents. Front Med (Lausanne) 2021;8:642296.

[7] Stauffer ME, Fan T. Prevalence of anemia in chronic kidney disease in the United States. PLoS One 2014;9:2–5.

[8] Hoeper MM, Bogaard HJ, Condliffe R, Frantz R, Khanna D, Kurzyna M, et al. Definitions and diagnosis of pulmonary hypertension. J Am Coll Cardiol 2013;62:D42-50.

[9] Simonneau G, Robbins IM, Beghetti M, Channick RN, Delcroix M, Denton CP, et al. Updated clinical classification of pulmonary hypertension. J Am Coll Cardiol 2009;54:S43-54.

[10] Kawar B, Ellam T, Jackson C, Kiely DG. Pulmonary Hypertension in Renal Disease: Epidemiology, Potential Mechanisms and Implications. Am J Nephrol 2013;37(3):281-90.

[11] London GM. Left ventricular alterations and end-stage renal disease. Nephrol Dial Transplant 2002;17 Suppl 1:29-36.

[12] Vito M. Campese, Left ventricular function and chronic kidney disease: how soon does it start? Nephrology Dialysis Transplantation 2014;29(11):1989-91.