

## Study Of Complications During Hemodialysis : An Observational Study

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### Abstract

**Introduction** - The requirement of dialysis therapy worldwide and in India has been increasing continuously. Despite the technological advances and better understanding of physiology associated with hemodialysis (HD), a number of complications are known to be associated with hemodialysis. Patients on HD develop many complications during the session of HD, post-HD session, and have long-term complications. Therefore this study is designed to study complications that occur during HD.

**Method**- This is a prospective study. Patients diagnosed with acute kidney injury or chronic kidney disease, admitted in the department of medicine, Netaji Subhash Chandra Bose Medical College were taken. The study was conducted between September 2009 and October 2010. After informed consent was taken cases were evaluated on the basis of history, examination and investigations. Total number of HD sessions were 100.

**Result**- Out of 100 HD sessions 70 were of AKI and 30 were of CKD. Most common complication seen during hemodialysis was hypotension seen in 23% mostly in first hour of HD. Nausea vomiting second most common complication in 19% and muscle cramps third most common in 12%. Hypertension seen in 5% cases and mostly precipitated during first hour of HD. Cardiac arrhythmias seen in 5% cases mostly ventricular ectopics. Vascular access complications seen in 3%. Intradialysis hemolysis seen in 1% and dialyzer reaction seen in 1%.

**Conclusion**- HD is live saving procedure for renal patients. In our study very few complications seen during HD (not significant). Most common complication was hypotension. Nausea- vomiting was second and muscle cramps were third complication.

**Keywords:** HD, complication, hypotension, nausea-vomiting, muscle cramps

### Introduction

Failure of renal functions results ultimately in alterations of the "milieu interieur" that affect every organ system in the body. Depending upon the course, severity and cause, the renal failure could be classified into two types; acute renal failure / acute kidney injury (AKI) and chronic renal failure / chronic kidney disease (CKD). AKI is characterized by the sudden impairment of kidney function resulting in retention of nitrogenous and other waste products normally cleared by the kidneys.[1] The

kidney has capacity to repair itself even after severe dialysis dependent AKI. However, many patients fail to recover and remain dialysis dependent and progress to CKD. In AKI dialysis is indicated when medical management fails to control volume overload, hyperkalemia, or acidosis; in some toxin ingestions; and when there are severe complications of uremia – (asterixis, pericardial rub or effusion, encephalopathy, uremic bleeding).[1] CKD encompasses a spectrum of different pathophysiologic processes associated with abnormal

kidney function and a progressive decline in glomerular filtration rate (GFR). Earlier, CKD was staged only on the basis of GFR into 5 stages. Currently albuminuria is also incorporated in the classification, as the worsening of kidney function is closely linked to the amount of albuminuria. Clear indication for initiation of dialysis for patients with CKD include uremic pericarditis, encephalopathy, intractable muscle cramping, anorexia, and nausea not attributed to reversible causes such as peptic ulcer disease, evidence of malnutrition, and fluid and electrolyte imbalances, principally hyperkalemia or ECFV overload, that are refractory to other measures.[1]

The process of removal of waste and extra water from blood is called dialysis.[18] It is an artificial replacement of kidney functioning, especially in renal failure cases. Dialysis cannot completely perform lost kidney function, but, to some extent, manages its activities by means of diffusion and ultrafiltration.[19] The number of individuals dependent on dialysis therapy worldwide continues to increase year by year. Majority of them being treated by hemodialysis and only 7-8% of patients are on peritoneal dialysis. Patients of renal failure are managed by dialysis therapy or renal transplantation. The available modes of renal replacement therapy is peritoneal dialysis (PD) or hemodialysis (HD). The mode of renal replacement therapy depends upon availability of technology and skilled medical staff. In developed countries, preferred modality is HD while PD is rarely performed. In developing countries where there is a lack of HD machines PD has gained much popularity. In PD a catheter is inserted through the abdomen into the peritoneal cavity and dialysate solution is being introduced and allowed to remain in the peritoneal cavity and then removed at regular intervals. The peritoneal membrane acts as a semipermeable membrane. The solutes are removed by the process of diffusion and convection and the ultrafiltration of water occurs by presence of osmotic gradient achieved by high concentration of dextrose in the dialysate solution. The major complications of PD are peritonitis, catheter associated nonperitonitis infections, weight gain, and other metabolic disturbances, and residual uremia especially in patients with no residual kidney function.[1] Hemodialysis can be intermittent and continuous and can be done through convective

clearance, diffusive clearance or a combination of the two.[1] The prerequisite for HD is to make a secure and reliable vascular access. temporary access can be made by inserting a double lumen catheter through the femoral vein, internal jugular vein, or subclavian vein. Permanent vascular access can be made by making arteriovenous fistula or vascular graft or prosthetic graft. Hemodialysis is typically performed 3-4 hours per day, three to four times per week, and is the most common mode of renal replacement therapy.[1]

The number of deaths attributable to CKD in India rose from 0.59 million in 1990 to 1.18 million in 2016.[20] In India majority of patients cannot afford transplantation therapy. Hemodialysis (HD) is the preferred method of treatment for Indian patients with AKI and CKD. A 2018 estimate put the number of patients on chronic dialysis in India at about 175,000, giving a prevalence of 129 per million population.[5] The first HD was performed at Christian Medical College (Vellore, Tamil Nadu) in 1961 on an erstwhile Maharaja under the supervision of Dr. Satoru Nakamoto, who had flown in from Seattle, Washington.[22] Until 1970, only patients with AKI were dialyzed at the four centers across the country, and maintenance HD was available at six centers in India in 1978.[22] Growth in the following years was slow, with HD being restricted to a few public and private hospitals in large cities until the 1990s. The number and distribution of HD units has increased over the last 20 years, and dialysis is now available in all 28 states and eight union territories.[21]

Despite the technological advances and better understanding of physiology associated with hemodialysis, a number of complications are known to be associated with hemodialysis. Patients on HD develop many complications during the session of HD (Intradialytic), post-HD session, and have long-term complications.[3,4] The most common intradialytic complications of HD are, hypotension, vomiting, epigastric pain, hypoglycaemia, chest pain, tachycardia, muscle cramps, cardiac arrest, shivering, hotness, epistaxis, melena, hallucination, restlessness leg, allergic reaction and jaw lock.[2] There are very few study conducted to assess complications that occur during HD session in India. Therefore, this study was done to assess the common

complications occurring during HD in patients of CKD and AKI.

**Material And Method**

This is a prospective study. For this study, patients diagnosed with AKI (acute kidney injury) or CKD (chronic kidney disease), admitted in the department of medicine, Netaji Subhash Chandra Bose Medical College, Jabalpur, MP, were taken. The ethical committee approval for the study was obtained from the institutional ethical committee. The study was conducted between September 2009 and October 2010 and after informed consent being done cases were evaluated on the basis of history, examination and investigations. Total number of HD sessions were 100.

**Inclusion criteria:**

Diagnosed cases of AKI and CKD of all age group and both sexes.

**Exclusion criteria:**

1. Alcohol induced acidosis.
2. Drug overdose and toxins
3. Isopropyl induced toxicity
4. Removal of poison from blood
5. Tumor lysis syndrome

**Procedure:**

Patients were dialyzed for minimum period of four hours. Any complication occurring during dialysis was noted and treated. After completion of dialysis blood pressure, pulse, temperature, weight recorded and detailed examination done. Blood sample taken for blood urea, serum creatinine, sodium, potassium, calcium and haemoglobin.

Dialysis which was used had the concentration as shown below:

Each 100 ml contains :

- |                          |            |
|--------------------------|------------|
| 1. Sodium chloride I.P.  | 20.475 gms |
| 2. Sodium acetate N.F.   | 19.054 gms |
| 3. Calcium chloride I.P. | 0.972 gms  |
| 4. Magnesium chloride    | 0.972 gms  |
| 5. Potassium chloride    | 0.534 gms  |
| 6. Purified water        |            |

Temporary vascular access to the bloodstream obtained with double lumen catheter which is inserted into a femoral vein and introduced at bedside. Before connecting the patients to artificial kidney dialyser is washed and primed with normal saline to remove any remaining sterilizing substances. Then patient's arterial line is connected with the arterial line of artificial kidney and the blood pump is started at the lowest speed so that artificial kidney is gradually primed with patient's blood. During this procedure patient's pulse and blood pressure is constantly monitored. Once the dialyser is completely primed with patient's blood the venous end of artificial kidney is connected to venous line of patient and blood is returned back to the patient's circulation. During connecting the venous end of the artificial kidney to the patient precaution is taken to avoid air embolism. Once the patient BP is stabilized, gradually the speed of blood pump increased upto 150-200 ml/min. After half an hour HD negative pressure of 50-85 mm of Hg is applied to facilitate the ultrafiltration. An initial dose of 5000 iu of heparin is given at the beginning of HD to prevent clotting of blood in artificial kidney and tubings subsequently additional doses of heparin are given two hourly depending upon clotting time of patients or by infusion (10-15 IU/kg BW/ hr) continuously during HD.

Patients are dialysed for a minimum period of 4 hours. During dialysis patients observed for blood pressure, pulse, rigors, muscle cramps, headache, chest pain, fever, vomiting, convulsion and bleeding. Any complication occurring during dialysis is noted and treated immediately.

**Statistical Analysis :**

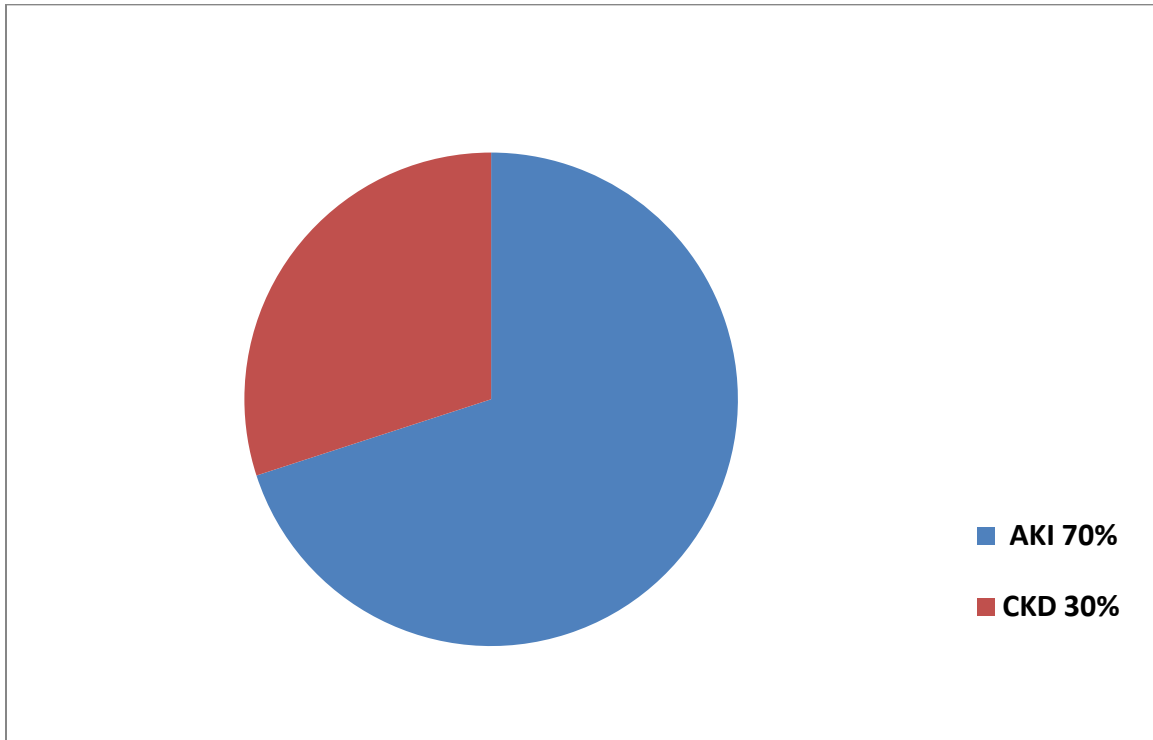
Data were collected and arranged at Excel sheet of Microsoft Excel program. and analysed using SPSS software. ANOVA test was used to assess statistical significance.

**Observation And Result:** This study is a prospective study included a sum total of 100 hemodialysis session in 44 patients. 70 % HD were of AKI and 30 % HD were of CKD, male constituting 65 % and female constituting 35 %. Most common age group presenting with renal failure due to various etiologies who undergone HD was between 30 - 45 yrs. Majority of cases observed in age range of 20 - 45 yrs in those HD was done. ( N = 44, 77.3 %). Most

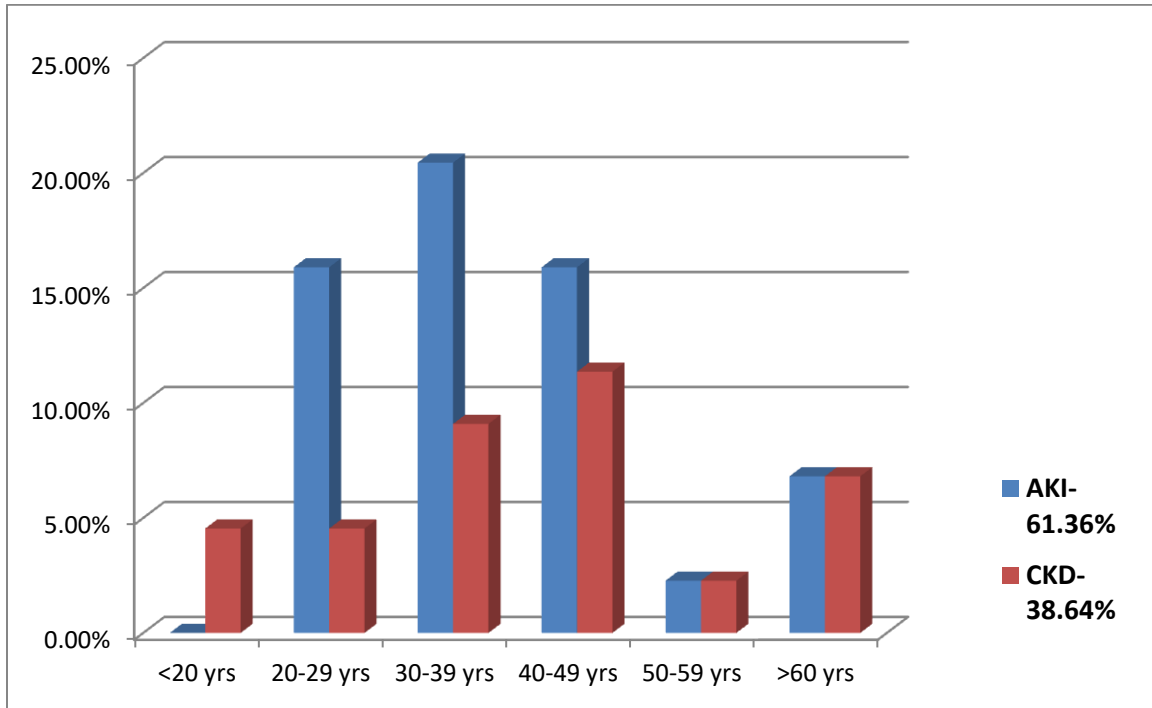
common complication seen during hemodialysis was hypotension seen in 23 % mostly in first hour of HD. Nausea and vomiting second most common 19 % seen within first hour HD and muscle cramps third most common 12 %. Hypertension was seen in 5 % cases and mostly precipitated during first hour of HD .

Cardiac arrhythmias seen in 5% cases mostly ventricular ectopics . vascular access complications were seen in 3%. Intradialysis hemolysis seen in 1% and dialyzer reaction seen in 1%. There were no cases of intra dialysis seizure ,DDS(dialysis disequilibrium syndrome) , technical faults or death .

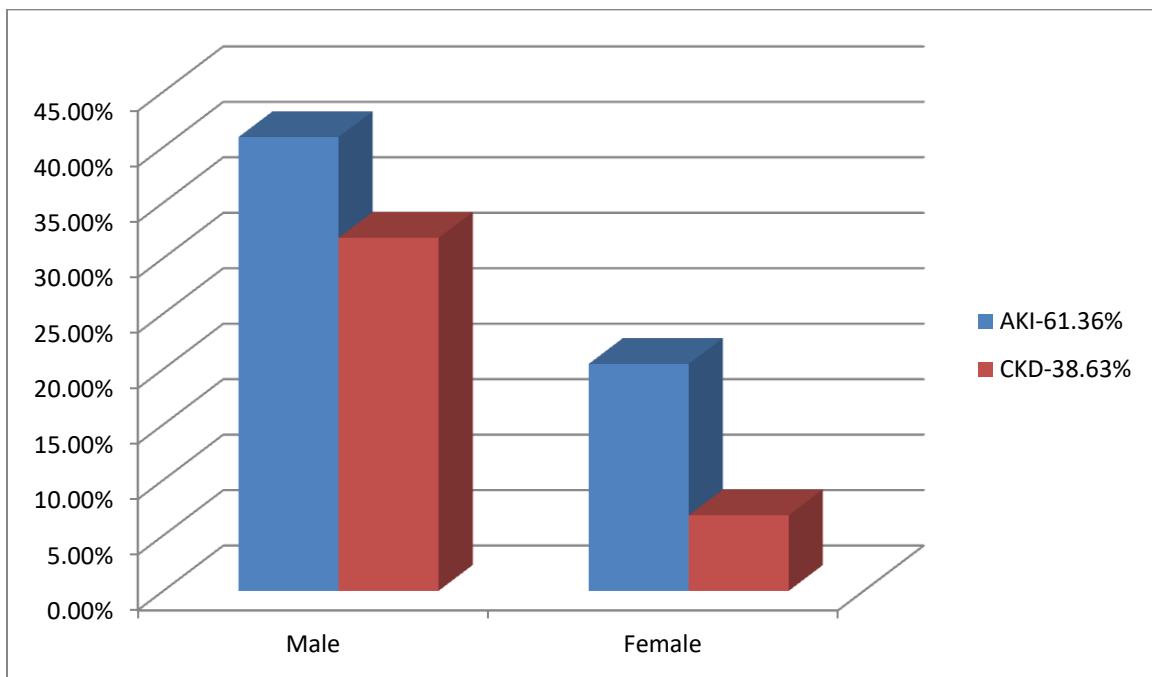
**Diagram:1 Distribution of HD sessions according to type of kidney diseases**



**Diagram:2** Distribution of cases according to their age and types of diagnosis n = 44



**Diagram:3** Distribution of cases according to gender and type of diagnosis n = 44



**Table No.1** Cross tabulation in between no. of HD sessions and no. of patients

No. of HD	No. of AKI pts	No. of CKD pts	Total
1	6	9	15

2	7	3	10
3	7	5	12
4	6	0	1
5	1	0	1
Total	27	17	44

Table no.1 showing no. of hemodialysis sessions done in AKI or CKD pts.

**Table No.2 Presence of Complications during hemodialysis in AKI and CKD patients**

COMPLICATIONS	AKI (n=70)	CKD (n=30)	TOTAL
PRESENT	28 40.0 %	13 43.3 %	41 41 %
ABSENT	42 60.0 %	17 56.7 %	59 59 %
TOTAL	70	30	100

Table 2 showed that complications present in 41 % of cases during HD but it was not significant ( $\chi^2 = 0.10$ ;  $P > 0.05$ ). Complications seen 43.3 % cases in CKD pts and 40.0 % cases in AKI

**Table No.3 Various Complications seen during hemodialysis in total of 100 hemodialysis**

Complications	Number	Percentage
Hypotension	23	23 %
Nausea and vomiting	19	19 %
Arrhythmia	05	05 %
Muscle cramp	12	12 %
Hypertension	05	05 %
Vascular access	03	03 %

complications		
Hemolysis	01	01 %
Dialyser reaction	01	01 %
Seizure	00	00
Dialysis disequilibrium syndrome	00	00
Technical faults	00	00
Death	00	00

Table no.3 showing most common complication was hypotension 23 %, second most common nausea and vomiting 19 %, third most common muscle cramp 12 %.

**Discussion**

Dialysis is required in the treatment of acute or chronic kidney diseases. With wide spread use of availability of dialysis life of thousands of patients with ESRD (end stage renal disease) have been prolonged. Regular HD is the commonest mode of renal replacement treatment in comparison with peritoneal dialysis and renal transplantation all over the world. Hemodialysis relies on the principle of solute diffusion across a semipermeable membrane movement of metabolic waste product takes place down a concentration gradient from the circulation into the dialysate. The movement of waste products from circulation to dialysate may also occur as a result of ultrafiltration. Convective clearance also occurs that means movement of solutes out of the blood compartment along with the movement of solvent across the semipermeable membrane. Hemodialysis consist of pumping of heparinised blood through the dialyzer at a flow rate of 300-500 ml/min while dialysate flow in opposite counter current direction at 500-800 ml/min.[1] The efficacy of dialysis is determined by blood and dialysate flow through the dialyser and the dialyser. The dose of dialysis is determined by fractional urea clearance

during a single treatment and also further governed by patient size, residual kidney function, dietary protein intake, degree of anabolism and catabolism and the presence of comorbid condition.[1]

Although HD saves many patient’s life, it can lead to major complications, disabilities and even death.[15] Long-term complications such as cardiovascular, respiratory, skin, central nerves system, musculoskeletal and vascular access are not uncommon.[16] Acute intradialytic complications are frequently encountered. The most commonly associated complications include hypotension, muscle cramps, nausea and vomiting, headache, pruritus, fever and chills. Many of the complications are associated with hypotension. Rarely, life-threatening complications such as arrhythmias and other cardiovascular complications occur.[17] The pattern of intradialytic complications has clearly changed over last 25 years. The significant progress made in HD technology, dialysate preparation and membrane biocompatibility have resulted in a reduction of intradialytic complications due to technical problems.

Today, cardiovascular complication such as intradialytic hypotension and muscle cramps



prevail.[6] Hypotension is the most common acute complication of hemodialysis.[1] In our study, the most common complication was hypotension (23 %). Common causes of hypotension during HD include target dry weight, high ultra filtration rate, excessive use of antihypertensive medication. Hypotension reported in 36.11 % patients in Habas El et al study and 15 % during the 1st hour of HD session.[10] According to Allen R Nissenson & Richard N. Fine intradialytic hypotension is the most common complication intradialytic problem, with an incidence of 5 to 40 % of treatment which varies from an asymptomatic percentage fall in systolic blood pressure to symptomatic hypotension requiring active treatment.[6] According to kidney international 1980 during hemodialysis symptomatic hypotension occurs in approximately 25 % of hemodialysis treatments.[7] According to Jean-Pierre Kinet et al eight patients exhibited a sudden fall ( $\geq 30$  mm Hg) in mean arterial pressure (MAP) while six others did not.[8]

Nausea and vomiting was second most common complication in our study (19 %). In Habas El et al study; vomiting reported in (61.8 %) of patients; during 1st hour, vomiting occurred in (40.9 %) of patients. During 2nd and at 3rd hour of HD session, patients had vomiting almost the same number during this time of HD session.[10] According to Jean L Holley acute complications commonly occur during routine hemodialysis treatments: Hypotension in 25 to 55 percent of treatments, Cramps in 5 to 20 percent, Nausea and vomiting in 5 to 15 percent and Headache in 5 percent.[9]

Muscle cramps was third most common complication in our study (12 %) and in 4 % cases it was associated with hypotension. According to Allen R.Nissenson & Richard N . Fine, muscle cramps occur during 5-10 % of Hemodialysis sessions, frequently concomitant with intra dialytic hypotension.

Arrhythmia found in 5 % cases, whereas PVC in 4 % & AEB in 1 %cases in our study. According to Allen R.Nissenson & Richard N . Fine ventricular ectopic beats are most common rhythm disturbance in dialysis . According to cardiac arrhythmia and silent myocardial ischemia during hemodialysis (2000) , ventricular arrhythmias detected in 29 % cases CRF patients on HD.[11] Hypertension was seen in 5 %

cases in our study. Vascular access complications found in 3 % cases, infection seen in 3 % cases, infection associated with bleeding in 2 % cases & there was no thrombosis in our study. According to Allen R.Nissenson & Richard N. Fine, bleeding manifestations observed in up to third of uremic patient. Kieren . A Marr, MD; Daniel J. Sexton, MD ; et al. 40 % patients with end-stage renal disease who underwent hemodialysis with dual-lumen cuffed catheters developed bacteremia.[12]

Hemolysis found in 1 % cases in our study. According to Allen R.Nissenson & Richard N. Fine, hemolysis occurs due to disinfectant of water or other toxins , hydrogen peroxide , hypoosmolar dialysate and hemodilution , dialysate temperature  $> 42$  degree C and patient specific factors. Hypersensitivity reaction in 1 % cases in our study. According to H D Lenke, a. Headland et al 13 of the 129 patients (10 %) studied were identified as having suffered from at least one episode of acute hypersensitivity.[13]

Seizure, dialysis disequilibrium syndrome , technical problem and also death were not found in our study . According to Fulvio alexandre scorza marly de Albuquerque et al 5 patients out of 189 (2.64 %) developed seizure during HD.[14] According to Allen R.Nissenson & Richard N. Fine Hemodialysis associated seizure activity occurs in less then 10 % of chronic dialysis patient. Dialysis diequilibrium syndrome (DES) is an unusual complication of current dialysis practice.

## Conclusion

HD is live saving procedure for renal patients. In our study very few complications seen during HD (not significant). Most common was hypotension. Nausea vomiting was second most common and muscle cramps were third most common complication.

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